THURSDAY, MARCH 9, 1899.

CHEMICAL PHYSICS.

Graham-Otto's Ausführliches Lehrbuch der Chemie. Dritte, Gänzlich umgearbeitete Auflage. Erster Band. Dritte Abtheilung. Beziehungen zwischen physikalischen Eigenschaften und chemischer Zusammensetzung der Körper, herausgegeben von Dr. H. Landolt. Pp. 890 (Braunschweig: Vieweg und Sohn, 1898.)

THIS work, which has grown out of the comparatively small book on Chemical Physics by Dr. W. A. Miller, first published in 1855, is now complete. Part I., entitled "Physikalische Lehren," was edited by Prof. Winkelmann, with the concurrence of Prof. Kopp, from the previous edition, and was published in 1885. Part II., on "Theoretical Chemistry and Thermo-chemistry," was written by Prof. Horstmann, and was published also in 1885. Part III., which is now complete, is divided into nine chapters, of which the first three were published in 1893, and are now printed without alteration.

The editor has secured the assistance of others, eminent in different branches of chemical physics, to write the various sections of the work; in this way the best information has been obtained, for the subjects are all so rapidly increasing in importance, and so many investigators are engaged on them, that it is practically impossible for one author to produce complete treatises on the several matters with which the book deals.

The first chapter is on the relation between crystalline form and chemical composition, and consists of 350 pages. This commences with an introduction showing the use of crystalline forms for distinguishing substances from one another, and the employment of crystallisation for the purification of bodies, followed by an account of the geometrical properties of crystals, the forms of which are well described, although the student might have been assisted by some diagrams; these, however, may be considered unnecessary, as the crystal forms are fully illustrated in Part I. of this volume. The physical properties of the different systems are given in the form of a table showing the elasticity and cohesion, the optical, thermal, electrical and magnetic behaviour. The first subject dealt with in the chapter is Polymorphism, twelve pages being devoted to its history and discovery; then follows a useful table, occupying twenty-three pages, of polymorphous substances, references being given in every case to the original papers from which the information is obtained: in fact, throughout the book copious references to original papers are given in the form of foot-notes, and in some chapters the year of the publication as well as the number of the volume of the periodical is stated; so that the gradual development of the subjects may be easily traced. It is to be regretted that this is not always done, for the date may be even of more importance than the number of the volume of the journal. The section on Isomorphism, consisting of 141 pages, includes an historical sketch of the subject, the employment of isomorphism for the determination of atomic weights, isomorphous series of elements, of which ten groups are given, the molecular volumes of isomorphous bodies and their geometrical and physical relations and isomorphous mixtures. The third section is on morphotropy or the change that crystalline forms undergo when certain constituents of compounds are replaced by others: seventy-eight pages are devoted to this subject. This is followed by twenty pages of review and explanations of the whole subject, and by thirty pages of additions. In the preface the editor tells us that this chapter was written by Prof. Arzruni in 1892, and it was published in 1893, together with the two following chapters, as before mentioned.

The second chapter (consisting of 111 pages), on the relations between the volumes of solid and liquid bodies and their chemical composition, was written by Prof. A. Horstmann about 1890. The relations of the volumes of gases and of vapours were considered in the second part of this book, so the present chapter deals only with the volume relations of solids and liquids. The atomic volumes of the elements are first considered, and the periodic character of these numbers with increase of atomic weight is pointed out, the molecular volumes of the oxides are shown to be very irregular, although certain resemblances can be traced in oxides of analogous composition, whilst in many isomorphous compounds the molecular volumes are not very different. The molecular volumes of salts containing water of crystallisation are discussed, and it is pointed out that all these numbers will be affected by the temperature at which the specific gravities are determined, so that it is not to be expected that a regularity such as obtains in the case of gases will be found. The molecular volumes of isomeric organic liquids are next compared, and there is a table showing the molecular volumes at 0° and at the boiling points, attention being drawn to the variations under these circumstances. Comparisons are made between the volumes of the halogen substitution compounds of ethane, of isomeric alcohols and ethers and of the isomeric esters of the fatty acids, and lastly the changes of volumes which occur during the formation of compounds organic and inorganic.

The third chapter of thirty-three pages, by Prof. R. Přibram, on the relation between internal friction and the chemical composition of liquid substances, was written in 1892, and was included in the previous publication. After an historical survey of the methods employed for determining the internal friction or viscosity of liquids, it is shown in a table that the viscosity of solutions of salts increases with the basicity of the acid, the acids are compared with the corresponding salts of ammonium, potassium and sodium, and the viscosity of the sodium salts is in all cases the highest. The next comparison is between the viscosity of salt solutions and their electric conductivity; as a rule there is a diminution of conductivity for an increase of viscosity; and a list is given of the viscosities of organic acids and their sodium salts and of solutions of chlorides, sulphates and nitrates of several metals. The chapter concludes with a table showing the viscosity constants of a number of organic liquids, with remarks on the relations existing between them and the composition of the componnds. The work of Thorpe and Rodger is of more recent date than this chapter, but some reference might have been made to it in the reprint.

The next chapter is by Dr. Willy Marckwald, on the

relation between melting points and the composition of chemical compounds. It occupies twenty-seven pages, and was begun in 1897. For an account of the periodic character of the melting points of the elements, reference is made to the second volume of the book, the fusing points of compounds only being dealt with in this chapter. A few examples of the fusing points of inorganic compounds are given, showing that those of the chlorides, bromides and iodides of the elements of a period fall with the increase of atomic weight; the period chosen being the second in the periodic table beginning with sodium, and ending with chlorine. When the haloid compounds of a group are examined, it is found that, generally speaking, the fusing points rise with an increase of atomic weight; this is exemplified by the compounds of the beryllium and nitrogen groups, but the haloids of the alkali metals behave irregularly. Tables iv. and v. give the melting points of isomeric organic compounds, in which it is seen that the symmetrical compounds melt at higher temperatures than the unsymmetrical. In the next table the fusing points of the para- meta- and ortho-compounds of benzene are compared, and it is shown that the para-compounds always fuse at the highest temperatures, whilst in the case of the sulphamides the ortho-compounds have the highest fusing points. More complex compounds are then studied, and the chapter contains no less than thirty-nine tables, in which the melting points of allied chemical compounds are compared.

The fifth chapter is also by Dr. Willy Marckwald, on the relation between the boiling points and the composition of chemical compounds. This was begun in 1897, and extends over twenty-nine pages. The chapter deals with organic compounds only, and contains forty-one tables giving the boiling points of bodies of various series. In some of the tables boiling points under varying pressures both above and below that of the atmosphere are included.

Chapter vi., on the relation between refraction and the chemical composition of bodies, was written in 1897 by Dr. E. Rimbach, and consists of ninety-seven pages, the first twenty-three of which are devoted to generalities in which the different methods of determining refractive indices are briefly mentioned and the three formulæ for calculating the specific refractive powers of bodies proposed by Laplace, by Dale and Gladstone, and by Lorenz and Lorentz are discussed, comparison being made of the constancy of the numbers obtained by the use of the different formulæ under varying conditions. The following section is on molecular refraction and the constitution of bodies; isomeric liquids are first considered, and it is shown that the differences of refractions of such bodies are not great unless there is a pronounced difference in their chemical structure; thus those bodies in which double bonds are supposed to exist, have different refractive powers from those in which single bonds occur; and it is seen that in homologous series the difference of CH_2 makes a nearly constant difference in the molecular refraction of the substance, and by subtraction the value of CH_2 is obtained. Similarly the values of carbon, hydrogen and oxygen are calculated, the latter element showing different numbers according to the other elements with which it is combined in the molecule. The atomic refraction of the constituents of a compound when added together should give the molecular refraction of the compound, but in cases in which the carbon atoms are doubly or trebly linked a difference is always found, and from these differences the values of multiple bonds are obtained. Cyclic compounds are next considered, and the effect of the three double bonds in the benzene ring is shown by the comparison between the observed and calculated molecular refractions of a number of benzene derivatives. The atomic refraction of the halogens is then studied, followed by some observations on molecular dispersion. The next section is on compounds containing nitrogen, and here it is seen that the atomic refraction of nitrogen varies according to the way in which it is combined in the various substances. The atomic refraction of other elements such as sulphur, phosphorus, arsenic, antimony, silicon, mercury, tin and lead are next dealt with. There is a short section on the refractive powers of gaseous bodies, and another on those of solids and of their solutions. The concluding section treats of electrical molecular refraction and the relation between dielectric constants and the constitution of bodies.

The next chapter, on the relations between the chemical nature and the spectra of elementary and compound bodies, was written in 1889 by Prof. Gerhard Krüss, and after his death in 1895, his brother, Dr. Hugo Krüss, wrote some additions. The chapter consists of twenty-five pages, and the addenda of seven. Emission spectra are first considered, and the relations between the wave-lengths of the lines in the spectra of various elements are shown to be the same as those between the overtones of a fundamental note, tables being given comparing the observed and calculated wave-lengths of the spectral lines of certain elements; the characteristics of the spectra of the elements of various groups are described, and also the relation between the spectra of compounds and those of their constituents. Absorption spectra of inorganic compounds are briefly mentioned, whilst those of organic compounds are fully treated and the alterations of the spectra by the introduction of different radicals are noticed. In the additions made by Dr. H. Krüss the remarkable investigations of Kayser and Runge on the several series of lines in the emission spectrum of an element are dealt with, and the connection between these observations and the periodic law are shown. There is also a short discussion on the variation of absorption spectra of solutions in connection with the ionic hypothesis. We do not find any notice of Abney's researches on the absorption in the infra-red part of the spectrum by organic bodies.

The eighth chapter, of eighty-four pages, deals with the relation between the optical rotation of organic substances and their chemical composition, and was written by the editor, Dr. H. Landolt, and finished in 1898. For methods of measuring circular polarisation reference is made to Part I. The rotation of the plane of polarisation by crystals is briefly mentioned, and a list is given showing the rotation for plates 1 m.m. in thickness and also the systems to which the crystals belong. The rotation by liquids follows, a list of thirty groups of active substances being given, and the method of finding the specific molecular rotation is described. The specific rotation of dissolved substances and the changes which

are observed in solutions of different concentration are discussed at length. The second section is on the connection between the optical rotation and the chemical constitution of carbon compounds, in which the original observations of Pasteur and the theory of the asymmetric carbon atom of Van 't Hoff and Le Bel are fully described, a subject on which a vast amount of work has been recently done. The third section is on the relation between the magnitude of the rotation and chemical constitution, and accounts are given of the rotations of isomeric bodies, of bodies belonging to homologous series and the effect of multiple bonding of carbon atoms.

The last chapter of the book is by Dr. O. Schönrock, on the relation between the electromagnetic rotation of solid and liquid bodies and their chemical composition; it extends over seventy-three pages, and was finished in 1898. The observation made by Faraday in 1846, that the plane of polarisation is rotated when the beam is passed through a transparent substance placed in a powerful magnetic field has led to valuable researches, principally by Perkin, on the rotation produced by various chemical compounds. The mode of calculating the molecular magnetic rotation and the influence of solvents are first mentioned, and then the effects produced by inorganic acids and salts and the atomic rotation of the elements. The periodic character of the magnetic rotation of some of the metals is pointed out. The next part deals with fatty substances, and numerous tables are given showing the variations which occur with change of composition, and the influence of the various radicals is calculated.

The volume concludes with an index of twenty-three pages, divided into sections corresponding to the nine chapters of the book; by this means the physical characteristics of the chemical substances can at once be found.

The whole volume has evidently been compiled with great care, and brings together a large amount of valuable information distributed in the *Transactions* of societies and other periodicals, thus saving the investigator desiring to make use of these researches, a great deal of time and labour in referring to the original papers. It will also enable the chemist to appreciate the great assistance that he may obtain from the study of the physical properties of compounds in his endeavours to ascertain their constitution and their relation to one another.

H. M.

THE SCIENTIFIC STUDY OF VACCINATION.

Vaccination: its Natural History and Pathology. By Dr. S. M. Copeman. Pp. x + 257. (London: Macmillan and Co., Ltd., 1899.)

THE Milroy Lectures on the Natural History and Pathology of Vaccination, delivered last year before the Royal College of Physicians, are now at an opportune moment given to the public. The Vaccination Act of 1898 has practically abolished compulsory vaccination. On the other hand, it aims at improving the administration of vaccination and at removing all objections that can, with the least show of reason, be brought against it. Without in any way admitting the existence of adequate grounds for giving up compulsory vaccination, which we look upon as a grave national misfortune, it must be acknowledged that opposition to the compulsory law has been in a measure based upon administrative defects. To do away with that opposition the first thing wanted is much greater care in the methods employed. Illness and death from vaccination ought to be as rare here as in Germany. To attain this end two things mainly are wanted: a scientific study of the quality of the lymph used, and a rigid and minute adherence to antiseptic principles on the part of the vaccinator. A lymph which is pure, in a bacteriological sense, and aseptic conditions from first to last, as regards the wounds made, ought to do away with all vacccination accidents.

Dr. Copeman's book deals mainly with the first of these subjects. In the early chapters he reviews the history of vaccination, of various lymph stocks, and of the relationship between variola and vaccinia. He relates the experiments made from 1801 to the present time, to prove experimentally the truth of Jenner's original thesis that vaccinia is small-pox of the cow. The experiments detailed are those of Gassner (1801), Viborg (1807), Thiele (1836 and 1838), Ceely (1839), Badcock (1840), Adams and Putnam (1852), Simpson (1885 and 1892), Fischer (1886 and 1890), King (1889), Hime (1892), Haccius and Eternod (1893), and Klein (1892). All these observers succeeded in inoculating human small-pox into a cow or calf, and in developing cow-pox as the result. Dr. Copeman's own experiments date from 1892. He was successful in one out of four attempts. The transformation of small-pox into cow-pox seemed in most of the successful experiments to require a series of inoculations from one cow or calf to another, and not to be an immediate result on first inoculating the contagium into its new conditions. It was probably from not knowing this fact that Chauveau, in 1865, and Martin, of Boston, in 1860, reproduced human small-pox by vaccinating from cows who had been the subjects of variolous inoculation. The variolous poison had, in these cases, not had the time required for its transformation into vaccinia. There remains, however, much still to learn as to the conditions under which the change from variola to vaccinia is accomplished.

With regard to the bacteriology of vaccine lymph, a subject on which much laborious investigation has been expended, Dr. Copeman comes to the conclusion that from lymph taken from matured vesicles "inoculation of plates or tubes of nutrient material usually result in abundant growths of micro-organisms." Dr. Copeman succeeded, however, in growing the small-pox contagion as a pure culture, by using hen's eggs as the culture medium. "For the purpose of such inoculations I employed variolous crusts. . . . These crusts were rubbed up in a small glass mortar with a minimal quantity of water . . . and the inoculation was carried out. Finally the small hole in the egg was closed up." The eggs so inoculated were kept in the incubator for a month, and calves were then inoculated with the egg culture, and after being passed through a series of calves the resulting lymph was successfully used for the vaccination of children. Drs. Copeman and Blaxall have since obtained pure cultures of "the same organism on the surface of agar plates, and this not only when vaccine

lymph, both of human and bovine origin, was employed, but from variolous lymph as well." From these plates sub-cultures were obtained, and from the third and fourth generation typical vaccinia was induced both in calves and in children.

Monkeys have been of considerable assistance to Dr. Copeman in his investigations upon lymph. He began by proving experimentally that they are susceptible both to vaccination and to variolation, and he found that in them vaccinia protected from small-pox, and *vice versa*. "In no instance had the experiment a fatal termination," nor does it appear from the report that even variolation caused serious illness; it was "inoculated" rather than "natural" small-pox. Dr. Copeman adds:

"In discussing the origin of the various lymph stocks at present in use, Messrs. Collins and Picton in their minority report make a point of the impossibility of employing at the present day what used to be known as the 'variolous test' as a proof of the efficacy or the reverse of any particular strain of lymph. In view, however, of my experiments with monkeys this criticism . . . falls to the ground; since if it is desired to apply the variolous test to any given lymph stock, all that is necessary is to vaccinate a monkey with a sample of the lymph in question, and subsequently to inoculate the animal with potent small-pox lymph after the lapse of such period from the first operation as may be thought desirable."

Dr. Copeman's researches upon the effect of glycerine in purifying and preserving vaccine lymph, date from 1891. Previous to this he had seen reason to think that the exuberant growth of what may be called extraneous organisms, might tend to check the development of the more important organism for which he was searching. He therefore set himself to find an agent which would check the growth of these extraneous or useless micro-organisms in lymph.

The use of glycerine as a diluent or preservative of lymph had long been known. What was not known was that by an intimate admixture of perfectly pure glycerine with lymph, and by storing the mixture for a considerable time under conditions which prevent the access of air and light, the foreign organisms in the lymph are gradually destroyed or so checked in their growth that they cease to multiply and come to an end. The proportion of glycerine required for this inhibitory influence is a large one—30 per cent., 40 per cent., or 50 per cent. for the different organisms. Dr. Copeman details experiments made by himself and Dr. Blaxall with lymph to which had been added, a month before using it, large quantities of virulent tubercle bacilli. No growth of the tubercle bacillus could be obtained, nor was any effect produced by repeated injections of this lymph into guinea-pigs, while from the same supply of tubercle culture material, not treated with glycerine, tuberculosis was in due course developed, at first locally and then generalised.

It must be borne in mind that an essential part of the process Dr. Copeman recommends is the length of time during which the organisms in the lymph are exposed to the influence of chemically pure glycerine, unaided by the vitalising influences of light and air.

Dr. Copeman gives photographs of a series of sub-cultures on nutrient agar-agar after twenty-four hours, then after one, two, three, four and six weeks respectively. The extraneous organisms progressively diminished till at the end of four weeks there were none, and after six weeks there were also none.

It is natural to ask if glycerine can in time, and under favouring conditions, entirely inhibit the growth of extraneous organisms, will not the essential vaccine organism presently share the same fate? Is glycerinated calf lymph sure to retain its activity for a sufficient length of time for all practical purposes? These questions scarcely admit at present of an absolute answer. Dr. Copeman believes the lymph from different calves varies very much in potency. He quotes facts which go to show that there is no reason to distrust the lymph treated as he recommends while stored in bulk.

"A lymph which was collected and glycerinated on July 13, 1897, has since been used at intervals of from twenty-four to thirty-two weeks after glycerination, for the vaccination of children. During this period sixty-one children have been vaccinated with this lymph in five places each, with a mean insertion success of 98 per cent."

It must, however, be borne in mind that for the children thus vaccinated the lymph had not been kept in capillary tubes. It is necessary to wait for further experience before it can be taken as proved that glycerinated lymph can be kept in an active condition for any considerable time in such tubes. It would be interesting to know if lymph can be stored and distributed in fairly large bulk in such a way as to be available when wanted, even where, as on board ship, otherwise perfect conditions as to temperature, exclusion of light and air can be secured. A method by which enough perfectly pure lymph to vaccinate, say, a thousand people, in one series, could be carried through the tropics would be of great value, and there seems some ground for doubting if glycerinated calf lymph in capillary tubes would under such conditions be absolutely trustworthy. It would have for the round voyage to retain its potency for at least from four to six months.

Dr. Copeman's contribution to the study of the bacteriology of vaccination is of high value and interest.

A MODERN TYCHO.

Siddhánta-Darpana; a Treatise on Astronomy. By Mahámahopádhyáya Sámanta Sri Chandrasékhara Simha. Edited with an introduction by Jogés Chandra Ráy, M.A., Professor of Physical Science, Cuttack College, Calcutta, 1897.

ANY one who reads the very interesting introduction of sixty-one pages that Prof. Ráy has attached to this Sanscrit work will regret very much his inability to fathom the work that follows. For therein is contained the results of the patient and industrious inquiry of one who, unaided by the accumulated knowledge of Western astronomers, resolutely set himself to solve the problem of celestial mechanics by the aid of such instruments as he could fashion himself, and where the time-honoured clepsydra supplied the place of the sidereal clock. The only assistance he seems to have had were the similar rough observations of Bháskara (born 1114) and some still older observers. Prof. Ráy compares the author very

properly to Tycho. But we should imagine him to be a greater than Tycho, for without the same assistance, without the encouragement of kings and the applause of his fellows, he has advanced his favourite science quite as effectually as did the Danish astronomer. It is especially curious to notice that the system at which Chandrasékhara ultimately arrived, and the explanation he offers of it, bears a very considerable resemblance to that which Tycho taught. The author has never been able to convince himself that the earth turns on its axis, or that it goes round the sun ; but to the planets he assigned heliocentric motion, much as Tycho did.

We get some notion of the success that attended the work, and of how much it is in one man's power to accomplish, if we examine the differences between the values he assigns to some of the constants of astronomy and those in use with ourselves. The error in the sidereal period of the sun is 206 seconds ; of the moon, 1 second ; Mercury, 79 seconds ; Venus, about 2 minutes ; Mars, 9 minutes ; Jupiter, an hour ; and Saturn, rather more than half a day. The accuracy with which he determined the inclination of the planets to the ecliptic is still more remarkable. Mercury offers the largest error, and that is only about two minutes. In the case of the Solar orbit the greatest equation to the centre is only 14 seconds in error. In the Lunar theory, the revolution of the node has been concluded with an error of about $5\frac{1}{2}$ days, less than the thousandth part of the whole period ; while he has independently detected and assigned very approximate values to the evection, the variation, and the annual equation.

The main object that Chandrasékhara had before him seems to have been to correct the calendar, and regulate the daily ritual of the Hindu religion. No two almanacs, Prof. Ráy tells us, agree ; but any attempt to introduce the Nautical Almanac and its acknowledged accuracy would prove unsuccessful. The necessary corrections and unification must, to be acceptable, come from within and be the work of a Hindu, uninfluenced by foreign education. The work of Chandrasékhara has received the sanction of the honoured Rashis, and the adoption of the corrections which he has shown to be necessary will exert upon native society a beneficial influence, whose importance can be hardly overrated in a community where a correct almanac is an indispensable equipment of every household. We should like much to linger over Prof. Ráy's remarks on the subject of precession and his chronological deductions. These and many other points are discussed with great ability, though Prof. Ráy modestly disclaims any special astronomical capacity. The effect is to leave us at every page with a higher opinion of the author laboriously recording his observations on a palm-leaf, and unselfishly devoting his life to the services of his countrymen, who do not appreciate the nobility of the effort and the entirety of his devotion. We are in full sympathy with the editor when he writes thus of the author, of his privations and his star-gazing :

"What has he done after all ? asks the impatient critic. To him I would say—Is it not enough to find in this man a true lover of science, who, regardless of other people's unfavourable opinion of his work, their taunts and dissuasions, has devoted his whole life to the one pursuit of knowledge ; who has shown the way to original research amidst difficulties serious enough to dishearten men in better circumstances ; who has employed his time usefully, instead of frittering it away like the usual run of men of his rank, on a work which guides the daily routine of millions of his countrymen."

W. E. P.

OUR BOOK SHELF.

Photography: its History, Processes, Apparatus, and Materials. By A. Brothers, F.R.A.S. Second Edition. Pp. xviii + 367. (London : C. Griffin and Co., Ltd., 1899.)

MR. BROTHERS, of Manchester, has been known for so many years in connection with photography and allied subjects, that his personal experiences have much value for the student. The time is gradually approaching when the history of the early developments of photography will be completed, because it will be impossible to add to our recorded knowledge of them ; meanwhile we welcome every addition. Mr. Brothers describes the first experiments in the use of magnesium as an illuminant for photographic purposes, and how he found that the wire burned better when it was flattened into ribbon by passing it between rollers. The first photograph taken underground was by Mr. Brothers, and he gives a reproduction of it. It was produced in 1864 in the Blue John Mine in Derbyshire, by the aid of burning magnesium. In the following year Prof. Piazzi Smyth used the same illuminant in photographing the chamber in the interior of the Great Pyramid. Being in doubt as to who was the first to use sodium thiosulphate as a fixing reagent, Mr. Brothers, in 1866, wrote to Sir John Herschel, and received from him a long letter on the subject, which is printed in full in the work before us. In it Sir John gives quotations from his papers on "hyposulphurous acid and its compounds," published in the *Edinburgh Philosophical Journal* of 1819, and also extracts from his own laboratory note-book of January 1839, which appear to establish his claim to being the first to use the thiosulphates in photography. The description of Sir John's attempts to imitate the photographic successes of Daguerre, of which at that time there were only very vague reports as the process was not published until later in the year, are very interesting.

Although the volume is called a "Manual of Photography," it is hardly what is commonly understood by this term. After introductory matter, which is chiefly a consideration of chemistry, optics, and artificial light, as applied in photography, there follow sections titled "Processes," "Apparatus," "Materials used in photography," "Applications of photography," and "Practical hints." In each section the numerous headings are alphabetically arranged, their descriptions extending from two or three lines to, occasionally, several pages in length. The space allotted to each subject is not proportional to its demands. While more than eight pages are devoted to the stereoscope, less than three are given to carbon printing, and for details of this most important of processes the student is referred to the guide issued by the Autotype Company ! This being a second edition, much new matter has been added, Radiography, the "krōmoscōpe," the new developers, and some of the newer lenses are described, the last chiefly by quotations from the makers' price lists. The greatest advance in photographic optics since Petzval calculated the portrait lens that bears his name, is practically ignored. Astigmatism is referred to, in a dozen lines or so, as "a defect most general in portrait lenses" that "has to be reduced to a minimum by the use of a diaphragm." It is worth noting that at both pages

Where large numbers of books have to be cared for, as in libraries, "silverfish" and cockroaches are, in this climate, the enemies perhaps most to be dreaded. These lurk and breed in the spaces between the woodwork and the walls, and in crevices and crannies about the shelves.

Mr. J. J. Fletcher, Secretary to the Linnean Society of N.S.W., has effectually rid the library of the Society of these pests by freely dusting into the crevices ordinary powdered Paris green. Wherever there was a space in which the insects could lurk, Mr. Fletcher applied the powder, and now the books, which were formerly much disfigured by the insects nibbling the bindings, remain entirely free from damage because of the extermination of the pests,

THOS. STEEL.

Colonial Sugar Refinery Company, Sydney, January 31.

Radiation in a Magnetic Field.

IN the very interesting summary of our present knowledge of the Zeeman effect, Mr. Preston has interpreted a number of results I obtained by the interferometer and the echelon spectroscope in such a way as to cast a general doubt over the performances of these instruments. Some of these interpretations are undoubtedly the result of misunderstandings due to my own want of clearness. I venture, therefore, to present a summary of the principal results, emphasising where necessary the points which require further explanation.

In the article to which Mr. Preston refers (*Phil. Mag.*, vol. xxxiv. p. 280, 1892), it was shown that the visibility curve, in the case of about twenty radiations examined, showed peculiarities from which the character of the spectrum could be inferred, and a considerable number of "lines" were shown to be double, triple, or more highly complex. Mr. Preston remarks: "This structure has never yet been observed by means of any ordinary form of spectroscope, and accordingly it has been suggested that it does not exist in the light radiated from the source, but is imposed on the spectral lines by the apparatus used, namely, the interferometer."

It might be replied that such an explanation would be very difficult to accept, in view of the very great constancy of the results, with instruments of different construction and dimensions, with different observers, and with different forms of vacuum tubes employed. But, if I am not mistaken, the only attempt at explanation of the peculiarities of my visibility curves, was that which attributes them to diffraction effects; which, however, would necessarily be of a totally different character, and indeed in most cases entirely insignificant.

The real reasons for the absence of confirmation of these results by the spectroscope are probably that the resolving power is insufficient; or where the resolving power is insufficient the radiating substance is not in a vacuum tube, and the consequent broadening of the lines under atmospheric pressure is so great as to mask the details of structure; or, finally, if the substance is placed in a vacuum tube, the light is not sufficiently bright.

Turning now to Mr. Preston's criticism of the results obtained in the investigation of the Zeeman effect, the following remarks may help to clear up the "most surprising statement that the separation of the lines in the triplets produced by the magnetic field is independent of both the spectral line and the substance."

The law referred to is stated thus: "The separation is proportional to the strength of field, and is *approximately* the same for all colours and for all substances."

But on p. 137 of the same article (*Astrophysical Journal*, vol. vii. No. 2, 1898) will be found the further modification:

"The following table shows that the law . . . is only approximately true. In fact, owing to the complexity of the spectra, there is considerable latitude in the choice of the distance between the outer groups. If this correspond to the brightest components *the law can hardly be said to hold at all*; but if the distance be taken between the centres of gravity of the light areas, a fair agreement is found. The table gives separation in tenth-meters for a field 10,000. The lines marked with an asterisk are less accurate than the others on account of broadening:

*Hydrogen	...	Red	...	0·48
*Lithium	...	Red	...	0·60
Cadmium	...	Red	...	0·42
Zinc	...	Red	...	0·42
Mercury	...	Yellow	...	0·36
*Sodium	...	Yellow	...	0·50
*Helium	...	Green	...	0·37
Mercury	...	Green	...	0·40
Cadmium	...	Green	...	0·41
*Thallium	...	Green	...	0·36
Cadmium	...	Blue	...	0·40
Zinc	...	Blue	...	0·33
Mercury	...	Violet	...	0·33

"Taking into account the uncertainty alluded to, the results show on the whole a fair agreement, from which it may be concluded that the separation is independent of the radiating substance and of the colour."

A number of radiations have been examined since the foregoing was published; and while there are undoubted exceptions to the law, I still think, keeping in mind the limitations referred to, it is in the main correct.

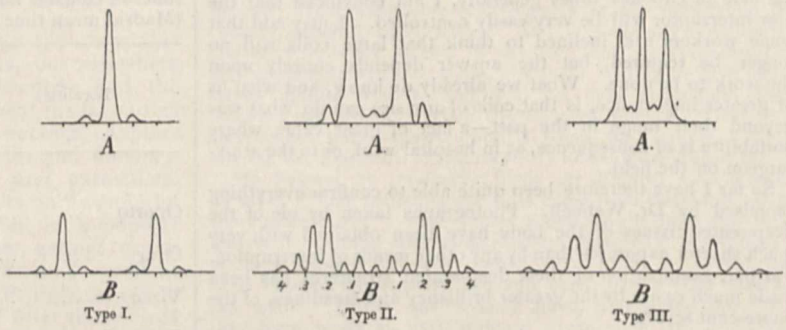


FIG. 1.—A, plane of polarisation, Equatorial.
B, ,, ,, Axial.

These results and others obtained by the interferometer, as Mr. Preston states, have been verified by the echelon spectroscope; and I think the explanation of apparent differences between results obtained by these methods and by other forms of spectroscope are to be explained, not by an actual variance, but by a misunderstanding of the degree of approximation the results

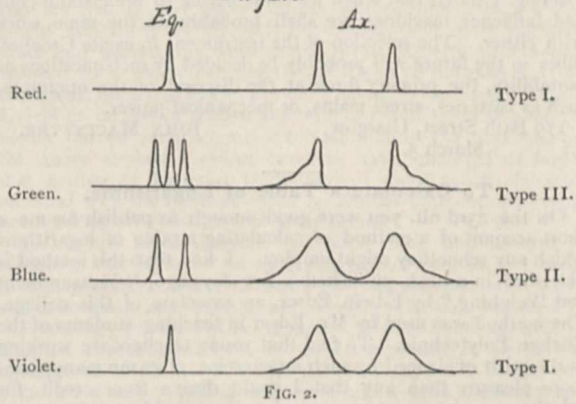


FIG. 2.

are intended to show, except where the resolving power of the other spectroscopes is insufficient.

Mr. Preston states: "With apparatus which reveals structure or multiplicity in the ordinary spectral lines, it is to be expected that multiplicity would be readily revealed in the constituents produced by the magnetic field; yet in the case of some lines, the amount of finer structure revealed does not appear to be as great as that observed with a good grating. . . ." In reply to

this statement, I would say that I know of no such instance. If there are cases of lines showing structure by the ordinary grating, which I do not mention, it is simply that my attention has not been directed to them, and I should venture to guarantee that if observed by either the interferometer or the echelon, they must show the same structure—or a finer.

I should have thought the tripling of the middle green line in the case of the green mercury and cadmium lines a matter of sufficient importance to add to those figured in Mr. Preston's paper.

To illustrate the preceding remarks, as well as to show the performance of the interferometer, I present a figure showing the three types of Zeeman effect, and another showing how these results are confirmed by the echelon.

It will be observed that there is an indication of structure in the outer lines, but at this time they had not actually been resolved. This has since been accomplished, as shown in the following figure :—

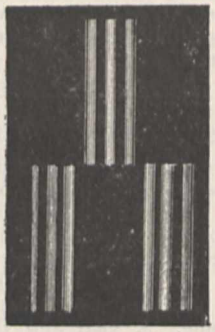


FIG. 3.

The following is a list of the radiations thus far examined, and their classifications according to these types :—

Mercury	Yellow lines	Type I.
	Green line	,, III.
	Violet line	,, II.
Cadmium ...	Red line	,, I.
	Green line	,, III.
	Blue line	,, II.
Zinc	Red line	,, I.
(? Cadmium) ...	Green line	,, III.
	Blue line	,, II.
Sodium	Yellow lines	,, II.
Thallium ...	Green line	,, II. (doubtful)
Lithium	Red line	Broadened.
[1]Hydrogen ...	Red line	Broadened.
Helium	Yellow line	Broadened.
	Green line	Type I.
Gold	Yellow line	,, II.
	Green line	,, I.
Silver	Yellow line	,, I.
	Green line	,, I.
[2]Copper	Yellow line	,, IV.
	Green lines	,, I.
Magnesium ...	Green line (5183) ...	,, III.
	Green line (5172) ...	,, II.
	Green line (5167) ...	,, I.
[2]Manganese ..	Green line (5340) ...	,, IV.
Argon	Red line	,, I.
Tin	Red line (6450) ...	,, II.
	Yellow line (5798)	,, I.
	Yellow line (5587)	,, I.
	Yellow line (5564)	,, I.
Iron	Most lines	,, I.
Carbon	Component lines of banded spectrum	Unaffected.

The University of Chicago Ryerson Physical Laboratory, Feb. 9. A. A. MICHELSON.

[1] Since this list was first published, decided indications of structure have been noticed, especially in the broadened middle line, which under favourable conditions appears as a group of six or seven very fine lines just resolvable, brightest at the centre, and extending through the entire space between the outer groups. Similar indications, though less distinct, were traced in the outer groups.

[2] Type IV. was added to include cases where a broad or complex line was simplified or narrowed in the magnetic field. This, as regards the copper line and the manganese line, is true of the central line of the triplet, and not (as might be inferred from the original paper) of the whole group.

Attraction in a Spherical Hollow.

THE theorem you published in your number of January 19, under the above head, may easily be deduced from the parallelogram of forces put in this form :

Let σa be intensity and direction of an attractive force, σb both for a repulsing force ; then the resultant of the two forces in σ will be parallel and equal to ba. LANG.

Vienna, February 18.

THE REPORT OF THE SELECT COMMITTEE ON THE SCIENCE AND ART DEPARTMENT.

IN the course of last year the newspapers contained an account of the doings of the Select Committee of the House of Commons appointed to inquire into, and report upon, the administration of the Museums of the Science and Art Department. It was an open secret that some of the members of that Committee were bitterly opposed to the officials of the Department ; but however this might be, all evidence tending to throw discredit was very widely reported long before the Report was issued.

The Report of the Committee in due time made its appearance, and it has now been considered by the Lords of the Committee on Education. The result has been embodied in the shape of the following Minute, which has just been distributed among the Members of the House of Commons and others.

By the Right Honourable the Lords of the Committee of Her Majesty's most Honourable Privy Council on Education.

Present :—His Grace the Duke of Devonshire, K.G., Lord President of the Council ; the Right Hon. Sir John E. Gorst, M.P., Vice-President of the Committee of Council on Education.

(1) The Lords of the Committee of Council on Education consider the Second Report from the Select Committee of 1898 appointed to inquire into and report upon the administration and cost of the Museums of the Science and Art Department. My Lords have also before them the observations on this Report prepared in accordance with their instructions by the Secretary of the Science and Art Department, a copy of which is appended to this Minute.

(2) A reference to the proceedings of the Committee shows that pp. 1 to 16 of the Report are based upon the Chairman's draft. This part of the Report appears to contain a correct statement of facts, but it is followed by paragraphs, introduced as amendments, which traverse to a great extent the same ground, and contain many inaccuracies and some inconsistencies.

(3) Having regard to passages which appear to reflect on individual officers, My Lords desire to emphasise the fact that they alone are responsible to Parliament for the administration of the Museums, and to declare that their directions have been loyally carried out by the staff, and that they retain the fullest confidence in Sir John Donnelly and his colleagues.

(4) They regret that the Committee should have insinuated in their Report that officers have been appointed because of their relationship to members of the staff, and have been dismissed because of the evidence they gave to the Committee. Such insinuations are devoid of any foundation in fact.

By order of the Committee of Council on Education.

SCIENCE AT LIVERPOOL.

THE Lord Mayor of Liverpool is to be congratulated upon a new departure. The Municipal authorities of one of our most important cities have actually held high festival in honour of a man of science, the occasion being the award of the Rumford Medal to Prof. Lodge. The Lord Mayor in the course of his speech said :

"Prof. Lodge was appointed to Liverpool University College in 1881, and since that time he had been closely associated with the work of the institution and done much to advance its reputation. Those who had come under the guidance and instruction of Prof. Lodge testified uniformly to his urbanity, courtesy, and kindness, and to the clearness and completeness of the instruction which he afforded them, but, apart from that, the original experimental work of Prof. Lodge entitled him to the greatest distinction. Their guest was a many-sided man, but the irreproachable certificate of his excellency as a man of science he received when he was awarded the Rumford Medal by the Royal Society. As to Prof. Lodge's attachment to Liverpool, it was so far back as 1881 that they were fortunate enough to secure association with him, and, notwithstanding temptations—some they knew of, and others of which they did not know—he had remained faithful to Liverpool. He thought he voiced the feelings of his fellow-citizens when he expressed the hope that Prof. Lodge would long continue his work in their midst. University College was an institution of which, with every reason, they were most proud, and he believed that in addition to the instruction which was there imparted, the taste of the community was directly raised, and the relations of the community to thought were very considerably ennobled by the existence of the college in their midst. The honour done to Prof. Lodge by awarding him the Rumford Medal was emphasised by the presence that night of some of the foremost men of science—Sir William Crookes, Prof. Fitzgerald, Prof. Myers, and others. If it required any further emphasis, it would have been afforded by the letters which he had received from some of the most prominent men of the time, in which they all expressed their deep regret at not being able to be present to do honour to their distinguished guest."

The Lord Mayor in conclusion alluded to the necessity for the erection and endowment of a physical laboratory at University College, and expressed the hope that before long one worthy of the institution would be provided, in which Prof. Lodge could carry on his important scientific work.

Prof. Lodge said he could not adequately express his sense of gratitude to the Lord Mayor for his speech—a speech of transparent sincerity—whether he deserved it or not. The chief magistrate had spoken about the endowment of a physical laboratory. The man or men who endowed such a laboratory in Liverpool would be doing a tremendous piece of work for the advancement of science. They of University College felt greatly indebted to the Lord Mayor for that magnificent reception and entertainment, and they rejoiced in the links that were every year drawing closer the city and University College. The contact could not be too close. He desired to take that opportunity of expressing his deep sense of the extreme kindness which had been shown to him during the time he had been in Liverpool. A few of his friends had gone, and amongst others, George Holt. No one helped him more directly in his scientific work than George Holt. The requirements of a man of science were not only friendly, but, unfortunately, they were also material, and it was a great thing that citizens of Liverpool and other places helped men of science to do their work. That was what George Holt and others had done, and what he believed others would do. The gathering that night was a remarkable proof of the amount of good feeling and appreciation shown by scientific men for the magnificent act of the Lord Mayor in doing honour to science, for the honour was really done to the Rumford Medal of the Royal Society. The chief magistrate of Liverpool recognised in the Royal Society the fountain of all purely scientific honour in this country, and he also recognised the biennial award of the Rumford Medal as an event of national—nay, even sometimes of international importance—because it was often given to foreigners, and in this way promoted friendly feeling among the workers in science in different parts of the world. It was undoubtedly a great honour to receive the Rumford Medal, and he was astonished when he got the intimation that by some concatenation of circumstances it had been awarded to him. After a reference to the splendid work done in connection with University College by Dr. Rendal, the former principal, Prof. Lodge concluded by saying that they in this peaceful and prosperous time had inherited the fruits of the labours of thousands who had gone before, and as the Lord Mayor had reminded them, they owed a great deal to the splendid era of peace through which they had lived, for it had given them an insight into the processes of nature more deeply than ever it was possible before. Science was yet in its infancy, human civilisation was but emerging from its cradle, the smoke and the noise and the squalor outside were evidences that we had not proceeded far on the road to civilisation; but we had made a start—a secure start, he hoped, this time—and he thought the human race would not again fall back.

Principal Glazebrook, speaking later, said that the estimated cost of a physical laboratory for Liverpool was between 30,000*l.* and 40,000*l.* One generous donor who at present wished to remain unknown had promised 10,000*l.*, and that night Sir John Brunner had offered 5000*l.*, whilst Mr. Alfred Booth had made a challenge offer of 2500*l.* if three other gentlemen would give the same amount.

The dinner, then, has not been without important results, and we hope that such an admirable precedent will be often followed.

AN ANTARCTIC MEETING IN BERLIN.

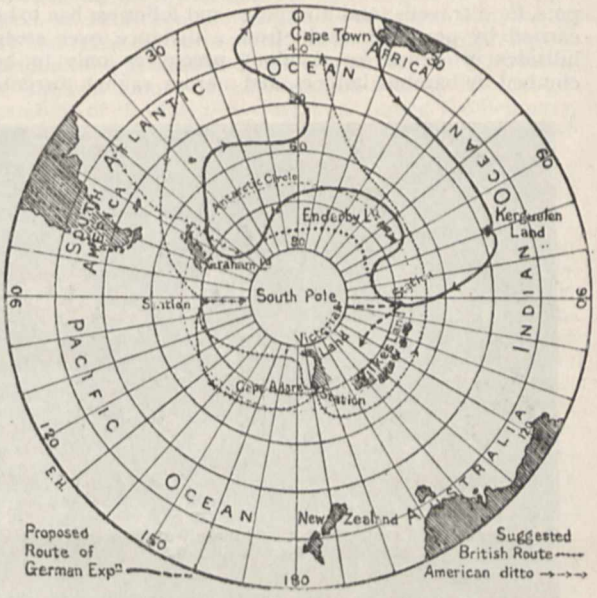
EVER since the idea of despatching a German exploring expedition to the Antarctic was first mooted in 1895, the leading scientific men of that country, headed by the veteran champion of Antarctic research, Dr. Neumayr, have been untiring in their efforts to bring the idea to practical realisation, and one by one most of the preliminary difficulties have been overcome. A year ago the project began to take definite shape, and the important question of the choice of a leader was solved by the adoption as such of Dr. Erich von Drygalski, then on the point of completing his lengthened studies on the inland ice of Greenland. During the past twelvemonth meetings have been held in many of the chief cities of Germany, where the proposals put forward by Dr. Drygalski and others have met with an enthusiastic response. The only remaining obstacle to success is the largeness of the sum required for the expedition, which can hardly be raised by private subscriptions, although these have already reached a considerable amount. It has therefore been necessary to look for Government aid in the matter, and the promoters of the enterprise have met with cordial encouragement in official quarters; but, with a view to further arousing the interest of influential circles in the capital, a combined meeting of the Berlin Geographical Society and of the Berlin-Charlottenburg section of the German Colonial Society was held on January 16 last, under the presidency of Baron von Richthofen, for the purpose of putting before the public the reasons for the despatch of an expedition and the plans which have already been formed for its prosecution.

The meeting, at which many distinguished visitors were present by invitation of the two societies, was opened by a short preliminary address from Baron von Richthofen, who sketched the history of the movement, and gave some account of the previous polar work of the chosen leader. Then, after some remarks by Prince von Arenberg, who represented the Colonial Society, Dr. von Drygalski spoke on the scientific, practical and national importance of the proposed expedition. He began by contrasting the broad features of the North and South Polar regions—the former now known to be occupied by a deep sea, the scattered islands in which form but the outposts of the known continents—while, in the South, men's minds have from very early times pictured the existence of a vast polar continent, the glamour of which long exercised a potent attraction on voyagers, and was finally dissipated only by the discoveries of Cook at the end of the last century. Sketching the progress of discovery since that navigator's time, the speaker laid stress on the important influence exerted by the German

mathematician Gauss, who by his work on terrestrial magnetism gave the impulse to the three expeditions of D'Urville, Wilkes and Ross, to the last of which we owe the whole groundwork of our scientific knowledge of the South Polar region. Although the work of Cook and his successors proved the non-existence of an Antarctic continent valuable from a commercial point of view, it is still the fact that their voyages have—unlike those to the North—brought to light more and more fragments of land, and led to the involuntary conclusion that a continent does lie in those regions.

From a geographical point of view, the fundamental problem attached to the South Polar region—the verification or disproof of the existence of such a continent—is still unsolved. No less important questions likewise await solution with respect to the geological structure and character of the southern lands—so important in connection with a knowledge of volcanic action and the supposed former connection of South America with Australia—and with respect to the conditions of inland ice. It was pointed out by the speaker that even the study of the floating ice broken away from the main mass may lead to important conclusions as to its mode of origin, and the nature of the land from which it comes. Other problems to be investigated are: the origin of the cold ocean currents which take their rise in the south; the conditions of atmospheric pressure and temperature in that region; and the questions relating to terrestrial magnetism, which have so important a bearing on the practice of navigation. Lastly, Dr. von Drygalski alluded, like Sir Clements Markham in this country, to the importance of such an expedition from the point of view of practical training to navigators, and the upholding of national prestige; while he also pointed out the advantages of international co-operation by the sending out of simultaneous expeditions.

The section of Dr. von Drygalski's address which will be read with most interest is, perhaps, that relating to the plans which have already been formed for the carrying out of the enterprise. He began by pointing out that the present seems a particularly favourable period for the resumption of South Polar research, by reason of the unusual amount of drift-ice which has within the last few years broken away from the main mass. This, together with the fact that we are now, according to Supan, passing through a warmer temperature-period, should make the next few years unusually favourable to navigation, and suggests as the most suitable starting-point for an expedition the Southern Indian Ocean, where drift ice has been particularly abundant since 1894. Such a choice also fits in well with the suggestions which have been made with regard to an English expedition, the Southern Pacific and Victoria Land having been mentioned as the probable sphere of the latter. Proceeding southwards on about the meridian of Kerguelen Land, and making *en route* the necessary scientific observations of all kinds, the expedition would attempt to reach some land where a winter station could be formed, and where systematic observations would be continued at the edge of the ice-sheet. In the spring an advance would be attempted southwards over the ice and towards the Magnetic Pole. In the autumn a return would be made as far as possible in a westerly direction along the coast-line supposed to be discovered, the programme being completed within about two years from the date of sailing. The accompanying sketch-map, based on one which accompanies the report of the meeting in the *Verhandlungen* of the Berlin Geographical Society, shows the proposed route in accordance with the above programme. On account of the stormy nature of the southern seas, the lines adopted for the construction of the *Fram* will not be suitable, seaworthiness being the first requisite. Ice-pressure is less to be feared in the south than in the north, since the currents radiate outwards instead of inwards; and the necessary strength can be supplied by internal supports. For many reasons it is thought unnecessary to despatch more than *one* ship, one having proved sufficient for recent North Polar voyages, while the movements of one ship are often hampered by the endeavour to keep in company with a consort. Should the vessels separate for the better prosecution of scientific work, there would be two expeditions, not one, and no additional security would be gained. The vessel should be built of wood, both for its advantages in ice-navigation and to allow of undisturbed magnetic observations. These, with those concerned with meteorology, formed the subject of special remarks by Dr. von Bezold, who pointed out the particular value attaching to such observations in the region in question.



Sketch-map of South Polar Region.

The whole plan of the expedition seems to have been well thought out, and, judging from his previous services to polar research, the scientific work could not be in better hands than those of Dr. von Drygalski. It is to be hoped that the remaining difficulties may speedily be overcome, and that the result may be an important addition, within the next few years, to our scanty knowledge of the southern regions.

THE SIKHIM HIMALAYAS.[1]

OUR ignorance of the Eastern Himalayas is simply astonishing. It is hardly credible that for nearly 1000 miles, from the western extremity of Nepal (long. about 81° E.) to the eastern end of Assam (long. 96° E.) there is only the one small tract of Sikhim, barely fifty miles broad, in which the higher mountains are accessible to Europeans. Throughout Nepal and Bhutan and in the wild forest tracts, inhabited by barbarous Indo-Chinese tribes, east of the latter, none of the rulers of British India can show their faces.

But even in the small mountain region that is open to exploration very few travellers take advantage of the opportunities afforded to them. In the book before us, the author justly insists on the great superiority of the Eastern over the Western Himalayas in scenery. Whether he is right or not in calling the magnificent panorama seen from Senchal, close to Darjeeling, "the

[1] "Among the Himalayas." By Major L. A. Waddell, LL.D., F.L.S., &c., Indian Army Medical Corps. Pp. xvi + 452. (Westminster: Constable, 1899.)

grandest snowy landscape in the world," it is certainly questionable whether a grander view is known. One reason amongst others why the prospect of the snowy range from Darjeeling so greatly excels that from Simla, for instance, is that the high snow-clad peaks are only half as far distant from the former as they are from the latter. Nevertheless, the higher Himalayas north of Naini Tal, Mussooree and Simla attract far more European travellers than the higher ranges of Sikhim because of the great difficulty and expense of journeying in the latter country. Where there are practically no roads, no rest-houses, no facilities for the conveyance of baggage or provisions, and only very small and precarious supplies of food, where everything, from tents to cooking-pots, for a traveller and his guides and followers has to be carried by porters brought from a distance, over steep hillsides in dense forest, along precipices only to be climbed by bamboo ladders, and across raging torrents

spanned by swaying cane bridges that afford, by the insecurity of their fastenings and the tenuity of their foothold, a lively conception of the approach to the Mahommedan Paradise, it is not surprising that but few travellers care to face the difficulties of the journey. It is true that within the last decade a few bridle roads have been made and rest-houses built, here and there, but still travelling in the interior of Sikhim is by no means so easy as in the Western Himalayas.

Yet Sikhim has many attractions besides its scenery. The fauna and flora are wonderfully rich and interesting; of birds alone nearly 600 species are known to occur, or about as many as are found in the whole of Europe, and the inhabitants afford a remarkable anthropological problem. Major Waddell, the author of the work before us, has peculiar advantages in undertaking a description of the country, for not only has he spent many years in studying the languages, religion and customs of the principal inhabitants, the aboriginal Lepchas who cultivate the lower elevations, and the Tibetans or Bhotias who occupy the higher habitable tracts, but he has also devoted considerable attention to the natural history of the country. He was the author of a very large portion of the *Gazetteer* of Sikhim, to which he contributed an excellent description of Lamaism or Tibetan Buddhism, and also a list, with numerous notes, of the Sikhim birds. Although his present work, "Among the Himalayas," wants the charm of Hooker's delightful "Himalayan Journals," treating of the same area, it contains a good descriptive account of Sikhim, with many excellent illustrations.

The book consists of notes on journeys made at different times through various parts of Sikhim, chiefly by the author himself. He was unfortunately prevented from visiting the Lachen valley and its tributary the Zemu, leading to perhaps the most interesting corner of the country, north of the great snowy mountain Kanchenjunga; and this is particularly to be regretted, because the tract specified has hitherto been very briefly and imperfectly described, though some beautiful photographs were obtained, of which one is now reproduced. Almost all of the routes traversed by Major Waddell had been previously described by Hooker or by other travellers; but the present work adds much useful information, as it is the first written by any one familiar with the languages and customs of the people. The illustrations, chiefly photographs of the scenery and of the people, their dwellings, monasteries, &c., reproduced by some of the processes now so largely used, are not only very numerous, but also well selected and, in the majority of cases, effectively printed. No better representations of Himalayan scenery have ever been published on a small scale.

It is impossible here to discuss the numerous subjects noticed by Major Waddell, but there is one of general interest—Mount Everest—to which he makes an im-

portant contribution. In the first place he not only confirms, by clear and independent evidence, the decision accepted by the officers of the Great Trigonometrical Survey of India, that the names such as Gaurisankar, Deodhunga, &c., applied by B. H. Hodgson and H. Schlagintweit to the highest peak of the Himalayas, do not belong to it at all, although the first of them has been extensively used on German maps, but he also shows that there is a Tibetan name *Jomo-kang-kar*, meaning "The Lady White Glacier," which apparently does apply to the culminating peak of the Everest group. Secondly he points out that, according to the Tibetans, there is another mountain, due north of Mount Everest, that exceeds even that peak in height, and must therefore be the highest mountain in the world, unless some other Tibetan peak, as yet unmeasured, exceeds it. Apparently no European has yet set eyes upon this mysterious summit of the upper Lap-chi-kang ; its discovery and measurement afford a grand opportunity for a future geographer and explorer. Before quitting this subject, a hope may be expressed that no one will be found so utterly lost to all sense of humour as to adopt the barbarous hybrid term of *Kong-kar-Everest* for the monarch of the Himalayas ; it is astounding to find Major Waddell writing calmly of the matter, and apparently without any appreciation of the fact that the name is absurd. This is the more surprising, for Major Waddell is justly severe on the ignorance which insists on adding superfluous aspirates and other letters to native names, and he reproves the people who write "Thibetian" for Tibetan and "Gnathong" for Na-tang.

Major Waddell has paid great attention to Sikhimese birds, but he appears to have a rather imperfect acquaintance with the mammals. He writes of the "marsh-deer or sambhar" (p. 260) apparently under the idea that both are names applied to the same animal, he calls the *Goomcher* or *Gumchen* of Tibetans a tailless rat or marmot, whereas it is a *Lagomys* or pika, and he even writes of the Serow, a goat-antelope, as the Serow deer. He must have been misled by some of his followers into supposing (p. 113) that tracks he saw on Tendong, a few miles north of Darjeeling, in oak and magnolia forests, about 8500 feet above the sea, were those of Bharal, *Ovis nahura*, an animal that does not inhabit this part of Sikhim, and that never enters forests at all. It may be added that, especially with regard to Latin names, the book appears not to have been read quite as carefully as is necessary, for *Ovis nahura* becomes *Ovis nehur* on p. 113, and *Ovis natura* on pp. 216 and 225 ; whilst *Nectrogale* for *Nectogale* (p. 219), *caerulus* for *caeruleus* (pp. 77, 240), *Grandula* for *Grandala* (p. 216), and *Calliophis* for *Callophis* (p. 77), are other instances of misprints. To some extent names of places suffer from the same want of revision ; thus the Sibu Pass of the map and Seeboo Pass of p. 215, is apparently the Sherboo Pass at p. 161. Another curious case of oversight is the statement, on p. 330, that the peaks of the Everest group are shut out from view at Senchal by a dark ridge, although a figure of the peaks in question, as seen from Senchal, is given on p. 33 ; the fact being that it is the lower portions of the Everest group, not the peaks, that are shut out.

These, however, are minor drawbacks, and do not prevent the work from being a valuable addition to Himalayan literature. W. T. B.

PROFESSOR SOPHUS LIE.

IT is with much regret that we have to announce the death of this distinguished Norwegian mathematician, which took place on February 18 of the present year.

Born at Christiania on December 12, 1842, he graduated as Doctor in the University of that city in 1868. Four years later he was appointed professor extraordinarius of mathematics ; and in 1886 he succeeded Klein as professor at Leipzig, when the latter was nominated to Göttingen. During the last few years a strong desire has been felt by his fellow-countrymen that he should occupy a professorship in his native country, and that a post should be specially created for him in Christiania. It was only quite recently that this desire had been gratified ; unhappily too late to be effective. His strength had been undermined by the intense ardour with which he pursued his investigations ; and his health, thus broken, has forbidden any long tenure of a chair in which, as had been hoped, he would be able to continue his mathematical researches.

When once the merit of his work began to be recognised, scientific honours were bestowed upon him freely. He had received the honorary or foreign membership of societies and academies in great numbers ; in particular, in England alone, he was enrolled among the foreign members of the Royal Society, and among the honorary members of the Cambridge Philosophical Society and the London Mathematical Society.

The list of his scientific productions includes over 100 papers, many of them of considerable length, and six volumes. Probably he will be best known by the treatise "Theorie der Transformationsgruppen," in the preparation of which he was assisted by the loyal devotion of Dr. F. Engel. It is a work of great originality, containing many methods and a wide range of development ; it exhibits in masterly manner the suggestive application of new methods to fundamental subjects ; and it may be described briefly as a systematic exposition of Lie's investigations on groups of transformations that are continuous and finite. Among the subjects to which application is made, may be mentioned the theory of ordinary differential equations ; the theory of partial differential equations, both single and in systems ; differential invariants and their types ; the solution of Pfaff's problem ; tangential transformations, specially in spaces of two and three dimensions, and more generally in n dimensions ; groups of functions transformable into one another, and a substantial simplification (by the use of their properties) in the integration of systems of partial differential equations ; a complete determination of types of the groups of transformation in one, two, and three variables, and a partial determination of those in n variables. It concludes with a profound study of the foundations of geometry from the point of view of Riemann and Helmholtz ; and after a critical discussion of the significance of the hypotheses which they made, he propounds a solution of his own, based upon more elementary hypotheses.

In a couple of instances, his lectures in amplification and elucidation of portions of his theory were edited and published in volume form by Dr. G. Scheffers, whose help is gratefully acknowledged : one of these relates to differential equations that admit of known infinitesimal transformations ; the other to continuous groups.

Two other works were promised by him. One of these, to be written in co-operation with Dr. Engel, was to deal with the theory of infinite continuous groups and the application of the general group-theory to the integration of differential equations : this work has not appeared. The other, to be written in co-operation with Dr. Scheffers, was to be devoted to a systematic exposition of his geometrical investigations ; the first volume has appeared under the title, "Geometrie der Berührungstransformationen."

As already indicated, his name at the present time would probably be associated most closely with the theory of continuous groups. An inspection of his memoirs, however slight, is sufficient to indicate his keen and essential interest in the domain of geometry. But while his method was that of the group-theory, and while his investigations so frequently referred to geo-

metry, his real aim is declared by Klein—and the declaration can find ample support from his memoirs and his treatises—to have been the achievement of progress in the theory of differential equations. It was for this purpose that he developed his theory of transformations, and worked at it from his earliest productive days to his latest with a consistent tenacity characteristic alike of the nature and the strength of his mathematical genius.

The death of Sophus Lie removes from the rank of active workers in pure mathematics one of the most conspicuous, independent, and original minds of his generation. A. R. F.

NOTES.

THE Joint Committee of the Royal Society and the Royal Geographical Society, appointed to promote the project of an Antarctic Expedition, have made recommendations to the Royal Society Council and to the Council of the British Association, in pursuance of which the Treasurer of the Royal Society has applied on behalf of the Council to the Government Grant Committee for 1000*l.*, and the Council of the British Association has resolved to recommend to the General Committee to contribute a like amount towards the expenses of the proposed undertaking.

THE Croonian Lecture will be given at the Royal Society on Thursday next, March 16, by Dr. Burdon-Sanderson, F.R.S. Subject—"The Electrical Concomitants of Motion in Animals and Plants."

A MEETING of the committee of the Liverpool Association of Foreign Consuls was held on February 27, in the office of the Brazilian Consulate, for the purpose of taking into consideration the Liverpool School of Tropical Diseases and its recognition by the Governments represented. The company having been addressed by Mr. Alfred L. Jones, as representing the Congo Free State, and by Mr. Ehrenberg, consul for Sweden and Norway, it was agreed to hold a general meeting of the consuls on March 9, so that they might be better able to inform their Governments on the subject. Prof. Boyce then explained that four courses of two months each would be given to qualified men every year. Liverpool, he thought, was the best possible place in which to establish such a school, as they had examples of the diseases in question brought from all the tropical regions of the world. Besides instructing qualified medical men who would have appointments on shipboard, or intended to practise in tropical countries, they would admit missionaries to the classes, and would also train black women as nurses.

BEING invited to take part in the opening of the new School of Tropical Diseases at Liverpool, Prof. Koch has written regretting his inability to be present, and saying: "Permit me to express my sympathy with the new institution and to offer my best wishes for the success of your grand and useful undertaking. I certainly hope to be able later to have the opportunity to personally visit the new institution." In another letter the professor says: "Blackwater fever is the most important disease in West Africa, but one which, I am convinced, it will be easy to prevent when the course and character of the disease become more familiar. Up to the present we have received, with very few exceptions, very satisfactory accounts. Those practitioners in the tropics who have written, give nothing more than anecdotary reports of no scientific value whatever. It will be one of the most important duties of the new school to give medical men going out to the tropics a clear idea of the disease, and to impress on them how to make and collect scientific and useful observations. You in Liverpool have opportunities of seeing cases; even here in Germany I have seen five cases (two in Berlin) during the last half-year in persons who have returned from the tropics."

WE are informed by the Secretary of the Institution of Electrical Engineers that, as many members and others failed to gain admission to the meeting on March 2, Mr. Marconi has promised, at the request of the Council, to repeat his lecture on wireless telegraphy, with demonstration, on Thursday, March 16, in the theatre of the Examination Hall, Victoria Embankment. Up to 7.45 p.m. admission will be only by tickets, to be obtained by members on application to the Secretary.

THE Royal Institution Friday evening discourse on March 10 is on "Measuring Extreme Temperatures," by Prof. H. L. Callendar, F.R.S.; that on March 17 is on "The Electric Fish of the Nile," by Prof. Francis Gotch, F.R.S.; and that on March 24 on "Transparency and Opacity," by Lord Rayleigh, F.R.S.

THE new laboratories in connection with the Middlesex Hospital Medical School are, we hear, now completed. They are equipped with all the best modern appliances for the purpose of instruction and original research. An inaugural conversazione will be held on the evening of Wednesday, March 15, in the new buildings, when many objects of interest will be exhibited.

THE President of the Board of Trade has consented to receive a deputation of representatives from the Decimal Association, Chambers of Commerce, Educational Institutions, and Trades Unions on March 22, when the Government will be urged to make compulsory the use of the metric weights and measures after a period of two years, January 1, 1901, having been suggested as a suitable date for the introduction of the new system.

THE Fothergillian gold medal for 1899 has, on the recommendation of a special committee of the Medical Society of London, been awarded to Dr. S. Monckton Copeman "in recognition of his researches on the preservative effects of glycerine upon vaccine lymph and of the benefits in a practical sense that have arisen therefrom."

Science announces that the House Committee on Appropriations has recommended an increase of 4200 dollars in the annual appropriation for scientific work of the United States Fish Commission. This increase is made after an examination of the practical results that have attended the lines of scientific research carried on during the past year.

A BILL has been introduced into the New York Assembly appropriating 30,000 dollars to continue the promotion of the sugar beet industry. Of this amount 2500 dollars are devoted to making experiments by the Commissioner of Agriculture.

IT is reported that a committee has been appointed by the Council of the Institution of Electrical Engineers to inquire into the future of electrical engineering in the domain of telephony in this country.

ON November 17, 1897, the sum of twenty thousand dollars was given to the National Academy of Sciences, as trustee, to establish a fund to be known as the Benjamin Apthorp Gould Fund, in memory of the father of the donor, Miss Alice Bache Gould, the income to be used to assist the prosecution of researches in astronomy. A sufficient available income has now accrued from the fund to warrant beginning its distribution, and the Directors are prepared to receive and consider applications for appropriations. In accordance with the wish of the donor, work in the astronomy of precision shall, in all cases, be given the preference over any work in astrophysics. The fund is in-

tended for the advancement and not for the diffusion of scientific knowledge, and is to be used to defray the actual expenses of investigation, rather than for the personal support of the investigator during the time of his researches, without absolutely excluding the latter use under the most exceptional circumstances. Although intended primarily to assist American investigators, foreign workers may occasionally receive benefit from the fund. Application for appropriations from the income of the fund should be made by letter to the Directors, at 16 Craigie Street, Cambridge, Mass., U.S.A., stating the amount desired, the nature of the proposed investigation, and the manner in which the appropriation is to be expended.

THE National Geographic Society of America offers two prizes of 150 dollars and 75 dollars respectively for the best essays on Norse discoveries in America. Essays submitted in competition must be type-written in the English language, not exceed 6000 words in length, be signed by a pseudonym, and received not later than December 31 of the present year.

PLANS have been made for the erection of a State meteorological station on the summit of Schneekope, one of the Riesengebirge, Silesia, which is 1605 metres in height.

Science states that in the Museum of the Brooklyn Institute a department will be established in which natural history and technology will be exhibited in a manner that will interest and instruct children. This, according to our contemporary, is a new departure for America.

THE *Times* correspondent in Zürich writes that a Volta commemoration is to be held in May next at Como, where the great electrician was born, and where he died in 1827. The *fêtes* at Como are to celebrate the centenary of Volta's discovery of the electric pile, in honour of which event an exhibition of inventions in electricity will be opened on May 14, the town contributing some 500,000 francs to the preliminary expenses. Como has always been proud of its greatest citizen, and Volta's memorials are carefully preserved in its Museo Civico, where can be seen his first electric pile, many of his scientific instruments, an electric pistol, and an electric lamp of his invention, besides many of his manuscripts, sketches, and designs. Exhibits are announced from all parts of Europe and America, and a congress of electricians and telegraphists will be held at the same time. In connection with the Volta commemoration an exhibition of Italian silk industries will be opened simultaneously with the electric exhibition. The exhibition buildings face the lake, on which the latest inventions in electric boats and launches will form a conspicuous feature of the *fêtes*. Volta's electric pile was first described in England in a letter to Sir J. Banks, then president of the Royal Society. This letter is dated March 1, 1800, and was read before the Society on June 26 of the same year.

ACCORDING to *Engineering* the Belgian Society of Electricians is organising an electrical exhibition to be held at Brussels next June, in the Central Telephone Building, Rue de la Paille. The scope of this exhibition is a small one, as it is intended to illustrate only the domestic applications of electricity, but it promises to be one of great interest. The contents will be divided into two sections, and fourteen classes. The first section comprises four classes as follows: (1) Lighting. (2) Electric heating. (3) Power. (4) Batteries and accumulators, including every variety of primary and secondary cells. The second section includes ten classes. (5) Telephones and telegraphs, especially adapted for private service. (6) Safety and control apparatus. (7) Clocks, chronographs, and other similar instruments. (8) Hygiene. (9) Medical electricity. (10) Miscellaneous, such as lightning conductors, luminous signs, the seasoning of wines and alcohols electrically. (11) Music. (12) Electric locks and other safety devices. (13) Electric toys and jewellery. (14) The combination of furniture and decoration with electrical appliances. No generators will be admitted for exhibition, but current will be supplied gratuitously to all exhibitors. A charge for space will be made, varying according to the location allotted, and whether isolated or grouped. Further information respecting the exhibition can be obtained by application to the Secretary of the Executive Committee, 18 Rue Melsens, Brussels.

THE tenth meeting of the International Congress of Hygiene and Demography will be held in Paris in August 1900. The division of Hygiene will comprise seven sections, of which the following is a list: (1) Microbiology and parasitology applied to hygiene, in which the questions to be discussed are the measurement of the activity of serums; the prophylaxis and preventive treatment of diphtheria; meat poisoning, its causes and the means of its prevention; pathogenic microbes in soil and water (cholera, typhoid fever, and other diseases); the part played by water and by vegetables in the etiology of intestinal helminthiasis. (2) Chemical and veterinary sciences applied to hygiene; alimentary hygiene, in which the questions to be discussed are tinned provisions and the means of preventing accidents; unification of international control; the establishment of a general and uniform system of inspection of slaughter-houses, &c. (3) Engineering and architecture applied to hygiene, in which the question to be discussed is the protection of water supplies. (4) Personal hygiene, in which the question to be discussed is contagious patients from the hospital point of view. (5) Industrial and professional hygiene. (6) Military, naval, and colonial hygiene, in which the question to be discussed is the means of ensuring the purity of water from the point of view of colonial hygiene. (7) General and international hygiene (prophylaxis of communicable diseases; sanitary administration and legislation), in which the questions to be discussed are the prophylaxis of tuberculosis in regard to individuals, families, &c.; the compulsory notification of communicable diseases, its necessary consequences (isolation, disinfection) and its results in different countries; the prophylaxis of syphilis; and the international prophylaxis of yellow fever.

ON Sunday morning, at about twenty minutes past two, a disastrous explosion occurred at the Lagouban Naval Magazine, which is situated on a hillside about two and a quarter miles from Toulon. It is said that the magazine contained 50,000 kilogrammes (or nearly fifty tons) of black powder; and, as every one agrees that only one report was heard, the whole must have been blown up simultaneously. Many of the effects of the explosion are of interest. For nearly two miles round, the country has been swept almost bare. Houses are razed to the ground, trees are overturned, or bent and distorted to the most extraordinary shapes, the fields are devastated and covered with stones and fine impalpable black dust. One stone, weighing nearly fifty kilogrammes, fell in the suburb of Pont de Las. Windows were shattered and doors battered in at St. Jean de Var, five miles from Lagouban. The explosion was heard and felt at Nice (84 miles), where it was at first supposed by some to be a slight earthquake; and it is also said to have been felt across the frontier at Ventimiglia, which is at a distance of about 98 miles.

AT a meeting of the Society of Arts, on the 17th ult., the Rev. J. M. Bacon read a valuable paper on the balloon as an instrument of scientific research. The author reviewed the subject from the time of the ascents organised by the Russian Academy at the beginning of this century, until the recent researches under the auspices of the international organisation now in active progress in various countries, and including the

experiments with unmanned balloons and with kites. He very properly attached much importance to the work carried on in 1852, under the auspices of the British Association, by Mr. J. Welsh, of the Kew Observatory, and by Mr. J. Glaisher ten years later. The primary objects of the exhaustive researches of the latter were to determine the temperature and hygrometric condition of the air below the clouds, in them and above them. These ascents clearly proved that the decrease of temperature with elevation is far from constant, and that during the midnight hours there is generally an increase of several degrees. The experiments with unmanned balloons, which have ascended far beyond the limits of human endurance, have brought down readings showing altitudes and temperatures never dreamed of. In those conducted at Berlin an altitude of upwards of 60,000 feet has been reached, and a temperature of −88° was recorded; while a temperature of 6° lower has been recorded in a similar balloon despatched from Paris. The author draws attention to important results obtained with regard to the motions of the atmosphere, and the transmission of sound waves.

AT the recently held annual meeting of the Washington Academy of Sciences, Prof. Charles D. Walcott was elected president for the ensuing year. A course of popular lectures on scientific subjects has been arranged for delivery during March and April, and a number of demonstrations will also be given on topics of special interest. The Academy has decided to publish its proceedings. The "brochure" plan has been adopted; each separate publication will have its own pagination as well as that of the volume, and be dated with the actual date of delivery to members. A welcome donation to the Academy was recently made by Mrs. G. Hubbard, of the value of 1000 dollars, as a token of her desire to aid in the advancement of science and the union of scientific interests in Washington.

IT is stated in *Science* that Dr. Charles Mohr, special agent of the Forestry Division of the United States Department of Agriculture, has recently presented to the Museum of Pharmacognosy of the University of Michigan some interesting and valuable specimens. They consist of a section of a pine-tree trunk, showing the American method of boxing and bleeding long-leafed pines for turpentine, and of samples of the twenty different turpentine products manufactured in the South. The various stages of the manufacture of turpentine are, it is said, well illustrated by these specimens.

THE *Geographical Journal* for March, speaking of the German Deep-Sea Expedition, says that a letter from Prof. Chun, the leader of the expedition, dated January 20, has reached Sir John Murray, from which it appears that the voyage of the *Valdivia* down the Atlantic to the edge of the Antarctic ice, and thence through the Indian Ocean, has been most successful, the soundings alone serving to fill an important gap on the charts, and showing that the average depth of the Southern Ocean must be considerably greater than has been supposed. The *Journal* says that Sir John Murray considers that the success of the German investigators in attaining so high a southerly latitude, as is mentioned in the letter, in a vessel not protected for ice-navigation is very remarkable, and that it augurs well for the prospects of a scientific Antarctic expedition. Prof. Chun's communication, which is printed in full in the *Journal*, states that Dr. Bachmann, the surgeon to the expedition, died in the Indian Ocean, but that all the other members of the party were well.

SIR CHARLES TODD has communicated to the *South Australian Register*, of January 14, a review of the weather of South Australia during the year 1898. He states that, although owing to dry weather at the beginning and end of the year, as well as in September, when the failure of rain was fatal to the harvest in many parts of the Upper North, more rain fell over the settled districts generally than during the two previous years. June was the wettest June in the north on record at all stations. As regards temperature, it was below the average during the first five months of the year in the northern and central parts, and above the average during the rest of the year; while in the extreme south it was generally warmer than the average all through the year. Altogether the harvest season has turned out a very fair one: a great improvement on the past two or three years.

IN the *Meteorologische Zeitschrift* for January, Dr. J. Hann has contributed a short paper on the climate of the Klondike district, collated from observations at present available. The following are the values for temperature at Dawson City during four months of January: means of the daily extremes (minima and maxima) −26°·1, −17°·0; means of the monthly extremes −54°·6, 12°·7; the absolute extremes are −67°·9, 21°·9. For July only one month is available: the mean daily extremes are 44°·4 and 68°·9, and the mean monthly extremes are 32°·9 and 81°·0. These values are not out of the way for a continental climate in such a high latitude (64° 5′ N.); they do not compare with the low winter and high summer temperatures in the same latitude of East Siberia.

A DESCRIPTION of the Vertebrate remains from the Port Kennedy Bone Deposit was the last scientific work of the late Prof. E. D. Cope, and it has now been published in the *Journal* of the Academy of Natural Sciences of Philadelphia (vol. xi. part 2, 1899). The MS. has been printed just as it left the hands of the author, and such of the fossils as it was necessary to figure have been illustrated in four plates by a photographic process. Curiously enough no other fissure or bone-cave has yielded such a large number of species as this cave or fissure at Port Kennedy, which is situated in Upper Merion Township, Montgomery County, Pennsylvania. So long ago as 1871 its ossiferous nature was discovered by workmen engaged in quarrying the Cambrian limestone in which the fissure occurs, and many of the fossil remains were then identified by Prof. Cope. The palæntological interest of the locality was, however, for more than twenty years lost sight of, until Mr. H. M. Mercer and others engaged in careful excavations, and obtained materials for the full report which is now issued. The assemblage is a remarkable one. Tiny Mammalia such as shrews, and voles occur alongside of the mastodon and giant sloth. Remains of horse, tapir, peccary, and porcupine occur together with machærodus, lynx, wolverine, wolf, and bear. Semi-terrestrial forms of tortoise, snake, and beaver are found with the hare, squirrel, and jumping mouse. The majority of the forms are not in any sense cave-dwellers, nor could they well have been dragged there by carnivorous species. The bones are neither gnawed nor water-worn. At the same time, two bones have been rarely found in their normal relations to the skeleton. As stated in a previous report (*Proc.* Acad. Nat. Sc. Philad. for 1895, p. 450), Prof. Cope believed that the larger animals fell into the fissure at intervals during a long period, while many of the smaller ones may have entered it by channels now filled with débris; and Prof. A. Heilprin (p. 451) thought that the large number of extinct or Neotropical forms, indicated more nearly a Pliocene than a Post-Pliocene (or Pleistocene) fauna—at all events a fauna which preceded the glacial epoch.

THE additions to the Zoological Society's Gardens during the past week include a Smooth-headed Capuchin (*Cebus monachus*, ♂) from South-east Brazil, presented by Mrs. Cecil Popham; a Sooty Mangabey (*Cercocebus juliginosus*, ♀) from West Africa, presented by Lieut. B. Horsburgh, A.S.C.; a

Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Mr. R. C. Cooper; a Wild Cat (*Felis catus*) from Scotland, presented by Mr. Claude Alexander; a Silver Pheasant (*Euplocamus nycthemerus*, ♂) from China, presented by Mr. W. McNaughton Love; two Thars (*Hemitragus jemlaicus*, ♂ ♀) from the Himalayas; a Long-billed Butcher Crow (*Cracticus destructor*) from New Holland; a Laughing Kingfisher (*Dacelo gigantea*) from Australia, deposited; a Thick-tailed Opossum (*Didelphys crassicaudata*, ♀) from La Plata, a White-eyebrowed Guan (*Penelope superciliaris*) from South-east Brazil, a Little Guan (*Ortalis motmot*) from Guiana, three Elliot's Pheasants (*Phasianus ellioti*, ♂ ♀ ♀) from China, purchased.

OUR ASTRONOMICAL COLUMN.

COMET 1899 *a* (SWIFT).—Three telegrams have been received from Kiel announcing the discovery of the first new comet of this year. Two observations of it appear to have been made, the respective positions being as follows:—

1899.	R.A. h. m. s.	Decl. ° ′ ″
March 3 ...	3 45 0 ...	−29 0 0
4 ...	3 48 0 ...	−27 7 0
6 ...	3 37 8 ...	−24 8 32

It is described as being bright enough to be seen with the naked eye, and having a slow movement.

The comet should be looked for immediately after sunset in the south-eastern sky. At present it is about 12° due south of the 2nd magnitude star γ Eridani, passing the meridian about 5.30 p.m. As a guide to its position, it is nearly on the line joining α and β Orionis, about twice as far from the latter as these two stars are apart.

TUTTLE'S COMET.—Another telegram from Kiel communicates an ephemeris of this comet, which has been computed by J. Rahts from data obtained in 1885.

Ephemeris for 12h. M.T. Berlin.

1899.	R.A. h. m. s.	Decl. ° ′	Br.
March 5 ...	0 59 58 ...	+33 36·2 ...	
7 ...	1 7 23 ...	33 17·8 ...	0·62
9 ...	14 51 ...	32 58·5 ...	
11 ...	22 21 ...	32 38·2 ...	0·66
13 ...	29 52 ...	32 16·9 ...	
15 ...	37 25 ...	31 54·4 ...	0·70
17 ...	45 0 ...	31 30·8 ...	
19 ...	1 52 35 ...	31 6·2 ...	0·75
21 ...	2 0 10 ...	30 40·0 ...	
23 ...	7 47 ...	30 12·8 ...	0·80
25 ...	15 23 ...	29 44·2 ...	
27 ...	2 23 0 ...	+29 14·4 ...	0·86

The brightness, in terms of its intensity in 1885, August 10, this being unity. The above positions extend from about halfway between α and β Andromedæ to the centre of the constellation Triangulum. It should be looked for soon after sunset.

As we go to press, a telegram has been received announcing the observation by Herr Wolf of a comet sufficiently near the position given in the above ephemeris to suggest its being the same. The coordinates are as follows:—

1899. d. h.	R.A. h. m. s.	Decl. ° ′ ″
March 5 11.5 ...	1 16 0 ...	+31 38 0

No information is given concerning the brightness of the comet.

LOWELL OBSERVATORY.—In "Popular Astronomy," vol. vii. p. 74, Mr. A. E. Douglass gives a *résumé* of the planetary work which has been done at the Lowell Observatory, Flagstaff, Arizona, during the past four years. Observations of Mercury, by Messrs. Lowell and Drew, confirmed Schiaparelli's result that the planet rotates once during its revolution round the sun. Lines of various widths and dark patches were seen. Venus was examined by the same observers, and also found to continuously present the same aspect to the sun. The markings are faint but certain with good seeing. The prevailing straw-colour seen is ascribed to the presence of an atmosphere. Mars has received special attention, Mr. Lowell having found a number of new canals and lakes. Much time was spent in tracing the seasonal changes on the planet. The white South Polar cap was observed to diminish as the equinox approached, and at the same time a dark line formed round it, the grey tint of the south temperate zone assuming a distinct bluish green, strongly suggestive of growing vegetation. Later this zone turned brown, and finally to a slowly lightening yellow.

The frequently observed projections on the terminator are ascribed by Prof. W. H. Pickering to clouds in the Martian atmospheres. These clouds appear to only form during the planet's night; and this, if true, helps to explain the high mean temperature of the planet as was suggested, in 1892, by Prof. Pickering.

Vesta is found to have a polar compression of $\frac{1}{10}$, the major diameter being almost in the direction of its orbit. The markings detected indicate a direct rotation in less than thirty hours. Jupiter's satellites have been carefully observed to compare with the results of Prof. Pickering at Arequipa in 1892. The period of rotation of Satellite I. is found to be 12h. 24·0m.; its ellipticity is perceptibly greater than in 1892, and its mean diameter slightly less. Detail was seen in Satellite II., showing rotation, but no time deduced. Satellites III. and IV. have direct rotation, always presenting the same face to Jupiter.

The paper concludes with a proposal to establish a systematic notation for further expressing the observing conditions under which astronomical work is carried on. The author gives a "scale of seeing," based on the appearance of the stellar image in a lens of six inches aperture.

THE NORTHERN POLYTECHNIC, HOLLOWAY.

TO form a correct estimate of the existing provisions for the education of the millions who are crowded into the metropolitan area, it is essential to give an adequate consideration to the work being done by the fifteen separate institutions and branches which are included under the London polytechnics. The buildings in which this work is being accomplished may be estimated to have cost at least half a million sterling in capital outlay, and to be expending about 130,000*l.* annually upon some 50,000 students of the multitude of subjects for which provision is made. The receipts from fees and other miscellaneous sources do not exceed 30,000*l.*, leaving 100,000*l.* to be met from other funds. Private subscriptions probably amount to 10,000*l.* The contributions of the City Companies (principally the Drapers', Goldsmiths', and Skinners') provide some 20,000*l.* more. But at least 70,000*l.*, or about two-thirds of the net cost of the work, is drawn from public funds. The grants of the Science and Art Department may be estimated at 10,000*l.* The Central Governing Body of the City Parochial Charities contributes altogether about 30,000*l.*, and the London County Council, through its Technical Education Board, supplies 30,000*l.*, definitely allocated to the part of the work falling within the statutory definition of technical instruction.

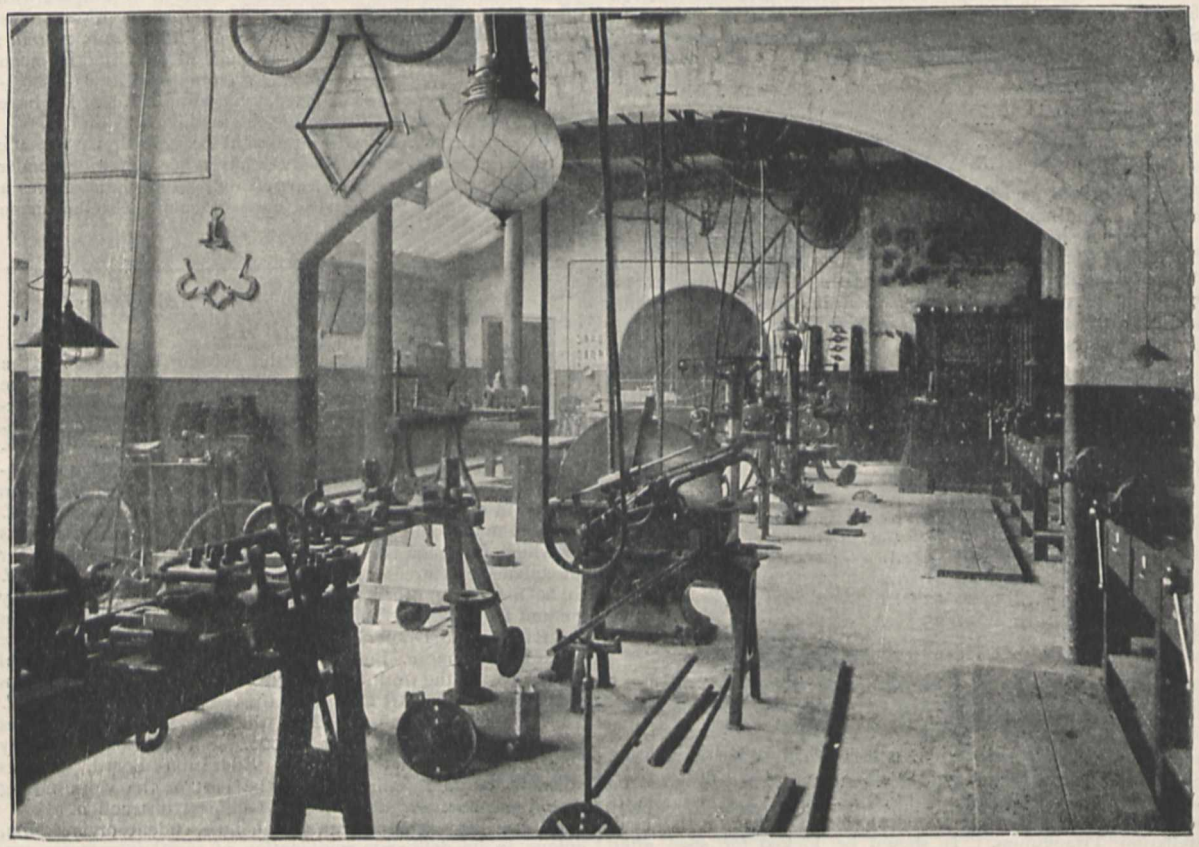
"Each polytechnic institute is an independent organisation, unique in its deliberate combination of social intercourse, recreation and instruction. It is not subject to control by any Government department or other authority, and free, within the limits of its own trust-deed or other constitutional document, to move in whatever direction may be determined on by its governing body." They are, however, with one exception, based upon schemes of the Charity Commission and subject, to a certain extent, to ultimate control by that body. They necessarily defer to any suggestions made by the trustees of the City Parochial Charities, since they, all but two, receive large sums of money from them. The Technical Education Board of the London County Council exerts a very real authority over the educational work carried on in these institutions; for all of them, with two exceptions, are in a great measure dependent upon the large subsidies from this source.

It must not be lost sight of that "in every polytechnic institute the club rooms for men and women respectively, the concerts and entertainments of various sorts, the popular lectures and excursions, form a leading feature. Well-equipped gymnasia and playing-fields, billiards and other games, reading-rooms and lending libraries, as well as mutual societies of all kinds (debating, essay, Shakespeare, swimming, rambling, cycling,

cricket, rowing, photography, and many others), enrol tens of thousands of members." It is to this part of the expenditure that (besides members' fees, and the private subscriptions) part of the contributions from the Parochial City Charities Fund are to be regarded as contributing.

The London Polytechnic is a pure addition to the educational system, neither competing with, nor superseding, previously existing institutions. There is no reason to believe that the alleged stagnation of the London University colleges and secondary schools is in any way connected with the remarkable growth of the polytechnics since 1890.[1]

The Northern Polytechnic Institute[2] was founded under a scheme of the Charity Commissioners, in accordance with the provisions of the City of London Parochial Charities Act, 1892. The scheme provides for the government and administration of an institute for educational and recreative objects, and endows it with an annual sum of 1500*l.* for maintenance, on the supposition that suitable buildings are assured from other sources.



A Laboratory of the Northern Polytechnic.

Subscriptions to the amount of 25,000*l.* were secured for that purpose, largely from private sources, but chiefly through the munificence of the Clothworkers' Company, and a site was obtained in the Holloway Road. Plans for the erection of an institute were prepared in 1893, but, in the first place, only the buildings necessary for educational purposes were erected. The cost of the site was 8500*l.*, and its total area is about one and a quarter acres. The buildings at present completed, at an expenditure of 28,000*l.*, cover some 3400 square yards of the site.

Up to the present some 8000*l.* has been spent upon the equipment of the institute. In every department a fairly complete set of apparatus and fittings for elementary work was provided from the beginning, and instruments for more advanced work have been added, as required, from special equipment grants made by the Technical Education Board of the London County Council.

The income of the Northern Polytechnic is made up as follows: (1) the amount, previously mentioned, received under the City Parochial Charities; (2) special grants made by the Central Governing Body, up to the present amounting to about 500*l.* per annum; (3) grants from the Technical Education Board, amounting for the session 1897–8 to 1900*l.*; (4) grants for attendance, or on the results of examinations, made by the Science and Art Department and the City and Guilds of London Institute, but which, in the absence as yet of a complete working year, cannot be exactly estimated; (5) students' fees, which for the last working year amounted to 1300*l.*; (6) fees received for hire of the large hall, and private subscriptions.

The more important items of expenditure are—salaries and wages, 4100*l.*; fuel, light, and water, 500*l.*; advertising, printing, stationery, and postage, 500*l.*; rates and insurance, 200*l.*

The Work of the Northern Polytechnic.

Almost the whole of the work has as yet been carried on in evening classes, but arrangements are to be made for complete courses of study during the day. In the words of the Principal, Dr. J. T. Dunn, "for the most part the work is *Brodstudien*—the object of the students is to gain knowledge which will be of service to them in their daily work, present or prospective, and any mental training which they receive is incidental." Within this limitation, however, every effort is made to co-ordinate the work of the different departments. Thoroughness is aimed at, and the students are encouraged to study cognate subjects bearing upon their own particular work. The artisan is urged to take up the branches of science upon which the practice of his trade depends, and in both the science and technological classes the greatest importance is attached to practical exercises. As in nearly every other technical institute in the country, the value of the work accomplished is very much discounted by the want of general preliminary training exhibited

[1] The reader is referred to Mr. Sidney Webb's able paper in "Special Reports on Educational Subjects," vol. ii., for further general information respecting London polytechnics.

[2] See the excellent illustrated account by Dr. Dunn in the *Record of Technical and Secondary Education*, January 1899.

by the students who present themselves for instruction in science and technology.

Broadly, the work of the evening classes may be grouped under the heads of (1) mathematics and science, (2) technology, (3) commerce and economics. A fair number of students, however, study languages and other literary subjects.

In addition to the classes in the various branches of study included under physics there is a three years' course in electrical engineering, and workshop classes are arranged for the fourth and succeeding years in electric wiring, fitting, &c. Courses in telegraphy and telephony are to be held later to supplement the other work.

Students in the department of engineering begin with elementary machine drawing, and are only admitted to the mechanical engineering lectures after they have made a certain amount of progress in such drawing. There is also workshop practice in fitting and machining, smith-work and pattern-making. Students work for two or three evenings a week in the shops, at a regular course of filing, chipping, scraping, &c., and are not allowed to go to the machines till they have proved their efficiency at hand work.

The department for the building trades is probably the most numerously attended, a natural result of the fact that these trades are strongly represented in the neighbouring localities. An endeavour is made to get all technological students to go through a course of building construction and to acquire an elementary acquaintance with mathematics, practical geometry, and experimental science. A short course of lectures on the chemistry of building materials is given. Classes in builders' quantities and quantity surveying are held, and practical work is done in the brick-work and plumbing shops. A collection of specimens of various woods arranged for students' inspection at any time, and practical work in masonry, plasterers' work, house-painting and decorating, complete the facilities placed at the disposal of all engaged in the building trade.

In addition to a very complete course of lectures and practical work in pure inorganic and organic chemistry, there have been arranged in the chemical department, lectures to trade class students on various technical applications of chemical and physical science, and a course of elementary experimental science, given by the Principal and the Head of the physical department. This simple course forms an introduction to the more systematic work in the chemical and physical departments, as well as providing the necessary preliminary training for students of technology.

The department of commerce and economics at present includes classes in book-keeping, shorthand, type-writing, and general commercial subjects. French and German are also extensively studied.

The women's department is in an undeveloped condition. Needlework, dressmaking, and millinery are the only subjects for which provision has yet been made. With the completion of the new buildings, now being erected, the organisation of classes in cookery, laundry-work, and general housewifery will be brought to perfection, and a day school of domestic economy will be started.

The Northern Polytechnic has, in addition to the students already referred to, a number working for University degrees, and many studying literature, vocal and instrumental music, elocution, and other subjects of a similar more or less recreative character.

The rapid increase of the numbers seeking admission has already raised a difficulty as to accommodation, and for the 2000 individual students at present enrolled every available inch of space has had to be utilised. A. T. SIMMONS.

THE DUKE OF DEVONSHIRE ON THE SECONDARY EDUCATION BILL.

A DEPUTATION representing a conference held in Manchester under the auspices of the Victoria University on the subject of secondary education, was received on Friday last by the Duke of Devonshire, Lord President of the Council, the object of the deputation being to present to the Lord President the following resolutions, which were passed at the Manchester Conference :—

(1) That, in the opinion of the conference, a Minister of Education of Cabinet rank should represent the Education Department in Parliament ; (2) that the creation of the consultative committee mentioned in Clause 3 of the Bill should be obligatory, and that the committee should be so composed as to be competent to advise as well on the various grades of technical as on those of secondary education ; (3) that it is desirable that immediate provision be made for the institution of local authorities for secondary education ; (4) that the relations of the proposed board of education to the Charity Commissioners should be more clearly defined in the Bill, so as to avoid as far as possible the risk of dual control.

We print, from the *Times* report, an abridgment of the speech delivered by the Duke on the occasion.

As to the resolutions they had brought before him, he was happy to see that the first one practically endorsed the action of the Government in relation to the Bill which was introduced last year. The Bill which will shortly be introduced will probably be altered in some respects as to the constitution of the new Education Department ; but he hoped that such alteration would make it more satisfactory than even the provisions of the Bill of last Session.

The subject upon which Principal Bodington chiefly spoke was that of the second resolution relating to the appointment and constitution of a consultative committee. Principal Bodington said that a certain amount of apprehension had been felt in some quarters that the assumption by the Government of supervision or control over secondary education might possibly have the effect of crushing out the individuality which has hitherto characterised the secondary school system, and might tend in the direction of undue uniformity. He could assure them that no such idea has entered into the minds of the present Government, and that they are perfectly aware, and feel as strongly as it is possible to feel, that it would be in the very highest degree undesirable to attempt, in relation to secondary education, to establish any such uniformity of system as must, perhaps necessarily, exist as regards primary or elementary education. And in so far as the appointment of an advisory committee may tend to make it impossible that any such result may follow, he attached very considerable importance to the constitution of such a committee. Principal Bodington admitted, however—and that is a point on which he felt equally strongly—that the appointment of the committee must not be allowed in any degree to impair the responsibility of the Minister himself.

It would, he thought, be a very unfortunate departure from our constitutional system if the Minister were able to feel that he was not absolutely and entirely responsible for the action of his department, and if he were able to take shelter under the advice of the consultative committee, however representative that committee might be.

As to the constitution of the consultative committee by the Bill to be introduced, he did not think it would be desirable to enter into too minute details. Words, however, he thought, might very well be inserted in the clause setting forth that the intention is to give it that representative character—representative of the Universities, representative of other parties interested in education, representative of the teachers themselves, as well as persons directly nominated by the Government,

Secondary education ought probably in the new department to have a sub-department of its own ; and technical education probably will remain, for the present, at all events, more closely connected with the Science and Art Department. Secondary education is concerned with boys and youths ; technical education is concerned with youths and people of more advanced age ; and he doubted very much whether it would be possible, without unduly enlarging the size of the consultative committee, to entrust to the committee duties connected with both secondary and technical education.

Not much had been said by the deputation on the subject of the third resolution—the institution of local authorities for secondary education. He trusted that anybody who did him the honour to read the speech he made on the subject last year will recognise that the Government are not in the smallest degree insensible to the urgency of the constitution of these authorities. If they refrained this Session from embodying proposals on that subject in the measure which constitutes the central authority, it would be for the reason stated last year.

He could give the strongest assurance that nobody could feel more than the Government that a measure which does not deal with the constitution of local authorities must necessarily be an utterly inadequate and imperfect one, and that it is the Government's firm intention, if they should be successful in passing the

Bill constituting the central authority this year, to introduce one for the constitution of local authorities next year.

The question of the relations of the proposed Board of Education to the Charity Commissioners was an extremely difficult one. He thought the provisions relating to the subject in the Bill of this year might probably differ in some respects from those in last year's Bill; and he hoped that any alterations that might be made in them might be in the direction which the deputation had indicated and appeared to desire. He did not anticipate much difficulty in obtaining assent to the general principle of the Bill. When they came to its details he had no doubt that some difference of opinion might be developed, and he would be very happy to have an opportunity of taking the advice of some of the gentlemen who composed the deputation, and who would be so competent to render it.

THE ORIGIN OF ATMOSPHERIC ELECTRICITY.[1]

ALMOST every suggestion that has ever occurred to any one as to the origin of atmospheric electricity, and the part it plays in meteorology, has been tested over and over again during the past century with only negative results. Some of these are noted in the following paragraphs:

Volta and De Saussure suggested the evaporation of the natural waters on the surface of the globe, all of which are more or less impure, but Pouillet showed that electricity could not come from the evaporation of pure water, but might come from salt water and also from the evaporating surfaces and chemical changes incident to vegetation. De la Rive showed that vegetation was entirely insufficient, and Reiss showed that evaporation of salt water does not, of itself, produce electricity; on the other hand, he showed that the friction of drops of water against the sides of a platinum vessel would produce a small amount.

The hypothesis that our electricity comes from the action of the sun in heating the atmosphere, as also that it is produced by the friction of warm air against cold air, have both been examined, but experiment has never been able to demonstrate the slightest trace of thermo-electricity in gases and vapours.

Schoenbein considered that the oxygen of the air might act electro-chemically upon the molecules of water of which the clouds are composed; but this again has received no experimental confirmation, and could hardly account for the electricity that we find in the clearest dry air. E. Becquerel suggests the decomposition of organic matters; but this, also, is not considered sufficient. It is recognised on all sides that the evaporation of terrestrial waters may carry the negative electricity at the surface of the ground upwards into the atmosphere; but this does not explain the origin of that electrified state at the surface, nor the fact that the atmosphere remains positive while the earth remains negative.

De la Rive considered that the continual chemical action taking place in the interior of the globe explains the origin of terrestrial electricity, and that, as beneath the ocean this action is due to infiltration of sea water, therefore, the ocean is charged with positive electricity, but the solid continents with negative. Especially in the equatorial regions would the atmosphere receive from the sea those positively electrified vapours which, after overflowing into the two hemispheres, would descend in the polar regions and produce auroras, lightning, &c. But this fascinating and comprehensive theory seems to be not at all in harmony with the recent careful observations as to the nature of the electrical distribution in latitude and over oceans and continents. It is generally acknowledged that a great amount of electrified vapour and dust is carried up in every volcanic eruption; but although the quantity is enormous, yet it is not sufficient to explain the condition of the whole atmosphere, although we may thereby explain some of the variations in its general electrified condition; this volcanic electricity apparently originates in a variety of ways, especially from friction.

The fact that a magnetised body when in motion gives rise by induction to an electric current flowing through a neighbouring conductor has led Rowland and S. P. Thompson to calculate the electric effect of motions, such as the wind blowing over the surface of a magnetised globe, or the effect of the rotating magnetic earth upon the ether of space in its neighbourhood. But here again the electric effect turns out to be too small.

[1] By Prof. Cleveland Abbe. (Reprinted from the U.S. *Monthly Weather Review*, June 1898.)

The discovery by Arrhenius that sunlight, especially the ultra-violet rays, greatly diminish the insulating power of dry air and produce what is called photo-electric dissipation and the phenomena discovered by Hallwachs, that a conductor carrying a negative charge gives it up to the surrounding gas when struck by a ray of ultra-violet light, have given rise to the idea that in this way the sunlight acting upon one-half of the earth's atmosphere may discharge the electricity therefrom as well as from the earth and ocean beneath the air; but this, again, has not yet been demonstrated by experiment.

Faraday and Sohncke have shown that dry crystals of ice, such as may occur in the coldest dry air, may become positively electrified by friction, as, for instance, by descending through the air, and Sohncke has formulated a theory explanatory of the electricity of thunderstorms as dependent upon the behaviour of cirrus and cumulus clouds. The electricity is generated in the region of the isothermal surface of 32° F., but this ingenious view still waits for its confirmation. Brillouin has advanced an ingenious explanation of the origin of atmospheric electricity, based upon the action of ultra-violet light upon the crystals of ice that constitute cirrus clouds (see *Monthly Weather Review* for 1897, p. 440), but some points in his theory remain to be established by further experimentation. P. de Heen suggests that as solar radiation illuminates and heats the earth, so it also has the power to electrify the upper strata of air; that these, in fact, as it were, absorb the electric influence, and then, being electrified, act indirectly on the ground below. Maclean and Lenard have studied the electrification of the air by drops of water falling through it. It is found that falling water drops give the air a negative charge, but so also do snow crystals; therefore the higher strata of air should be negative instead of positive, as actually observed. Marvin observes that a rain of fine drops of mercury in dry air electrifies the drops and presumably the air. Palmieri has shown that the condensation of aqueous vapour in and of itself does not develop electricity. Gay Lussac and Pouillet did the same for all changes of condition from solid to fluid to vapour to gas, and the reverse; no electricity is developed except in the change from fluid to solid, when some solids, such as sulphur, show slight manifestations which are due to the action of the edge of the solidifying liquid on the glass vessel containing it.

The inductive action of the earth on its atmosphere is undoubtedly important, but the action of the sun, distant as it is, may be appreciable. Edlund and Siemens have advocated the solar origin of atmospheric electricity, but their hypotheses have not yet been generally accepted.

The spread of the electro-magnetic telegraph lines and the electric cables over the globe has shown that local electric currents generally flowing in an east-west direction exist everywhere in the earth, thus suggesting that the electrified condition of the atmosphere depends upon them. Clerk Maxwell, in his treatise on electricity, after recognising that all other sources are insufficient, suggests that possibly the changing pressures to which the earth's crust is subjected by tidal strains may give rise to piezo-electricity sufficient to explain the negative charge of the earth; the editor, quite independently of Maxwell, has elaborated this hypothesis in his "Preliminary Studies." The laws of these tidal strains have been studied by Chree, Davison, Darwin, and others.

The thermo-electric currents of Peltier and the piezo-electricity so fully investigated by Gaugain are not sufficient to explain the amount of electricity represented by the currents flowing through the earth's surface, but the piezo-electric currents due to tidal strain may be quite sufficient. The latter represent the conversion of gravity into electricity.

Lord Kelvin, without touching the question as to the ultimate origin of the electrified state, shows that observed phenomena are sufficiently explained by simply recognising the fact that the atmosphere can be treated as the dielectric of a condenser (like the glass between the two sheets of tinfoil in a Leyden jar); the lower or earth's surface is negative, and the upper layer of the atmosphere is positively electrified.

But without pursuing further the maze of hypotheses as to the ultimate origin of the electrified state of the atmosphere, we must conclude that this problem is too difficult for immediate solution; it is one of many that a following generation of physicists will undoubtedly cope with successfully.

If we turn to the simpler question of the meteorological phenomena that are evidently associated with atmospheric electricity, we shall find that the best physicists are not yet wholly

clear as to the method of formation of lightning and auroral discharges, the phosphorescent glow of the clouds, ball lightning, and other every-day phenomena. Is a cloud to be considered as one big conductor, or does it insulate and separate the electrified masses on either side of it? Are the great displays to be seen on the summits of the Rocky Mountains due to the influence of the atmosphere or to something going on in the earth beneath? Are large drops really made up by the agglomeration of small cloud particles, or are both the drops and electricity formed simultaneously by the sudden dissipation of unstable molecular equilibrium that exists in supersaturated cloudy air (as suggested by the editor in his article of 1891 in *Agricultural Science* on the "Artificial Production of Rain")? Do the larger drops of rain really possess a greater electrical density on their surfaces than the small drops and particles, or do they not rather lose their charges immediately either by evaporation or by gentle discharge to the neighbouring drops? These and other questions crowd upon our thoughts; but satisfactory replies can only be given after physicists have invented appropriate methods of investigation. Meteorological observers may contribute to the solution of the problems by collecting both general data and special observations of exceptional phenomena, but the discussion of the data and the definitive decision by means of experimentation as to the merits of conflicting hypothetical explanations must be left to the leading physicists of the world.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The election of a professor as member of the Council of the Senate, to fill the place of Prof. Robinson, now Canon of Westminster, will take place on Friday, March 17.

Prof. Woodhead is appointed an Examiner in State Medicine, in the place of the late Dr. Kanthack.

Syndicates are to be appointed to obtain plans and estimates for the new buildings of the Medical School and of the Botanical Department.

MR. FREDERICK TREVES, consulting surgeon to the London Hospital, has been appointed an Emeritus professor of surgery to the London Hospital, and will give a course of lectures in clinical surgery in the winter session. The special subjects and dates will be announced in due course.

PROF. A. H. SAYCE, of Oxford University, has been appointed Gifford Lecturer in Aberdeen University for 1900–1902. The honorary degree of LL.D. has been conferred upon Mr. Charles Stewart, F.R.S., Curator of the Museum of the Royal College of Surgeons, England; and Mr. George F. Stout, Lecturer on Comparative Psychology in Aberdeen University.

AS will be seen from our advertisement columns a successor to the late Prof. Rutherford in the chair of Physiology of the University of Edinburgh will shortly be appointed. Applications for the post, accompanied by relative testimonials, should reach the Secretary to the Curators, at 66, Frederick-street, Edinburgh, on or before May 20.

IN connection with the inauguration of the new buildings of the Middlesex Hospital Medical School, Dr. F. Hetley, a former student, has contributed the sum of 1000*l.* to perpetuate the Hetley Clinical Prize of 25*l.* per annum, founded in 1884.

A CHAIR of Hygiene has been endowed in Harvard University by a donor whose name is withheld.

THE following appointments abroad are announced in *Science*:—Dr. James Monroe Taylor to be president of Brown University; Dr. T. J. J. See to be professor of mathematics at the Naval Academy, Annapolis; Prof. Fritz Regel, of Jena, to be professor of geography at Würzburg; Dr. Erich v. Drygalski, of Berlin, to be professor of geography at Tübingen.

THE resignation of Dr. Robert Otto, professor of chemistry in the Institute of Technology at Braunschweig, is announced.

SCIENTIFIC SERIALS.

American Journal of Science, February.—Contact metamorphism, by J. M. Clements. The various Huronian sediments which form a great portion of the iron-bearing districts of the Upper Peninsula of Michigan have in all of these districts been found to be penetrated by dikes of igneous rocks, which are predominantly basic in character. The author describes the products which have resulted from the intrusion of basic dikes in the Mansfield slate formation. Between the dolerites and the slates there are masses of hard, peculiar hornstone-like rocks, which have a well-banded character. Beginning with the clay-slate, the least metamorphosed rock in the district, the series passes through phyllites, spilosites, and desmosites to those which are known as adinoles, the latter being those which immediately adjoin the intrusive.—The origin of mammals, by H. F. Osborne. The author traces the ancestry of mammals to the Upper Permian, and in doing so he adopts Gill's two subclasses of mammals, namely the *Eutheria*, comprising marsupials and placentals, and the *Prototheria* or monotremes. There are grounds for the view that the *Theriodontia* are the *Hypotheria* or *Promammalia*, because it appears that within the order may well have existed some small insectivorous types, far less specialised in both structures than either the carnivorous Cynodonts or herbivorous Gomphodonts, as one of those conservative species of adaptive radiation which form the focus of a new progressive type.—Chemical composition of tourmaline, by S. L. Penfield and H. W. Foote. The composition was deduced from the results of an analysis of a few specimens carried out with the utmost regard to accuracy. The specimens selected were the colourless tourmaline from De Kalb, St. Lawrence County, New York, and the pale green variety from the felspar quarries at Haddam Neck on the Connecticut River. The authors regard all varieties of tourmaline as salts of the acid $H_9Al_3(B.OH)_2Si_4O_{19}$, in which the complex aluminium-borosilicic acid radicle exerts a mass effect by virtue of which the remaining hydrogens may be replaced by metals of essentially different character without bringing about any pronounced change of crystalline form.—The thermodynamic relations for steam, by G. P. Starkweather. Discusses the application of Van der Waals's equation of condition to steam along the saturation line.—A volumetric method for the estimation of boric acid, by L. C. Jones. This is based upon the reaction $5KI + KIO_3 + 6HCl = 6KCl + 3H_2O + 3I_2$. The liberated iodine may be removed by sodium thiosulphate, and a solution obtained which is absolutely neutral, containing only neutral salts, potassium iodide, iodate, and tetrathionate. Boric acid in moderate amount in solution has not the slightest action on a mixture of iodide and iodate.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 16.—"The Thermal Deformation of the Crystallised Normal Sulphates of Potassium, Rubidium, and Cæsium." By A. E. Tutton, B.Sc. Communicated by Captain Abney, C.B., F.R.S.

In this memoir are communicated the results of sixty-four determinations of the thermal expansion of the orthorhombic crystals of the normal sulphates of potassium, rubidium, and cæsium, carried out for the three axial directions of the crystals with the aid of the compensated interference dilatometer previously described by the author.

The coefficients of cubical expansion exhibit a progression, corresponding to the progression of the atomic weights of the three respective metals. This is true of both the constants a and b in the general expression for the coefficient of cubical expansion, $\alpha = a + 2bt$, for any temperature t.

The order of progression of the two constants is inverted; a, the coefficient for 0°, diminishes with increasing atomic weight of the metal, while b, half the increment of the coefficient *per* degree of temperature, increases. Consequently, the coefficients of cubical expansion of the three salts converge, with rise of temperature, and attain equality in pairs. Beyond the temperature of identity divergence occurs, and an increase of atomic weight is now accompanied by an increase of expansion.

The differences between the coefficients of linear expansion along the three axial directions of any one salt, although only amounting to one-eighth of the total coefficient, are large compared with the differences between the values for the same direction of the three salts. This, together with the fact that the replacement of one metal by another is accompanied by considerable modifications of the relations of two of the three values for the original salt, those corresponding to the axes a and c, prevent the coefficients of linear expansion for any one direction of the three salts from exhibiting any progression corresponding to that of the atomic weights of the three metals.

The increment of the linear coefficient of expansion along the axis c of each salt is about twice as large as the increments for

the other two directions, *a* and *b*, for which latter the increments are nearly equal. This is analogous to the optical behaviour.

The amount of expansion along the direction of the axis *b* is approximately identical for all three sulphates, indicating that interchange of the metals is without influence on the thermal behaviour along this axis.

The chief of the directional perturbations previously referred to consists of a reversal, for temperatures below 50°, of the directions of the maximum and intermediate axes of the thermal ellipsoid for rubidium sulphate, compared with their directions in the potassium and cæsium salts. The maximum thermal axis is *c* for the two latter salts, but *a* for rubidium sulphate. A similar reversal of the direction of the maximum axis of the optical ellipsoid (the indicatrix), the first median line, from *c* to *a*, occurs for the same temperatures, in the case of rubidium sulphate. The maximum thermal axis is identical with the first median line in all three salts.

At higher temperatures the same relations continue to hold for the potassium and cæsium salts, both thermally and optically. But owing to the increment of expansion along *c* being so much greater than for the other directions, the intermediate expansion along *c* for rubidium sulphate attains equality at 50° with the expansion along *a*, and beyond this temperature *c* becomes the maximum thermal axis for this salt, as it is for the other two sulphates. Consequently, at 50° the crystals of rubidium sulphate are apparently thermally uniaxial. At temperatures varying 10° each side of 50° for different wave-lengths of light, they have previously been shown to simulate uniaxial optical properties. The thermal and optical ellipsoids of revolution are not, however, identically orientated, the axis of the former being *b* and of the latter *a*.

The final conclusion of the investigation, therefore, is that:

The thermal deformation constants of the crystals of the normal sulphates of potassium, rubidium, and cæsium exhibit variations which, in common with the morphological, optical, and other physical properties previously investigated, follow the order of progression of the atomic weights of the alkali metals which the salts contain.

"Observations on the Cerebro-Spinal Fluid in the Human Subject." By St. Clair Thomson, M.D., Leonard Hill, M.B., and W. D. Halliburton, M.D., F.R.S.

One of the authors, Dr. Thomson, has had under his care for some years a very remarkable patient, in whom, without any history of injury, cerebro-spinal fluid dripped continuously from one nostril. Research into the literature of the subject has shown that there are other cases on record which must have been similar, although the true nature of the fluid was not recognised. Some of these patients ultimately died from inflammation of the membranes of the brain, which had probably spread from the nose through the opening in the bony lamina that normally completely separates the cranial and nasal cavities.

The fluid itself is characterised by its clear watery character, its low specific gravity, the small amount of proteid in it, and the absence of albumin, and by the presence in it of a substance which reduces Fehling's solution, but is not dextrose; the substance is possibly related to pyrocatechin. The contrast between such a fluid, and the mucin-containing fluid of ordinary nasal hydrorrhœa is very marked.

Analysis of the fluid which escaped in the evenings showed it to be more watery than that collected first thing in the mornings; the difference is due principally to an alteration in the amount of organic solids. This confirms an observation of Cavazzani on dogs, and is what one would expect, as the decreased capillary pressure during rest would lessen the rate of exudation of water.

The case afforded a unique opportunity to Dr. Leonard Hill to confirm the theories he has advanced concerning the cerebral circulation. He has put forward the view that the rate of secretion of the cerebro-spinal fluid, when the cranio-vertebral cavity is opened, depends directly on the difference between the pressure in the cerebral capillaries and that of the atmosphere. At the same time it was shown that cerebral capillary pressure varies directly and absolutely with vena cava pressure.

On the other hand, cerebral capillary pressure varies directly, but only proportionately, with aortic pressure, for between the aorta and the capillaries there lies the peripheral resistance.

It follows from the above that the easiest methods of raising the cerebral capillary pressure in man are:—

(*a*) By compression of the abdomen.

(*b*) By the assumption of the horizontal posture. In this position, however, the rise of venous pressure may be compensated by the fall of arterial pressure, which normally occurs when the body is at rest. This is, no doubt, the case during sleep.

(*c*) By straining or forced expiratory effort, with the glottis closed.

By all these methods the vena cava pressure is considerably raised; and by the last method the venous inlets into the thorax may be completely blocked, and the pressure in the cerebral capillaries raised to something like aortic pressure.

It is true that by such a forced expiratory effort the aortic pressure is lowered. Nevertheless, the total effect on capillary pressure is a very great rise, for a fall of aortic pressure of 25 mm. of mercury produces a fall in cerebral capillary pressure of less than 5 mm. of mercury, while a rise of vena cava pressure of 25 mm. of mercury produces a rise of cerebral capillary pressure of 25 mm. Hg.

The figures, which are given in detail in the paper, show that in the present case the flow of the cerebro-spinal fluid is accelerated by all the circumstances enumerated, which raise the cerebral capillary pressure. The increase of flow is, moreover, accompanied by a decrease in the percentage of solid matter.

One of the authors (W. D. H.), in conjunction with Dr. Mott, F.R.S., has examined the results of injecting into animals cerebro-spinal fluid removed from cases of brain atrophy, especially from cases of general paralysis of the insane. This fluid contains a toxic substance, choline, doubtless derived from the disintegration of lecithin in the brain. Injection of such fluid into the jugular vein of animals, anæsthetised with ether, causes a marked lowering of arterial blood pressure, which is partly cardiac in origin, but principally due to the local action of the poison on the neuro-muscular apparatus of the peripheral vessels, especially in the splanchnic area.

The fluid obtained from the present case was also injected in a similar way. Quantities varying from 7 to 10 c.c. were injected into the circulation in dogs, but with entirely negative results. Such a quantity in the case of fluid from a general paralytic would be quite sufficient to cause a marked fall of arterial pressure.

Mineralogical Society, January 31.—Prof. A. H. Church, F.R.S., President, in the chair.—On a new mode of occurrence of ruby, in North Carolina, by Prof. John W. Judd, F.R.S., and Mr. W. E. Hidden; with crystallographic notes by Dr. J. H. Pratt. About fifteen years ago, very finely-coloured rubies were found at Cowie Creek, North Carolina, and some of these, according to competent experts, have the colour and brilliancy of the finest stones from Burma. These rubies are found in gravels and alluvia underlaid by a "saprolitic" material, the product of the decomposition *in situ* of the rocks of the district. The gems are derived, not like those of Burma from a limestone rock, but from certain basic rocks, such as eclogite, amphibolite, and hornblende schist. Associated with the rubies are found specimens of "rhodolite," a very clear and fine-coloured variety of garnet having a composition intermediate between pyrope and almandine. This garnet is often found enclosed in corundum, so that it must belong to an earlier period of consolidation. In habit, the corundum crystals of Cowie Creek are very similar to those found at Yogo Gulch and other localities where the mineral occurs in rocks of undoubted igneous origin. It is suggested that the rubies of both Burma and Cowie Creek may have originally existed in rocks of basic character of very similar composition.—Experiments on zeolites, by Prof. A. H. Church, F.R.S. The author describes an experiment tending to show that the action of silver nitrate on phillipsite is analogous to that investigated by Eichhorn and by Lemberg in the case of other salts on other zeolites. Prof. Church also exhibited numerous specimens of pure blue apatites from Ceylon, which, owing to their beautiful colour, had been mistaken for sapphires. One of these specimens contained as much as 3·21 per cent. of chlorine, but others only 0·63 per cent. and 0·34 per cent.—On the constitution of mineral arsenates and phosphates. II. Pharmacosiderite, by Mr. E. G. J. Hartley. In continuation of his chemical investigation of mineral arsenates and phosphates, the author gives the results of analyses of pharmacosiderite. From 2·4 to 4 per cent. of potash was found in the specimens analysed, and all the Cornish specimens examined contained this alkali. Water determinations made with special care showed that the mineral contains eighteen molecules instead of fifteen, as previously supposed.—The specific identity of binnite with tennantite, by Mr. G. T.

Prior and Mr. L. J. Spencer. Owing to variations in previous analyses, the true character of this rare mineral from the Binnenthal has been hitherto in doubt. The result of the chemical analysis of very carefully selected material, and of the crystallographic examination made by the authors, shows that binnite is identical with tennantite, since neither in its chemical nor in its physical characters can it be distinguished from that mineral.

Linnean Society, February 16.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. Clement Reid exhibited some fruits of *Najas minor*, Allione, and of *Najas graminea*, Delile, found during a further examination of the interglacial deposits at West Wittering in Sussex.—Dr. A. B. Rendle exhibited specimens of a freshwater Alga (*Pithophora*) new to Britain, and described its structure.—Mr. Gilbert C. Bourne read a paper on the genus *Lemnalia*, Gray, with an account of the branching systems of the order *Alcyonacea*. In the course of his remarks some new terms were proposed specially applicable to the morphology of the Alcyonaceans.—Messrs. I. H. Burkill and C. H. Wright read a paper "On some African *Labiatae* with alternate leaves," a peculiarity which had been recently used by M. Hua to characterise a new genus, *Icomum*. To this genus three new species were now added.—Messrs. J. Cosmo Melvill and Robert Standen communicated a "Report on the Marine Mollusca obtained during the first expedition of Prof. A. C. Haddon to the Torres Straits." Over 400 forms of Gastropoda and Pelecypoda were collected, together with a few Polyplacophora. Twenty-four novelties were described, one of the most noteworthy being a Neriteid Mollusc allied on the one hand to *Vanicoro*, and on the other to *Nerita*, for which the generic name *Magadis* was proposed. *Photadomya Haddoni* was described as a new species.

Zoological Society, February 21.—Prof. G. B. Howes, F.R.S., Vice-President, in the chair.—Mr. A. Smith Woodward read a paper by Dr. F. P. Moreno and himself, on a piece of skin supposed to belong to the *Neomylodon listai* of Ameghino, from a cavern near Consuelo Cove, Lost Hope Inlet, Patagonia. Dr. Moreno's contribution was an amplification of his remarks on the subject made at a previous meeting. He maintained that the specimen in question was of great antiquity, and belonged to the extinct ground-sloth, *Mylodon*. In reply to objections founded on its state of preservation, he supported his contention by mentioning that he had found a well-preserved mummified human body in another cavern in the same district, which certainly belonged to an extinct race of great antiquity, unknown even to the present Tehuelche Indians. Mr. Woodward gave a detailed description of the specimen, pointing out that the skin was unique, even for an Edentate, in having the armour of ossicles confined to the lower half of the dermis, while the covering of hair was implanted in every part of the upper half. He thought he could recognise in it the base of the left ear, and concluded that the piece of skin had probably belonged to the neck. It certainly represented an animal quite as large as *Mylodon*; but he noted discrepancies in the microscopical structure of the dermal ossicles, which inclined him to believe in its generic distinctness. The problem could not be solved, because the dermal armour of *Mylodon* had only been definitely described in the lumbar region, and it was quite possible that the ossicles in the flexible neck of the animal might not agree with those in the comparatively rigid back above the pelvis. If Dr. Moreno had not been able to give so circumstantial an account of the discovery, Mr. Woodward would have unhesitatingly pronounced the skin to belong to a recent animal killed quite lately.—A communication was read from P. W. Bassett-Smith, R.N., containing observations on the formation of the coral-reefs on the N.W. coast of Australia. Special attention was called to the part played by massive *Polyzoa* in forming coral-reefs.—A communication was read from Mr. G. A. Boulenger, F.R.S., containing an account of a collection of reptiles and batrachians made by Mr. J. D. La Touche in N.W. Fokien, China. Eight species were described as new to science in the present paper, amongst which was a snake belonging to a new genus, most nearly allied to *Opisthotropis* of Günther, proposed to be called *Tapinophis latouchii*, after its discoverer.—A communication was read from Sir G. F. Hampson, Bart., containing the second portion of his "Revision of the Moths of the subfamily *Pyraustinae* of the family *Pyralidae*."

Anthropological Institute, February 14.—Mr. C. H. Read, President, in the chair.—A paper was read by Colonel Sir T. H. Holdich, K.C.I.E., C.B., on "The Arab Tribes of our India Frontier." After describing the physical features of the country, the author proceeded to discuss certain ethnological questions. Many of the existing tribes can be identified with those named by Herodotus and Strabo. The author gave a sketch of Arab influence in Baluchistan, which was, he suggested, greater than is commonly supposed. The explanation why our control of the southern borderland is more effective than it is in the north, is that in the former we are not merely facing the Baluch tribes, but we are at the back of them. Besides this, the Baluchis have a well-defined tribal organisation, and the dealings of the Indian Government with them are thereby much facilitated. The author's view as to the predominance of Arab influence in Baluchistan was disputed by Messrs. J. Kennedy and W. Crooke.

MANCHESTER.

Literary and Philosophical Society, February 7.—Mr. J. Cosmo Melvill, President, in the chair.—Notes on the slipperiness of ice, by Prof. Osborne Reynolds, F.R.S. The author referred to some experiments by Mr. Beauchamp Tower on the lubrication of two metallic surfaces, and showed the extraordinary degree of coherence between two "Whitworth planes" after they had been pressed together so as to squeeze out the film of air between. All lubrication is due to the presence of a fluid, either liquid or gaseous, between the opposing surfaces, and in the case of ice the pressure induces a partial liquefaction, which is the sole cause of slipperiness. When ice is cooled below a certain point, it becomes no more slippery than a polished surface of stone.—On science in the "Historical English Dictionary," by C. L. Barnes. It was pointed out that "astronomy" and "astrology" have interchanged meanings since they were first introduced, as is clearly shown by Evelyn in his "Memoirs" (1676), where he says: "Dined with me Mr. Flamsteed, the learned astrologer and mathematician, whom his Majesty had established in the new observatory in Greenwich Park." The science of chemistry appears to have been unhappy in its first introduction into literature, for Gaule (1652) speaks of it as "a kind of praestigious, cheating, covetous magick," and Bentham, in 1812, makes use of this language: "Idioscopic, or cryptodynamic anthropurgics has for its single-worded synonym the unexpressive appellation chemistry." The curious derivation of "alcohol," from the Arabian "kohl," referred to in 2 Kings, ix. 30, and in Ezek. xxiii. 40, as a material for personal adornment, was next referred to. From meaning a fine powder, produced either by trituration or sublimation, the latter sense gradually slid off towards distillation, though in Spanish the words alcohol, alcoholado, alcoholador, and alcoholar still retain their ancient significance in part. The derivation of the word "antimony" itself, and Littre's conjecture that the same Arabic root has furnished both "antimonium" and "stibium"—the latter through the Greek "stimmi"—was also noticed. Under the heading "Atom," the Dictionary quotes, besides the ordinary meanings, a table of Papias, Bishop of Hierapolis in Phrygia in the second century, in which the word signifies a small interval of time, the 22,560th part of an hour. A similar usage is found in the Greek text of 1 Cor. xv. 52, where the expressions "en atomo, en rhipe ophthalmou" are translated "in a moment, in the twinkling of an eye." But most important of all is the discovery, announced alone in this dictionary, that the word "gas" was suggested to Van Helmont by the Greek "chaos," or, as he himself puts it: "Halitum illum 'gas' vocavi, non longe a chao veterum secretum." The spirant sound of the Dutch "g" was probably taken as a nearer equivalent of the Greek "ch" than "k" would have been. Lastly, allusion was made to the originally divergent meanings of "algebra," as a branch of mathematics and the art of bone-setting, which are still both in use in Spain.

PARIS.

Academy of Sciences, February 27.—M. van Tieghem in the chair.—The Perpetual Secretary announced the death of M. Sophus Lie, Correspondant of the Section of Geometry.—Notice on M. Sophus Lie, by M. Darboux.—An electrolytic interruptor, by M. d'Arsonval. A description of Wehnelt's electrolytic interruptor.—On a new uranium mineral, carnotite,

by MM. C. Friedel and E. Cumenge. The mineral occurs mixed with silica in a finely divided state at Montrose, Colorado. It dissolves readily in nitric acid, and contains uranium, vanadic acid, and potassium, together with traces of iron, alumina, copper, lead and barium. The composition was found to be $2U_2O_3.V_2O_3.K_2O.3H_2O$.—On some new and important applications of photography made in Canada in the production of plans, by M. A. Laussedat.—An attempt at a new form of the characteristic equation of fluids, by M. E. H. Amagat. A somewhat complex formula containing ten constants is given as a closer approximation to the behaviour of carbon dioxide than the usual $pv = RT$ equation.—Prof. Ray Lankester was elected a Correspondant for the Section of Anatomy and Zoology, in the place of the late M. Lovén.—M. Lortet was also elected a Correspondant for the same section, in the place of the late M. Steenstrup.—On linear partial differential equations, by M. E. Vessiot.—Transformation of the X-rays by different bodies, by M. G. Sagnac.—Influence of very low temperatures on phosphorescence, by MM. Auguste and Louis Lumière.—The amplification of sounds in phonographs, by M. Dussaud. The intensity of the sound emitted by the phonograph increases with the diameter of the registering cylinder.—On the relation which exists between the molecular weights and densities of fluids, by M. Daniel Berthelot.—On the phosphorescence of strontium sulphide, by M. J. R. Mourelo.—On ethene-pyrocatechol, by M. Ch. Moureu.—Method of analysis of acetone oils, and their composition, by MM. A. and P. Buisine. The acetone oils obtained from wool contain about 75 per cent. of ethyl-methylketone, and less than 5 per cent. of acetone.—On the combinations of phenyl hydrazine with alcoholic iodides, by MM. P. Genvresse and P. Bourcet.—On the direct transformation of ammonia into nitric acid in liquid media, by M. E. Demoussy.—On the fermentation of galactose, by M. Dienert.—On the source of the fossilised shells of ostracods which fell at Oullins, near Lyons, on September 24, 1898, by M. R. Fourtau. The author concludes that the shells could not have come from Egypt.

DIARY OF SOCIETIES.

THURSDAY, MARCH 9.

ROYAL SOCIETY, at 4.30.—A Preliminary Note upon certain Organisms isolated from Cancer, and their Pathogenic Effects upon Animals: H. G. Plimmer.—On the Gastric Gland of Mollusca and Decapod Crustacea; its Structure and Functions: Dr. MacMunn.—On the Structure and Affinities of *Matonia pectinata*, R.Br., with Notes on the Geological History of the Matonineæ: A. C. Seward, F.R.S.—A Sugar Bacterium: Prof. H. Marshall Ward, F.R.S., and Prof. J. R. Green, F.R.S.—Note on a New Form of Light Plane Mirrors: A. Mallock.

SOCIETY OF ARTS (Indian Section), at 4.30.—Leprosy in India: H. A. Acworth.

MATHEMATICAL SOCIETY, at 8.—Note on a Property of Groups of Prime Degree: Prof. Burnside, F.R.S.—Note on the Expansion of $\tan(\sin\theta) - \sin(\tan\theta)$ in Powers of θ: R. H. Pinkerton.—Remarks on the Phenomenon of Zeeman and its Bearing on the Problem of the Origin of Spectra: Dr. J. Larmor, F.R.S.—Note on Involution: G. B. Mathews, F.R.S.—The General Conic and its Normic Equations: Prof. A. Sawin.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Subject announced at Meeting of March 2.

FRIDAY, MARCH 10.

ROYAL INSTITUTION, at 9.—Measuring Extreme Temperatures: Prof. H. L. Callendar, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 8.—(1) Occultations observed during the Lunar Eclipse of 1898 December 27; (2) Nebulæ observed during the Year 1898: Cape Observatory.—On the Use of the Electric Light for the Artificial Star of a Zöllner Photometer: W. de Sitter.—The Radiant Point of the April Meteors (Lyrids): W. F. Denning.—Observations of Hind's Variable Nebula in Taurus: E. E. Barnard.—Determination of the Diameter and Compression of the Planet Mars: Prof. W. Schur.—Periodic Variation in the Colours of the Equatorial Belts of Jupiter: A. Stanley Williams.—Double-Star Observations, 1895-98: W. H. Maw.—*Papers promised:* (1) Note on the Diurnal Variations of the Nadir and Level of the Greenwich Transit Circle; (2) The Greenwich Meridian Observations of Polaris, 1836-93, with Reference to Personality, the Constant of Aberration, and the Star's Parallax: Royal Observatory, Greenwich.

PHYSICAL SOCIETY, at 5.—(1) A Study of an Apparatus for the Determination of the Rate of Diffusion of Solids dissolved in Liquids; (2) Note on the Source of Energy in Diffusive Convection: Albert Griffiths.—An Exhibition of Dr. A. Wehnelt's Electrolytic Current Interruptor for Ruhmkorff Coils: A. A. Campbell Swinton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction of the Elan Aqueduct, Birmingham Waterworks: H. Lapworth.

MALACOLOGICAL SOCIETY, at 8.—On an Apparently Undescribed *Ariophanata* from Mysore, with a Note on *Mariaella dussumieri*: W. T. Blanford.—Description of a New Species of *Hemiplecta* from Perak: Edgar A. Smith.—On a New Species of *Dinoplax* and *Chiton* from South Africa: E. R. Sykes.—Description of Five New Species of New Zealand Land Mollusca: H. Suter.

SATURDAY, MARCH 11.

ROYAL INSTITUTION, at 3.—Mechanical Properties of Bodies: Lord Rayleigh, F.R.S.

MONDAY, MARCH 13.

SOCIETY OF ARTS, at 8.—Cycle Construction and Design: Archibald Sharp.

ROYAL GEOGRAPHICAL SOCIETY (at the University of London, Burlington Gardens, W.), at 8.30.—The Uses of Practical Geography, as Illustrated in Recent Frontier Operations: Colonel Sir T. H. Holdich, K.C.I.E., C.B., R.E.

TUESDAY, MARCH 14.

ROYAL INSTITUTION, at 3.—Morphology of the Mollusca: Prof. E. Ray Lankester, F.R.S.

ANTHROPOLOGICAL INSTITUTE, at 8.—Secret Tribal Societies of West Africa: H. P. FitzGerald Marriott.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Papers to be discussed: Water-Tube Boilers for Marine Engines: J. T. Milton.—Recent Trials of the Machinery of War-Ships: Sir. A. J. Durston, K.C.B., R.N., and H. J. Oram, R.N.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Theoretical Considerations in choosing Colours for Three-Colour Printing: Captain W. de W. Abney, C.B., F.R.S.

WEDNESDAY, MARCH 15.

SOCIETY OF ARTS, at 8.—Liquid Fuel: Sir Marcus Samuel.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Projection Microscope: Lewis Wright.

THURSDAY, MARCH 16.

ROYAL SOCIETY, at 4.30.—The Croonian Lecture: On the Relation of Motion in Animals and Plants to the Electrical Phenomena which are associated with it: Prof. J. Burdon Sanderson, F.R.S.

LINNEAN SOCIETY, at 8.—So-called Quintocubitalism in the Wing of Birds: P. Chalmers-Mitchell.—Some Facts concerning the so-called Aquintocubitalism of the Bird's Wing: W. P. Pycraft.—A Further Contribution to the Freshwater Algæ of the West Indies: W. West and G. S. West.

CHEMICAL SOCIETY, at 8.—Influence of Substitution on Specific Rotation in the Bornylamine Series: Dr. M. O. Forster.—Rotatory Power of Optically Active Methoxy- and Ethoxy-propionic Acids prepared from Active Lactic Acid: Prof. Thomas Purdie, F.R.S., and James C. Irvine.

FRIDAY, MARCH 17.

ROYAL INSTITUTION, at 9.—The Electric Fish of the Nile: Prof. F. Gotch, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Backwater or Hæmoglobinuric Fever: Dr. W. H. Crosse.

SATURDAY, MARCH 18.

ROYAL INSTITUTION, at 3.—Mechanical Properties of Bodies: Lord Rayleigh, F.R.S.

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