THURSDAY, JULY 10, 1913.

ATOMS AND MOLECULES.

Les Atomes. By Prof. Jean Perrin. Pp. xvi + 296. (Paris: Félix Alcan, 1913.) Price 3.50 francs.

IN these days, when such notable and extensive advances are being made in nearly all fields of physical research, it is extremely desirable that the results which mutually bear upon one another should from time to time be collected together and recorded in more or less popular language. If, in addition, a leading expert can be persuaded to undertake the record, the event of its publication is still more to be welcomed. Prof. Perrin is the ideal author for a book on atoms and molecules. He has virtually made them visible and established their reality, and it is scarcely too much to say that his work on Brownian movement is the most notable of recent physical researches.

It is not always that the brilliant experimentalist is an equally brilliant exponent, but in the present case it is true, and the book makes fascinating reading. It must not be supposed that Prof. Perrin has confined his attention to the particular sphere of work with which his name is so intimately associated. Naturally enough, the details of theory and experiment are treated more completely in those chapters which are mainly records of the author's work. But the book as a whole has a broad outlook, and the atomic theory is considered from many different points of view and in the light of all the recent developments of the subject.

The first two chapters are devoted to a historical survey of the chemical and physical sides of the atomic theory and the early methods of estimating the size and number of the atoms. Then follow the chapters on Brownian movement previously referred to, in which the author shows how it is possible by four distinct methods to measure the atoms, with remarkably consistent results. The later chapters on opalescence, the quantum theory, and radio-activity have the same end in view, and in conclusion the author compiles the values obtained by thirteen different methods for Avogadro's number. A quotation from the author is the best comment on these noteworthy results.

"On est saisi d'admiration devant le miracle de concordances aussi précises à partir de phénomènes si différentes. D'abord qu'on retrouve la même grandeur, pour chacune des méthodes, en variant autant que possible les conditions de son application, puisque les nombres ainsi définis sans ambiguïté par tant de méthodes coïncident, cela donne à la realité moléculaire une vraisemblance bien voisine de la certitude."

Chapter vii. is one of special interest. In it the author deals with the determination of e, the atom of electricity, by the method of falling drops. He takes the view that the accuracy claimed by Millikan for his measurements is not justified on account of the magnitude of the correction to Stokes's law which has to be applied, and produces evidence which he regards as removing the well-known discrepancy between his own and Millikan's estimates. It remains to be seen whether Prof. Millikan assents to this view.

THE CULT OF THE THUNDERSTONE.

The Thunderweapon in Religion and Folklore. A Study in Comparative Archæology. By Dr. Chr. Blinkenberg. Pp. xii + 122. (Cambridge University Press, 1911.) Price 5s. net.

THIS little book forms an interesting addition to the archæological and ethnological series for which anthropologists are indebted to the Cambridge University Press. The author shows much erudition and industry in his search for specimens illustrating the cult of thunderstones which are preserved in the museums of England and the Continent. He has explored the voluminous literature of the subject, and he has added a series of illustrations which add much to the scientific value of the monograph.

His theory assumes that the cult of the thunderstone was an element of human culture which, at an early date, that is to say, in the Stone age, was gradually spread from people to people over a great part of the world; that it appears in the early Ægean culture; that the ideas of tabu or sanctity attaching to these stones indicate the rise of the belief from primitive conceptions of nature and religion. In other words, he supposes that as early as the Stone age men compared the effects of the lightning-stroke to that of the axe wielded by primitive man, and that this explanation accounts for the superstition in most parts of the world.

Various difficulties, of which the author is aware, prevent the acceptance of this theory of origins. The most important is that the superstition has not been traced among those races which possessed a Stone age culture down to modern times—the peoples of Australia, Oceania, and North America—while in South America, to say the least, the evidence is weak. On the other hand, it is common in Africa, among races which

have no such theory of the origin of objects which they supposed to be divinely produced. These facts being admitted, a different explanation suggests itself as being more probable. Such things usually come to light after torrential rains, and are thus naturally attributed to the thunder which accompanies the storm; and thus, besides flint axes, things like belemnites, fossil echini, and other quaintly shaped stones come to be revered like lithic artefacts.

It is also very doubtful if Mjölnir, the hammer of Thor, or the double-axe of Crete come within this category. The former was not a stone, but a forged metal axe, and the sanctity of the latter was possibly due to its use as a sacrificial implement. Poseidon's trident, again, was more probably the fish-spear which is the natural weapon of a sea-god.

In short, thunderstones, sacred fossils, sacred axes, and tridents may have their origin in general animistic conceptions, and their cult need not necessarily have arisen in any single centre or from any one train of thought. However this may be, the facts which the author has collected form a useful contribution to the study of primitive beliefs.

PURE AND APPLIED CHEMISTRY.

(1) *Problems in Physical Chemistry with Practical Applications.* By Dr. E. B. R. Prideaux. Pp. xii+311. (London: Constable and Co., Ltd., 1912.) Price 7*s.* 6*d.* net.

(2) *An Introduction to the Physics and Chemistry of Colloids.* By Emil Hatschek. Pp. ix+94. (London: J. and A. Churchill, 1913.) Price 2*s.* 6*d.* net.

(3) *Exercises in Gas Analysis.* By Dr. Hartwig Franzen. Translated from the first German edition (with corrections and additions by the Author) by Dr. Thomas Callan. Pp. vii+120. (London: Blackie and Son, Ltd., 1913.) Price 2*s.* 6*d.* net.

(4) *Theorie und Praxis der Grossgasindustrie.* By Rudolf Mewes. Band 1. Hälfte 1. Pp. xx+403. (Leipzig: H. A. Ludwig Degener; London: Williams and Norgate, n.d.) Price 18*s.* net.

(5) *Lehrbuch der Thermochemie und Thermodynamik.* By Prof. Otto Sackur. Pp. viii+340. (Berlin: Julius Springer, 1912.) Price 12 marks.

(6) *A Foundation Course in Chemistry.* For Students of Agriculture and Technology. By J. W. Dodgson and J. Alan Murray. Pp. x+244. (London: Longmans, Green and Co., 1913.) Price 3*s.* 6*d.* net.

(7) *Qualitative Determination of Organic Compounds.* By J. W. Shepherd. Pp. xvi+348. (London: W. B. Clive, 1913.) Price 6*s.* 6*d.*

(1) DR. PRIDEAUX has compiled a book of problems to serve as exercises for students in physical chemistry. The students who have worked through these will not be able to complain that they have not been exercised sufficiently, as the examples selected are very numerous and by no means all easy. They are, however, selected directly from the original literature, and so require the student to give real solutions to real problems, instead of the sham answers to fictitious questions which so frequently disfigure books of chemical calculations. The form in which this excellent material has been published is much less satisfactory. The table of contents suggests that the volume is composed of eight chapters, but these do not appear in the text. The reader is informed on each of the 300 pages that the book he is studying is called "Problems in Physical Chemistry," but no hint is given as to the topic that is dealt with on the pages at which the book is opened. The eight chapters run on continuously, and almost the only way to discover where one chapter ends and another begins is to turn back to the table of contents, for the chapters are not even allowed the luxury of beginning at the head of a fresh page. As no index has been supplied, the contents of the book are far less accessible than they need be to a reader who does not wish to work right through the book from beginning to end.

(2) A somewhat similar complaint may be made in reference to the reprint of Mr. Hatschek's articles on colloids. These are divided into ten chapters, but the chapter-divisions do not correspond in every case with the natural divisions of the subject, and subject-headings are not given, so that the classification of the material is not immediately obvious. This defect is, however, very largely remedied by the provision of a very detailed table of contents and two indexes. The book has the great merit of presenting in a simple and readable form all the leading points of a difficult and little-known subject. It may be commended without hesitation to the many readers who at the present day are being compelled by the pressure of technical or scientific problems to acquire some knowledge of "colloid chemistry."

(3) The English translation of Dr. Franzen's "Gas Analysis" forms a very useful introduction to the subject. Directions are given for carrying out forty-two exercises. Thirty-three of these have to do with the analysis of gases. The remainder, which are collected under the heading

of "Volumetric Gas Analysis," are not exercises in the volumetric as contrasted with the gravimetric analysis of gases, but have to do with the analysis of solids and liquids by measuring the volumes of gas set free from them. In this section, for instance, are described the methods of estimating nitrates by the Lunge nitrometer and analogous processes. The book is presented in an attractive form, and carries out admirably the purpose of the author and translator to provide an introduction to the larger standard works on gas analysis.

(4) The German treatise on the theory and practice of the gas industry is a large work of which the present volume constitutes "I. Band, I. Hälfte." It includes the historical development of the principles of mechanics and physics, and the fundamental laws of thermodynamics. The subjects treated include isothermal and adiabatic compression, change of state, evaporation and boiling, viscosity of gases and vapours, specific heats, entropy of water-vapour and vapours used in refrigeration, radiation and conduction, flow of liquids, vapours, and gases. The chemist or engineer who is called upon to handle gases on a large scale will find in this treatise all that he is likely to require in the way of scientific preparation for his work.

(5) Prof. Sackur's "Text-book of Thermochemistry and Thermodynamics" deals with the fundamental laws of heat and of thermodynamics, which are then applied to many of the chief problems of physical chemistry. Thus we find chapters devoted to the theory of solutions, including van't Hoff's equations for osmotic pressure, and to chemical equilibrium based upon the equations of Helmholtz and of van't Hoff, and applied, for instance, to calculate the heat of ionisation from the change of the ionisation-coefficient with temperature. There are also chapters on the applications of thermodynamics to electrochemistry, thermoelectricity, and capillarity. The last chapters deal with radiation and with Nernst's "heat-theorem."

(6) The "Foundation Course in Chemistry" of Messrs. Dodgson and Murray is a well-written book of rather exceptional character. Special attention is paid to topics which have an interest for agricultural students, but this is by no means a drawback from the point of view of the general reader, as it gives an air of reality to the whole treatment of the subject. Structural formulæ are freely used for inorganic as well as for organic compounds, and a long chapter is given up to the chemistry of aliphatic compounds under the title "Paraffins and their Derivatives." The chapter on general principles gives a clear exposition of the doctrine of equivalents, but is scarcely an adequate exposition of the atomic theory, as Avogadro's hypothesis, which is the real basis of the modern system of atomic weights, is postponed to a later chapter, and is there treated only in the most incidental manner.

(7) The modern system of examinations is responsible for the development of a form of qualitative organic chemistry in which attempts are made to determine the nature of organic compounds without carrying out a combustion or quantitative analysis of any sort. This type of organic chemistry is only distantly related to the requirements of scientific or technical research, and has only a very limited range of usefulness. But if the student is aware of the supreme necessity of quantitative work there is little harm in allowing him to get some practice in recognising the qualitative properties of the chief radicles. Mr. Shepherd's book gives a scheme whereby the most important groups of organic compounds may be identified by qualitative tests; the scheme has been in use for some years, and has thus been adequately tested by actual work in the laboratory.

OUR BOOKSHELF.

A Text-book of Experimental Metallurgy and Assaying. By A. R. Gower. Pp. xiv + 163. (London: Chapman and Hall, Ltd., 1913.) Price 3*s.* 6*d.* net.

THE new edition of this book conforms to the syllabus of the Lower Examination in practical metallurgy of the Board of Education. The first portion of the book consists of a series of experiments and explanations to illustrate the reactions occurring in various metallurgical operations, while the second part deals, in quite a satisfactory manner, with elementary assaying. It would have been an advantage if the book gave a little more guidance to the beginner, for very often he does not realise the economic character of metallurgy. For instance, a student sometimes thinks that as sodium carbonate is used in the laboratory as a flux for silica, therefore it would be charged into a blast-furnace smelting copper ores when silica has to be removed. The first chapter of this book may give some students an impression of this kind, for the substances classed as used in metallurgical operations are not all commonly so employed, although frequently used in experimental metallurgy and assaying. Then, again, in the chapter "Formation of Alloys," the theoretical quantities of the metals have been given, and no allowance made for loss in the case of volatile metals.

During the past twenty-five years the book has proved of use, and the present edition should be of assistance to those preparing for the Board

of Education examination, and if the exercises are performed under the supervision of a teacher, none of its minor defects will cause the beginner to gain wrong impressions.

Ministère de l'Agriculture. Direction Générale des Eaux et Forêts. 2e partie. Eaux et Améliorations Agricoles. Service des Grandes Forces hydrauliques dans la Région des Alpes. Résultats des Etudes et Travaux à la Fin de 1911. Tome v., 1912. Pp. 530.

THE present volume is the fifth of the series published by the French Ministry of Agriculture since the inauguration of the Service of the Great Hydraulic Forces in Alpine regions, and it brings the account of operations down to the end of the year 1911. Of the 530 pages of which the volume consists, 487 are devoted to a tabulation of the results obtained from observations in the basins of the Arve, the Fier, the Isère, and the Drôme. A series of nine charts also accompanies the report, covering the regions of the Arc, the Breda, the Durance, and the Guil.

It is interesting to note the expedients and devices by which an investigation, demanding for its most effective development the employment of expert scientific observers, has been enabled to be carried on to a large extent by voluntary workers and local auxiliaries, for the most part untrained and indifferently coordinated. Such agencies in many cases have had to be relied upon for the collection of data, and as there is a constant change of personality in the assistants, the difficulties in the way of securing trustworthy records are sufficiently obvious.

"However," concludes the prefatory note, "in spite of defects, of which we more than anyone are conscious, we are convinced that the study of hydraulic forces, so far as circumstances permit, constitutes none the less a real utility"—and a cursory glance through the pages of statistical matter, carefully annotated and compiled, bears incontestable witness to the patient labour and exactitude of those engaged in the French hydrographical service and of M. de la Brosse, its chief engineer.

Weather Bound. By R. T. Smith. Pp. 319. (Birmingham: Cornish Bros., Ltd., n.d.) Price 15*s.* net.

THE author gives, in great detail, summaries of results of twenty-seven years' observations at five stations situated to the west of Birmingham, in a series of tables and diagrams occupying 170 pages. He adds a diary, "Weatherwise and Otherwise," for the same period, which occupies sixty pages, and explanatory text (seventy-two pages). He also gives a diagram of the normal course of the meteorological elements throughout the year, which is unintelligible owing to want of explanation. The amount of industry displayed is worthy of praise, and most of the tables appear to contain climatic data of real value, but the author's exposition cannot be recommended to the attention of serious students of meteorology.

R. C.

LETTERS TO THE EDITOR.

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

Radio-activity and the Age of the Earth.

IN his letter in NATURE of June 26, Dr. Schiller quotes with disapproval Mr. Holmes's deduction that the "heavy metallic core" of the earth "must be completely destitute of radium"; for this deduction, in Dr. Schiller's opinion, "involves the improbability that the heaviest metal of all, uranium, has not gravitated to the 'metallic core,' and does not explain why this core should be destitute of radio-active substances."

In the next paragraph, however, Dr. Schiller suggests a possible escape from the difficulty with the words, "it is possible that under the physical conditions obtaining in the interior uranium does not dissociate, or does so much more slowly."

Last autumn, as a sequel to certain speculations into the effects of pressure on the mineralogical constitution of the earth's crust at great depths, I was led to a consideration of this very question of the dissociation of elements when subjected to the high temperatures and pressures that prevail at such depths.

So far as I was able to discover, no determination of the specific gravity of radium had then been made, presumably for lack of sufficient material; but, judging from its chemical relationship with barium, the atomic volume of radium must be much greater than that of uranium. Heat is known to be evolved during the disintegration of radium, so that the break-up of this element is an exothermic change. I am writing this letter whilst travelling, and am, consequently, unable to verify my impression that heat is also evolved during the conversion of uranium into radium. But in any case, the passage of uranium into radium may be expressed in a general way by some such equation as the following:—

$$U = Ra + m + e,$$

where m indicates the loss of mass due to liberation of helium in the successive stages of disintegration, and e the loss of energy represented by the various manifestations of energy. Since radium has a higher atomic volume than uranium we see that the progress of this reaction from left to right means an increase in volume and an evolution of energy, part of which is doubtless speedily transformed into heat. In fact, it is exactly the kind of reaction that would be inhibited by high pressure and temperature conditions.

That high pressure should be able to prevent the disintegration of uranium seems reasonable, if one accepts the electronic constitution of the atom. Judging from the extreme length of the half period of disintegration of uranium under surface conditions, the constituent electrons of an atom of uranium perform on the average a vast number of revolutions before the system arrives at the position of instability that permits the escape of a helium atom. In fact, the uranium atom is evidently stable during an enormous number of revolutions or vibrations. And if, when the electronic system arrives at last at an unstable configuration, a sufficiently powerful counterbalancing force can be applied from without, then the system will be helped past the danger point and be able to commence another long cycle of movements before the dangerous configuration is again assumed.

In view of the experiments of Humphreys and Mohler upon the displacement of the spectral lines, and the work of Richards on the com-

pressibility of elements, amongst other facts, it is evidently possible to influence intra-atomic activity by means of forces applied from without. It seems probable, therefore, that pressure, if sufficiently great, could be transmitted to the interior of a uranium atom and supply the countervailing force required to help the atom past a position of instability. Once we realise this probability, we see a cogent reason why the interior of the earth should be free from radium and all other radio-active substances the formation of which from heavier elements demands an increase in volume; these heavy elements being at great depths only potentially radio-active.

From this point of view radio-activity is, as Dr. Schiller suggests, "an acquired habit of the substances that exhibit it," the habit being acquired when such an element passes by any means whatever from great depths below the earth's surface to regions of less pressure.

In a paper just issued in the Records of the Geological Survey of India (vol. xliii., part 1) I have given a preliminary account of these speculations concerning the mineralogical constitution of the earth's crust, and in a final paragraph have appended a brief reference to this question of the inhibition of the disintegration of uranium at great depths below the earth's surface.

L. L. FERMOR.

Pianoforte Touch.

IN connection with the discussion on this subject originated by Prof. Bryan's paper, I may mention that I have been making some measurements during the past winter with the view of obtaining some idea of the velocities and forces involved in the motion of the transmitting mechanism. By fitting an electric chronographic arrangement to an upright piano I have been able to measure the actual times taken in different stages of the movement with different degrees of loudness.

Among other results, I have found that the time during which the hammer is flying freely towards the string after losing contact with the propelling mechanism varies from about 0·04 sec. for *pp* to 0·001 sec. for *ff*. The distance of flight was about 1 cm., so the velocity ranged from 25 to 1000 cm. per sec. At the latter extreme, however, the force used in striking the key was greater than would be used in ordinary playing. On the other hand, when a weight was allowed to fall on the key from the smallest height to produce a note the time could be brought up to 0·07 sec., corresponding to a velocity of only 14 cm. per sec.

With regard to the much disputed point as to whether it is possible to vary the quality of the note independently of the loudness, this must, I think, still be regarded as an open question. Very positive affirmations are made by musicians on both sides. From a physical point of view the suggestion made by Mr. Tobias Matthay in his work on touch seems to be the only possible way to explain the effect, if it exists, viz. that the quality can be spoiled by vibrations of the hammer-shaft at the instant of striking the string. In accordance with this, Mr. Matthay holds that the tone is good when the final velocity is given to the key gradually, and is bad when the same velocity is imparted by a sudden blow. That vibrations of the shaft occur is, of course, undoubted, but whether they are sufficient to cause an appreciable effect is another matter. On the other side, recent German theorists, such as Breithaupt, Steinhausen, and Ritschl, deny the effect altogether. The last-named author holds that good touch consists in the power to produce fine gradations of intensity and in complete mastery of *legato* and the use of the pedal.

The essential question seems to be whether good and bad touch can be distinguished in a *single note* struck and allowed to die away, or in a succession of notes following each other at so long intervals as to be musically detached. As I understand Prof. Bryan, the improvement effected by his invention is chiefly apparent in a sequence of notes forming a melodic phrase. Further, I think that the exact dynamical effect of the contrivance on the motion of the key has not been made quite clear in the published account.

W. B. MORTON.

The Queen's University of Belfast, July 2.

The Reflection of X-Rays by Crystals.

IT is interesting to find that an X-ray bulb having a rhodium antikathode gives off a strong, sharply defined (and therefore very homogeneous) beam which is reflected from the (100) face of rock-salt at a glancing angle of 6·2°. Its mass absorption coefficient in aluminium is 3·2. A second weaker beam is reflected at an angle of 5·8°, and this appears to complete the rhodium X-spectrum. Assuming the correctness of my son's determination of the spacing of the atoms of rock-salt (in a paper read before the Royal Society on June 26), the wave-length of the stronger beam is $0{\cdot}61 \times 10^{-8}$, and of the weaker $0{\cdot}57 \times 10^{-8}$. It can be calculated that radiation of about this wave-length should be emitted by a rhodium antikathode; the argument is given in a paper recently read before the Royal Society (see abstract on p. 496 of this issue).

Platinum and rhodium give much stronger homogeneous reflected rays than iridium, tungsten, or nickel. The current produced in an ionisation chamber 15 cm. long, filled with SO_2, the slits being 3 mm. long and 0·8 mm. wide (Proc. Roy. Soc., lxxxviii., p. 428), is so great that the leaf of a Wilson electroscope races across the field of view at the rate of thirty or forty measurable divisions (three or four scale divisions) in a second. The setting must be exact, and the bulb should be very soft.

W. H. BRAGG.

Rosehurst, Grosvenor Road, Leeds.

Wireless Antennæ.

PROF. FLEMING, in a recent letter to a contemporary journal, has made a suggestion similar to that of Mr. A. Lander, in NATURE of July 3 (p. 451), to the effect that the space wave in wireless telegraphy is supplemented by some effect which travels through the earth. Indeed, it would appear natural to expect that, in addition to the electric disturbance which must travel outwards in all directions over the conducting surface of the earth when the electrical potential at any point on this surface is disturbed, the passage of the electromagnetic waves through the air above the earth's surface should be accompanied by some form of electrical disturbance along the conducting earth's surface beneath them. This is, however, a subject that, so far as I am aware, has not yet been tackled by mathematical physicists, and I would point out that it is well worth their attention.

In connection with the matter, it may be of interest to mention that I find that my own body, without any wires or anything else, will serve as antenna for the reception of signals from the Admiralty. My receiving apparatus is on the ground floor of my house in Chester Square, and with my ordinary aërial disconnected I find I can get the Admiralty signals, faintly but quite audibly, simply by touching with my finger the terminal to which the aërial is usually connected. No doubt in this case my body does not act as an aërial in the ordinary way, but merely as a capacity into which the electrical disturbance arriving

through the earth passes in and out through the receiving apparatus. The Admiralty station is, of course, comparatively near, and the signals are very powerful. This explains why it is only Admiralty signals that I am able to receive by this method.

I am unable to agree with Mr. Lander in his remarks as regards tuning, as I find that with my bedstead aërial it is just as easy to tune in and out such signals as I am able to receive as it is with my proper aërial, which is suspended on poles above the roof of the house. The Eiffel Tower signals are always difficult to tune out, for the reason, as I suppose, that they are of irregular wave-length, while I find it impossible to tune out the Admiralty by reason of its power and proximity. Norddeich and other unidentified signals that I obtain are, however, tuned in and out both with the bedstead aërial and with the other with equal facility.

For time signals very accurately tuned waves, such as are sent out by Norddeich, are perhaps not altogether an advantage, as badly tuned waves, such as are sent out by the Eiffel Tower, are much more easily picked up by all and sundry.

A. A. CAMPBELL SWINTON.

66 Victoria Street, Westminster, S.W., July 7.

A Mechanical Vacuum-Tube Regulator.

MAY I supplement Mr. Campbell Swinton's letter in NATURE of June 26? The device of sliding a glass sleeve over the kathode for the purpose of varying the hardness of a discharge tube was also used and fully described by Wehnelt in 1903 (*Deutsch. Phys. Gesell. Verh.*, 5, 14, p. 259), some five years after Mr. Swinton.

The important part that the electrification on the walls plays in a discharge tube is not, I think, generally realised; and Mr. Swinton is not quite right in assuming that Mr. Whiddington's explanation is novel.

The electrification on the glass walls adjoining the kathode, and its concentrative effect on the beam of kathode rays, were remarked by Goldstein in 1901 (*ibid.* 3, 15, p. 192).

I remember some half-dozen years ago, Sir J. J. Thomson, in one of his lectures at Cambridge, gave a similar explanation of the formation of the fine pencil of kathode rays which can be seen crossing the bulb from the centre of the kathode in a soft X-ray tube. He attributed the effect entirely to the negative electrification of the glass round the kathode. The pencil of rays is as definite with a plane kathode as with a concave one.

But X-ray tube-makers have long been aware that, by withdrawing the kathode from the bulb into a side tube, the discharge can be hardened. In the earliest X-ray bulbs, the kathode was always mounted in the body of the bulb; but the advantages of a side tube had been realised by 1896, and the design has since been universally adopted.

Mr. Swinton was also responsible about 1897 for another adjustable form of X-ray bulb, in which, instead of a sliding sleeve, a movable kathode could be advanced in or out of a side tube. The bulb is at present in the Röntgen's Society's historical collection in the South Kensington Museum.

G. W. C. KAYE.

June 28.

IN order to remove the possibility of any misunderstanding that may arise from Mr. A. Campbell Swinton's letter in NATURE of June 26 (p. 425), may I state that the mechanical vacuum-tube regulator is *not* claimed by me as new in the paper referred to. If Mr. Campbell Swinton will read the actual paper he will find it clearly stated that the regulator was discovered by him.

RICHARD WHIDDINGTON.

St. John's College, Cambridge, July 7.

The Humphrey Owen Jones Memorial Fund.

THE committee formed to carry out the generally expressed desire that some suitable memorial of the late Humphrey Owen Jones, F.R.S., should be established, has received subscriptions amounting to about 3600*l*. It is proposed to devote the sum collected to the endowment of a teaching post in physical chemistry in the University of Cambridge.

The committee desires to close the subscription list at the end of this month, and requests further intending subscribers to send their contributions to the account of the H. O. Jones Memorial Fund, Messrs. Barclay and Co.'s Bank, Cambridge, before that date.

W. J. POPE
(Chairman of the Committee).

The Chemical Laboratory, Cambridge, July 7.

Smithsonian Physical Tables.

ATTENTION was directed by Mr. C. T. Whitmell on p. 320 of NATURE of May 29, to a "very awkward error" in the Smithsonian Physical Tables (1896). The institution is always glad to have attention directed to errors for correction in subsequent editions, but as this particular error does not appear in the first revised, second, third, fourth, and fifth editions, it seems rather unfortunate to have discredit thrown on the tables through an error long since corrected.

C. D. WALCOTT,
Secretary.

Smithsonian Institution, Washington, U.S.A.,
June 21.

MODERN VIEWS OF ELECTRO-THERAPEUTICS.

DURING the last few years our views upon the true meaning of the action of electricity upon living subjects have been growing much clearer. We begin to see the principles upon which our practice should be based, and already, as a consequence of this, our methods are changing and our results are growing more valuable.

There are two factors which have brought this about. One is the recognition of the importance of the theory of ions in all matters which concern the movement of electric currents in living tissues, and is due to the genius of Leduc, and the other is the recognition of the thermal action of high-frequency currents, an action which remained unappreciated, even if not unknown, until it was insisted on and emphasised by Nagelschmidt. It is upon these two basic facts, the chemical or ionic effects and the thermal effects of electric currents, that the electro-therapeutics of the future will be established.

First, as to the chemical aspect of the medical applications of electric currents. To begin with, all movements of current in the body, whether the currents are direct, interrupted or alternating, are ionic movements pure and simple, and their effects are due to the chemical displacements produced. We may not speak of effects which are additional to or independent of the ionic movement, for such effects do not exist. The current in the body is the double ionic movement only. The treatment

by electric currents is a chemical treatment, and its chemical actions must explain the results obtained.

The stimulation of nerve and muscle is a chemical stimulation by displacement of ions. Nernst, in fact, has expressed the formula for nerve excitation in terms of ions. The sensation felt in the skin during the passage of a current is a chemical effect, and by altering the composition of the saline solution with which the electrodes are moistened, its character can be altered so that the sensory effects become more noticeable either at the negative or at the positive electrode. With sodium carbonate it is the negative electrode (ions of CO_3) which gives the greatest sensation. With sodium chloride it is the positive electrode (sodium ions), and so on in great variety.

Thus a practical lesson may at once be drawn from a knowledge of ionic effects, namely, that a solution of sodium carbonate should not be used for moistening the electrodes in electro-diagnosis, because in that procedure a small negative electrode is used with high concentration of current, and in these circumstances the presence of a carbonate in the liquid causes unnecessary pain to the patient. Again, in using chlorine ions for the softening of scar-tissue it saves the patient some discomfort and facilitates the toleration of massive currents to use the chloride of ammonium at the anode in preference to that of sodium, because the ammonium ion affects the sensory nerves of the skin in a less degree than the ion of sodium.

There is another direction in which the application of the principles of ionic movement has increased the therapeutic powers of electrical applications, and that is in the direction of treatment by larger currents. If we look in the text-books of electro-therapeutics we see continually that currents of 5 or 10 milliamperes are prescribed. Formerly that was as much as could be given without causing discomfort or producing superficial burns. The metal-plate electrodes and the small buttons or discs covered with a thin layer of chamois leather and set in handles and applied to the affected region did not permit the use of large currents; Leduc has told us why this is the case. With such electrodes the ions of hydrogen and hydroxyl which are formed at the metallic surfaces can quickly reach the skin surface. They are strongly caustic and tend to produce pain and burns, and this can be obviated by the use of electrodes composed of thick, folded cloths over which is laid a metal electrode faced with two or three layers of thick felt. The whole is moistened with appropriate saline solutions and bandaged to the patient, who thus can tolerate applications of 50 milliamperes or more, and that for times of fifteen or twenty minutes or longer without any burning or blistering of the skin.

It is not surprising that this change of method brings results which are superior to those of the past. Indeed, if the theory of ions in medical electricity had done nothing else of value, it would deserve all praise for having taught us how to use larger currents. Take, for instance, the treatment of paralysed muscles. A distinguished French writer has recently told us that he has gradually increased the duration of his electrical applications in such conditions to periods of one hour twice daily, and uses rhythmic currents which are not less than 25 milliamperes, and that in the infantile paralysis of children the little patient is so slightly inconvenienced by these applications as to play and even to sleep while they are proceeding; also that the results of such intensive treatment are entirely good, and produce not the least sign of fatigue or exhaustion.

The ionic theory of electrical treatment which has shown us how to use large currents has also shown the necessity for them. If the results to be gained are produced by the chemical interchange set up in a tissue, it is manifest that to obtain them one must use a strength of current which is capable of producing a distinct effect; and for the same reason the time of an application must be lengthened. The chemical changes caused by a current of 50 milliamperes for twenty minutes are ten times greater than those given by 10 milliamperes for ten minutes, and are therefore ten times more likely to produce an appreciable effect. The results of adopting this view and of increasing the quantity of current employed may make all the difference between success and failure. It is thus that the treatment of neuralgias can be made effective, and the same occurs in the treatment of many affections of the joint structures.

In the ionic theory of electrical treatment we have to consider two factors—the chemical interchanges set up within the tissues and the introduction of ions from without. The second of these considerations has added notably to the scope of electrical treatment. In the treatment of superficial morbid states there can be no doubt of the actual penetration of the external ions into the part treated; and the use of the zinc ion introduced at the positive pole from material moistened with a solution of a zinc salt has led to the successful treatment by electrical means of a whole series of superficial ulcerative conditions of the skin and the various orifices of the body.

In the treatment of affections of the deeper tissues the method of the introduction of ions from pads moistened with appropriate solutions has also achieved many successes, notably in conditions of so-called neuralgia, states which are almost always due to neuritis or perineuritis—for example, in many severe neuralgias of the trigeminal nerve. Quinine and salicylic acid, the latter especially, are useful in these conditions when introduced by the electric current.

In chronic gouty conditions the introduction of the salicylic ion is also of great value. Iodine ions and lithium ions to a lesser extent also seem to be useful in gouty conditions. The chlorine ion, recommended by Leduc for its softening action upon scar-tissue, has proved itself valuable.

Leaving the chemical effects of electrical currents, let us turn to the consideration of the thermal effects. The use of electricity for thermal

effects requires currents of large magnitude, and therefore requires that the ionic effects shall be reduced to a minimum. The currents of high frequency answer these requirements. With them the duration of each wave of current is so brief that the ionic movement set up is imperceptible; the displacement which the ions undergo in the very small fraction of a second for which each wave continues is minute and does not strain the elasticity of the protoplasm, if one may make use of such a phrase. On this account the currents employed may reach an ampere or more, and the usual ionic effects of currents, such as pain and muscular contraction, are absent. The thermal effects become manifest in proportion to the magnitude of the currents employed. The practical recognition of the thermal action of high-frequency currents remained long unnoticed, in spite of the great popularity enjoyed by high-frequency treatment some time ago. Somerville may be said to have awakened medical practitioners to its possible importance by his paper in 1906 on the effect of high-frequency currents in raising the surface-temperature of the body.

When we look back upon the cases which have been reported as cured by currents of high frequency we may now recognise that a large part of them can be justly attributed to thermal actions and the vasomotor effects secondary to these. The circulatory effects, the relief of various states of spasm and congestion, and of painful affections of the joints, of neuritis and neuralgia come into this category. An improvement in the lymph circulation due to the warmth would account for the results obtained with high-frequency currents in certain local infections and inflammations.

In another section of high-frequency treatment, namely that of the use of the effluve or of showers of sparks in cutaneous affections, we also have to deal with thermal effects, intense but minutely localised, though it is possible that in these cases there may be another factor concerned, namely the influence of the ozone, and of the nitric acid vapours which are associated with luminous electrical discharges.

We now perceive that in high-frequency applications we have an agent for the direct warming of the tissues traversed by the current, and that the future development of high-frequency treatment will be based upon these thermal effects. The progress which has been made by Nagelschmidt and others with the large currents obtained from the modern type of high-frequency apparatus, which uses sustained oscillations, and is known under the name of diathermy, serves to emphasise this aspect of high-frequency currents. Duddell's singing arc in a modified form is used for the production of the oscillations in the diathermy apparatus.

Again, in electro-diagnosis we are on the threshold of another change. The long and patient work of many investigators upon the use of condenser discharges has begun to bear fruit, and it is clear that from the condenser we gain greater information than the induction coil and the galvanic current can give us as to the degree of abnormality in muscle in cases of paralysis, while the process of testing with condenser discharges is simpler in application and far less painful to the patient. Whereas hitherto neurologists have been content to divide muscles into two categories, those with "normal" reactions and those with a reaction of degeneration, the condenser method now permits the recognition of a considerable number of intermediate degrees. The method is based upon the observation of the minimum capacity needed to provoke the muscular contraction. As a muscle deviates from the normal standard it comes to need waves of longer and longer duration in proportion to its degree of damage, and these waves are best obtained by using a series of condensers of progressively increased capacity, charged from a constant source and discharged through the patient. Many of the muscles formerly described as normal because they had not lost the power of responding to induction-coil currents can now be seen to present different degrees of deviation from the normal, and those classed together as showing a reaction of degeneration can also be divided into distinct groups. Working with 100 volts to charge the condensers, one can use a series of ten or twelve capacities, ranging from 0·01 to 2·0 microfarads, and can find muscles showing their initial contraction at almost every step in the scale.

The work of Boudet de Pâris, Hoorweg, Zanietowski, Weiss, Doumer, Cluzet, and of many other patient students of condenser discharges must be gratefully acknowledged in this connection. They have gradually brought their methods through the laboratory stages and rendered them suitable for everyday clinical work so that electro-diagnosis in the immediate future is sure to develop in the direction of condenser discharges, and the old method with induction coil and battery current may be regarded as obsolete.

With these evidences of progress the electro-therapeutist of to-day can feel more hopeful. He is no longer tied to the old routine methods, and sees before him the commencement of a therapeutic method based upon the laws of chemistry and physics. H. L. J.

INTERNATIONAL FISHERY INVESTIGATIONS.[1]

THE series of reports now under review on the work of the International Council for the Study of the Sea furnishes evidence of continued activity in many branches of the work. One of the most interesting new features is described in the hydrographical bulletin, which contains an account of a series of observations on tempera-

[1] Conseil Permanent International pour l'Exploration de la Mer. Bulletin Hydrographique pour l'Année Juillet 1910–Juin 1911.—Bulletin Planktonique pour les Années 1908–11.—Publications de Circonstance, No. 62.—Rapports et Procès-Verbaux des Réunions, vol. xiv., 1910–11.—Bulletin Statistique des Pêches maritimes des Pays du nord de l'Europe, vol. vi., pour l'année 1909.—Investigations on the Plaice. General Report by Dr. F. Heincke. I. Plaice Fishery and Protective Measures (Preliminary brief summary of the most important points of the Report).—Procès-Verbaux des Réunions du Conseil et des Sections, Copenhague, Septembre 1912.

tures, salinities, and direct-current measurements made from ten vessels which were anchored for fourteen days (June 1 to 14, 1911) in a series of positions in the North Sea, selected with the view of studying the principal currents. A repetition of observations of this character from time to time as opportunity offers cannot fail to give information of the utmost value.

The plankton bulletin is composed entirely of tables, recording the species found in samples taken during the years 1908 to 1911; and from the number of records given it is evident that this side of the investigations has recently received far less attention than was formerly given to it. This is probably due to two causes. In the first place, the amount of time which is necessarily consumed in examining and recording a large series of plankton samples is very great indeed, and in the second place a doubt exists in many minds as to whether any very useful results will accrue from an indefinite continuation of work on the plan which up to the present has been followed. What seems to be required at the moment in plankton work is more freedom and liberty to the individual worker to devise and test new methods of quantitative investigation, which may eventually enable a trustworthy estimate of the annual and seasonal fluctuations to be arrived at by some means less open to criticism on the ground of trustworthiness and at the same time not so prohibitively laborious as the enumeration method of the Kiel school of workers.

For investigations on the minutest plankton forms—the nannoplankton of Lohmann—the enumeration method will doubtless have to be retained, and the plan for the preservation of samples for this purpose, described by Gran in *Publications de Circonstance*, No. 62, marks a useful step in advance. The method consists in adding to samples of sea-water, taken with a water-bottle from known depths, a small quantity of Flemming's strong solution. The samples may be kept in this way for many months, and, without any attempt at washing out the Flemming's solution, portions of the sample can be centrifuged, the minute plankton forms which are thus separated out being identified and counted under the microscope.

Vol. xiv. of the *Rapports et Procès-Verbaux* contains a number of papers of great interest dealing with investigations of food fishes. Dr. P. P. C. Hoek reports on the Clupeoids (other than the herring), Prof. D'Arcy Thompson on the later stages of the Gadoids, Dr. Masterman on the later stages of the Pleuronectidæ, and Dr. Johansen on the eggs, larvæ, and later stages of Pleuronectidæ from the Baltic. Dr. Ehrenbaum contributes a summary of a more extensive report which he is preparing on the mackerel, which not only brings together previous work, but also gives much new information on the habits and life-history of this important fish, at the same time making it clear that much further investigation is necessary. He points out amongst other things that little or nothing is known of the small adult stages of this common fish, which, in spite of extensive fishing with nets that certainly ought to capture them, have rarely been taken, and then only in very small numbers.

Finally, the volume contains a useful report by Dr. Redeke on the present condition of our knowledge of the races of marketable fishes, in which the importance of further researches into this subject is made clear.

The International Council publishes as a separate volume what is described as a "preliminary brief summary" of the first part of Prof. Heincke's general report upon investigations on the plaice. This first part is entitled "Plaice Fishery and Protective Measures," and from the *procès-verbaux* of the meeting held in Copenhagen in September, 1912, we learn that the summary was then laid before the council and referred by it to a special committee. The latter committee was not, however, prepared to adopt immediately the recommendations made by Prof. Heincke, and the matter was further deferred.

These recommendations, put forward in a somewhat tentative way, comprise the imposition upon an international basis of a size-limit for plaice, below which the fish may be neither landed nor sold. It would appear that the great destruction of immature plaice which now takes place could only be effectively stopped if this size-limit were fixed at 25 to 26 cm. Such a high limit would, however, mean the immediate ruin of many inshore fisheries carried on by sailing trawlers. As most of these vessels on the continental side land their plaice *alive*, Prof. Heincke suggests that a lower size-limit of 22 or 23 cm. might be allowed for fish which are so landed. It must be pointed out, however, that this would not meet the difficulty in English ports such as Lowestoft and Ramsgate, where a size-limit of 25 or 26 cm. would probably mean the ruin of the trawling industry. Prof. Heincke emphasises the fact that the introduction of a size-limit would, in the first instance, be in the nature of an experiment, and that it is not possible to say beforehand with any certainty exactly what effect it would have on the fishery. The problem is, in fact, a much more complex one than it at first sight appears to be. A consideration of the present preliminary report rather suggests that the International Council has not yet had that problem adequately laid before it in all its numerous aspects and in a sufficiently comprehensive way. The council would scarcely at present be justified in proposing restrictions which would certainly, in the first instance, injure very seriously the livelihood of many owners and fishermen who are dependent upon the smaller boats.

AMERICAN UNIVERSITIES AND COLLEGES.

THE seventh annual report of the president and treasurer of the Carnegie Foundation for the Advancement of Teaching bears ample witness to the stimulating powers which come from the wise administration of an income of

nearly 130,000*l.* a year in furtherance of a definite end. Here it is the provision or supplementing of pensions for the teachers of institutions of university rank. The trustees' report is as interesting and informing as ever. The glimpses one gets into the heart of higher education in the States offer some comfort to the Englishman who is inclined to lament what he may call the mediævalism of our ancient universities. After all, there is in the States the Brown University, the governing body of which must contain a majority of Baptists; the same denomination also controls the destinies of the great University of Chicago, the president and two thirds of the trustees of which must conform. Neither of these institutions can share in the benefits of the Carnegie fund because of their religious restrictions, but, as a result of the existence of that fund, Brown is saving 1,000,000 dollars and Chicago 2,000,000 dollars, each for its own pension purposes.

The report contains a survey of State and municipal schemes for teachers' pensions, which is particularly interesting to us at the present moment. In many, if not in most, States, the "flat-rate" system has been adopted. A pension of 400 dollars after thirty to forty years' service is the normal arrangement. New York is more liberal. It provides pensions equal to one-half the retiring salary after thirty years' service. No pension is to be less than 600 dollars, and none more than 1500 dollars. The upper and lower limits in Boston are 600 and 312 dollars respectively, the basis of calculation within those limits being one-third the annual salary. Philadelphia gives from 400 to 800 dollars on the half-salary basis. Many cities and States have, however, not yet made provision of this kind for the staffs of their public schools, but the movement is progressing, thanks to the example of the Carnegie foundation.

The influence of the foundation has been particularly beneficent in the vexed question of college or university entrance requirements. "The border-line between secondary school and college resembles nothing so much as a species of border warfare," but colleges are steadily changing their standards of admission by requiring the completion of a satisfactory four-year course instead of a certificate of having completed so many "units" of study—a system not unlike that which encouraged elementary-school teachers to pile up as many South Kensington science certificates as possible, in order to increase their chances of promotion.

Nothing illustrates more effectively the good which this annual survey of higher education in the States is exerting than the chapters on "Advertising as a Factor in Education," "Education and Politics," and "Sham Universities." Readers of American journals know something of the first, but probably they have not realised the full extent of the evil. The examples pilloried in this chapter come as a violent shock to our sense of academic decorum. The trustees think the use of pictorial and coloured circulars by universities and colleges is distinctly limited, and they see objections to the practice of printing academic biographies of professors in the college prospectus, but Reed College at Portland, Oregon, exceeds all bounds by including in these biographies "editorships of college annuals, class votes on popularity, degrees that are expected, academic biographies of professors' wives, the number of their children, and finally portraits" of the staff. Even this gross breach of academic decency is beaten by McMinnville College, which advertises a "hand-picked" faculty producing "a product second to none in America." But Muskingham College, Ohio, bears the palm in this type of vulgarity. Its alumni include "the most beloved Bible teacher in America." It represents itself as at the geographical centre of the Church (Presbyterian), and prints "a rude cartoon of an old shoe filled and overflowing with riotous students, while a figure in academic costume chases others away with a bundle of sticks." Below the cartoon are verses of which this is a specimen:—

There is a college president, like the woman in the shoe,
Who has so many children that he doesn't know what to do.
He tries to treat them fairly, and give them each some room,
But the college grows so grandly, like a town site on the boom,
That unless her friends soon rally and provide another shoe,
He must say to all new-comers: "Get out of here! Skiddoo!"

Abuses of this kind obviously do much to discredit all that is really good in the higher education of the States.

The Educational Bureau at Washington is also waking up to some well-known evils. The Commissioner has been looking into the question of universities and colleges which confer degrees. He finds only fifty-nine the degrees of which are wholly satisfactory, and 161 where they are approximately so, but the report under review tells us that these are less than a fourth of the institutions in the country which call themselves universities and colleges, all of which grant degrees.

The trustees of this foundation deserve the thanks of the American community for the courageous way in which they are discharging their great trust. J. A. GREEN.

NOTES.

As announced already, the dedication of a window in memory of Lord Kelvin will take place in Westminster Abbey on Tuesday, July 15, at 3 p.m. The window, which is the result of action taken by engineers in the British Dominions and the United States, has been placed in the north aisle of the nave, in close proximity to the one erected in 1909 by civil engineers to the memory of Sir Benjamin Baker; and it has been designed and made by the same artist, Mr. J. N. Comper. A special service, with music, is being arranged by the Abbey authorities, and Mr. R. Elliott-Cooper, president of the Institution of Civil Engineers, will make the formal pre-

sentation of the window on behalf of the donors. Members of the American engineering societies and of the Canadian Society of Civil Engineers who may be in London at the time are invited to attend the dedication ceremony, whether they subscribed to the cost of the window or not, and they may obtain cards of admission by writing before Monday, July 14, to the secretary of the Institution of Civil Engineers, 12 Dartmouth Street, Westminster, S.W.

THE allocation by the Mansion House Committee of the Scott Fund shows every evidence of a most careful consideration of all the interests involved. The allocation falls under the three main headings of provision for the relatives of those lost (or, in one instance, incapacitated), for the publication of the scientific results, and for memorials. The provision for the relatives includes 850*l*. each for Lady Scott and Mrs. Wilson, 600*l*. for Mrs. Scott and her daughters, 450*l*. for Mrs. Bowers and her daughters, and 350*l*. in trust for the child Peter Scott, with smaller sums for Evans's family and to meet need in other two cases. The arrangements for publication of the scientific results have failed to commend themselves to one member of the committee, but they can scarcely, on general grounds, be regarded as ungenerous. One of the honorary secretaries of the Royal Geographical Society, Capt. H. G. Lyons, F.R.S., appropriately undertakes their editorship, and representatives of that body and of the Royal Society, with Surgeon Atkinson, will control the work. A total sum of 17,500*l*. provides, besides the cost of publication, for the services of three biologists, three geologists, two physicists, other specialists, and a draughtsman, and the figure of 800*l*.—an ample but not excessive provision—is earmarked for the production of charts and maps. As regards the arrangements for memorials, a tablet in St. Paul's Cathedral is fitting; a group of statuary was doubtless inevitable; it is proposed that it should stand in Hyde Park facing the Royal Geographical Society's house. A contribution to a memorial to Oates, which is being raised by his regiment, is admirable as a special expression of regard for the memory of one whose relatives need no assistance from the fund. The published results of the expedition will not form its only scientific memorial; the establishment of a trust fund of some 10,000*l*. for the endowment of future polar research will perhaps in the long run preserve most honourably the memory of a great scientific expedition, and would, in the belief of the committee, have commended itself greatly to its leader.

THE council of the Royal Society of Edinburgh has awarded the Gunning Victoria Jubilee Prize for the quadrennial period 1908–12 to Prof. J. Norman Collie, F.R.S., for his distinguished contributions to chemistry—organic and inorganic—during twenty-seven years, including his work upon neon and other rare gases. Prof. Collie's early papers were contributed to the Transactions of the society. The council has also awarded the Makdougall-Brisbane prize for the biennial period 1910–12 to Dr. John Brownlee, for his contributions to the theory of Mendelian distributions and cognate subjects, published in the Proceedings of the society within and prior to the prescribed period.

AT a meeting of the electing trustees of the British Museum, held on July 2, Sir Archibald Geikie, K.C.B., P.R.S., was elected a trustee of the British Museum in succession to the late Lord Avebury. Sir A. Geikie was already an *ex-officio* trustee, in virtue of his position as president of the Royal Society; but his tenure of that office comes to an end in November next, and his services would have been lost to the British Museum but for his present election as a trustee for life.

AN association of amateurs interested in wireless telegraphy and telephony has been formed, under the title of "The London Wireless Club." A meeting will be held in September next, for the purpose of electing a committee. The honorary secretary *pro tem.* is Mr. R. H. Klein, 18 Crediton Road, West Hampstead, N.W.

SIR ROBERT LUCAS-TOOTH has given a donation of 1000*l*. to the fund that Capt. J. K. Davis is raising in this country for Dr. Mawson's Australasian Antarctic Expedition. We learn from *The Times* that Capt. Davis leaves England on July 18 for Australia. On his arrival there the *Aurora* will be refitted and will proceed to Commonwealth Bay to bring back Dr. Mawson and his six companions at present in the Antarctic.

THE discussion by a Standing Committee of the House of Commons of the Bill to prohibit experiments on dogs was continued on July 2. As was pointed out in our issue of last week, the Bill proposes to enact that it shall be unlawful to perform any experiments of a nature causing or likely to cause pain or disease to any dog for any purpose whatsoever, either with or without anæsthetics. At the Committee meeting on July 2 an amendment was carried that the Bill should apply only to inoculation experiments. The Bill is again under consideration by the Committee as we go to press.

THE annual conference of the Museums Association, which is to be held at Hull this year, will open on Monday next, July 14, under the presidency of Mr. E. Howarth, curator of the Sheffield Public Museums and Art Gallery. Many interesting subjects are to be discussed, among them being the possibility of showing our museums and art galleries to the blind, arising out of experiments made by Mr. J. A. Charlton Deas, at Sunderland Museum and Art Gallery. The peripatetic guides at the British Museum (both Bloomsbury and South Kensington) will attend to give their experiences in the personal conduction of visitors around these institutions, and Prof. Rathgen, of Berlin, is to discourse on the decay and preservation of antiquities. The local secretary for the meeting is Mr. Thos. Sheppard, of the Hull Museum. The secretary of the association is Mr. E. E. Lowe, curator of the Leicester Museum and Art Gallery.

THE Institut de Paléontologie Humaine, founded by Albert I., Prince of Monaco, has issued a report of the investigations conducted in 1912 by MM. Breuil

and Obermaier. The most interesting discoveries are two fine examples of the decorated staves called by French archæologists *batons de commandement*, from Spanish caves; a rough delineation of an animal, perhaps a horse, and a male human figure from the grotto of San Garcia in Burgos; and a remarkable series of figures from the Sierra Morena and Velez Blanco caves, illustrating the evolution of design in a female idol of the early Neolithic age. The explorers record their obligations to an English antiquarian, Col. Willoughby Verner, for his researches in the Peleta cave at Benaojan, Malaga, and describe the visit of M. Breuil, under the guidance of Prof. Sollas, to the well-known Bacon Hole, near Swansea, which corroborated the identification of the Palæolithic drawings on its walls.

AMERICAN archæologists, having settled the main problems which the continent presents, are now devoting themselves to regional, intensive exploration. Mr. Clark Wissler has recently issued in Bulletin 9 of the Geological Survey of New Jersey a preliminary report on archæology. The surface sites so far reported are rare except in restricted areas, which correspond with the distribution of the Lenápé Indians during the early settlement period, and it thus appears that all such remains belong to the historic Indians and their immediate ancestors. No positive traces of a pre-Indian culture have been discovered. Long lists and descriptions of the remains are given, classified as camp and village sites, shell-heaps, cemeteries, rock shelters, quarries, caches, and trails, the camp and village sites being most abundant. Stone implements are abundant, but as regards palæoliths, though the existence of such seems to have been demonstrated by Volk in the Delaware Valley, some archæologists are not satisfied that they are human in origin.

WE have received the Livingstone College Year Book for 1913, which gives particulars of the work done there, extracts from the letters of old students, &c. The college is established for the training of missionaries in the elements of medicine and hygiene. An appeal is made for 10,000*l.* for paying off a mortgage on the property and establishing a small endowment fund.

PARTS 1 and 2 of *Mikrokosmos* (7 Jahrg., 1913–14) contain several well-illustrated articles of interest to microscopists, *e.g.* a simple illuminating apparatus, a new form of mechanical stage, preparation of material, development of protozoa, &c. Herr Günther and Dr. Stehli contribute lists of common plants in suitable condition during April and May for the demonstration of special structures, &c., which are indicated, with their habitat.

A NINTH research report, by Dr. Houston, director of water examination, has been issued by the Metropolitan Water Board. It deals with a search for the typhoid bacillus in *raw* river water and crude sewage, and is a continuation of the author's former investigations on the same question (see second, fifth, and seventh research reports). Twenty-eight samples of crude sewage were examined, mostly from Barking or Hendon, also from Dublin, Belfast, Edinburgh, and Aberdeen, but in no case was the typhoid bacillus detected. Dr. Houston concludes that the home of the typhoid bacillus is not so much in impure water, or even in the crude sewage from a large community, as in the "factories" of disease, as exemplified by the "carrier" case.

AMONG the cases referred to in a recent batch of Opinions (52 to 56) issued by the International Commission on Zoological Nomenclature at Washington is that of the rodent genus Ondatra, frequently considered as applicable to the South American coypu, commonly known as Myocastor or Myopotamus. In the opinion of the majority of the committee this usage is, however, considered erroneous, the name really belonging to the musk-rat, originally described as *Mus zibethicus*.

TO the May number of *The National Geographic Magazine* Mr. E. C. le Munyon communicates a richly illustrated account of his experiences in conveying a motor-car for the use of the Tasha-Lama from Tientsin across the Gobi to Urga, in northern Mongolia. One of the plates shows a vast flock of sheep, probably of the Hunia breed, on the march to Pekin, whence a large quantity of the wool—which is chiefly employed in carpet-making—is exported to America. The author also encountered enormous herds of wild horses and "antelopes," the latter being doubtless the Mongolian gazelle or one of the allied species. It may be added that the motor reached its destination in excellent working order.

A PAPER by Prof. A. Keith on the teeth of prehistoric man is published in the Odontological Series of the Proceedings of the Royal Society of Medicine, vol vi. After noticing certain variations from the modern type characteristic of many prehistoric molars, the author proposes the term "taurodontism" for the modification in which the crown tends to become excessively wide in proportion to the root, while "cynodontism" is suggested for the opposite condition. Taurodontism is stated to be excessively developed in Neanderthal man, whose teeth, although primitive or simian in some features, are regarded as highly specialised in others; the dentition of the Galley Hill man is, however, regarded as still more simian in character.

IN an article in the June number of *The Zoologist* on his experiences of hunting the hump-backed whale from one of the two whaling stations at Durban, Mr. T. B. Goodall directs attention to what he regards as a misinterpretation of the relationship of the plates of whalebone to the plate in the whalebone-whales. It is generally stated in text-books that these plates are outgrowths of ridges on the palate, comparable to the rugæ on that of cattle. Mr. Goodall states, however, that the plates arise on the outer sides of two median raised ridges of mucous membrane, which can apparently be raised or depressed. These ridges, or folds, he thinks, probably represent the gums, although it is also suggested that they may correspond to the upper lips. In consequence of this, the plates of whalebone, according to the author, appear

to be quite distinct from the palate, and to be outside the gums and inside the cheeks, or, on the hypothesis that the longitudinal folds are the upper lips, the plates "are really modified hairs of a veritable moustache on an inverted upper lip." It is added that the weight of one of these whales is computed at a ton to the foot, so that a 60-ft. humpback would weigh 60 tons. A newly-born humpback is stated to have measured 16 ft. in length, and to have weighed a couple of tons.

DR. GERTRUD TOBLER has given an elaborate account of the genus Synchytrium in her recently published work, "Die Synchytrien: Studien zu einer Monographie der Gattung" (Jena: G. Fischer, 5 marks). The group (Chytridiales) to which this genus belongs includes the most interesting of the lower fungi, and Frau Tobler's detailed studies include its morphology, cytology, development, influence on the host plants, and geographical distribution, together with systematic descriptions of the fifty-one recognised species and a list of their host plants. The work also includes a historical summary and a full list of literature, and there are four plates.

THE greater portion of tome 25, No. 4, of the *Bulletin de la Société Impériale des Naturalistes de Moscou* is occupied by two papers on the mechanical tissues of plants. In the first paper W. Rasdorsky gives a useful historical summary of previous work on this subject between 1873 and 1910, and of the present state of knowledge concerning the mechanics of vegetable tissues in both flowering and flowerless plants. In the second paper this author and I. A. Kalinnikow give a long account of their own researches with apparatus devised by themselves for testing the strength of fibres and other tissues. The results are set forth in numerous tables and diagrams, relating chiefly to experiments with the stalks and blades of palm leaves and with various kinds of iron and steel. Plant fibres were found to have about the same tensile strength as wrought-iron, and in some cases approached that of steel, while they greatly exceed iron and steel in elasticity, though falling far short of these metals in ductility.

A COPY has reached us of the first report of the Forest Branch of the Department of Lands, British Columbia. This branch was created in February, 1912, and the result of the first year's work reflects great credit upon the Chief Forester, Mr. H. R. Macmillan, and his assistants. British Columbia contains one of the few great bodies of commercial timber left in the world which are not yet materially reduced by destructive lumbering, and, with the possible exceptions of Siberia, Brazil, and the north-western United States, the timber wealth of British Columbia is unparalleled in any other country, since it contains not less than one hundred million acres of forest land. At the present rate of cutting, making no allowance for annual growth, it would take nearly 250 years to use up merely the mature timber now standing; the annual growth of the forests is even now, though they are not yet adequately protected against fire and waste, not less than five times the present annual cutting. Great stress is laid on the need for a prudent policy of forest utilisation and protection, including the formation of forest reserves in such areas as are unsuited for agricultural use. The report is illustrated by thirty-three very fine photographs, which, besides their immediate purpose, serve to convey an admirable impression of the forest vegetation of the province in its ecological aspects.

THE useful ice reports contained in the meteorological chart issued by the *Deutsche Seewarte* for the North Atlantic Ocean for July show that early in June a great quantity of drift ice was still met with, especially north of latitude 45° N., where the Newfoundland Bank and the district to the east of it, as far as longitude 41° W., were thickly beset with bergs. South of latitude 45° N. the difficulties were not so great; drift ice had much increased since the previous month, but a further advance of the ice southwards was not observed. Two bergs were sighted on June 7, so far south as 43·1° N., 42·8° W., and the possibility of a further advance would naturally have to be taken into account.

THE valuable publication entitled *Deutsche überseeische meteorologische Beobachtungen*, vol. xxi., containing data for 1911, is issued by the Seewarte, as in previous years, with the assistance of the Imperial Colonial Office, the results being prepared with much care by Dr. P. Heidke. The volume is considerably enlarged compared with that of the previous year (NATURE, August 22, 1912) by the addition of observations at definite hours at some stations in the Cameroon district and in German South-West Africa. The discussion and publication of observations for the Protectorate of German New Guinea, and for several islands in the Pacific Ocean, are also contemplated. The volume forms a most important contribution to our knowledge of the climatology of many remote regions.

WE have received from Dr. Louis Bell, whose book on illumination is so well known, a copy of a note he communicated to *The Electrical World* for May 24 on silvered mirrors and their preservation. It appears that the method of covering a silver mirror with a thin layer of collodion, first suggested by M. Perot in the *Comptes rendus* for November, 1909, may be carried out by applying the ordinary lacquer supplied commercially for protecting silverware. Dr. Bell uses clear "Lastina" lacquer diluted with two parts of the thinner provided with it, and floods the mirror with the solution. On drying, the mirror has lost about 4 per cent. of its reflecting power. A still more dilute solution was used for the 2-ft. parabolic speculum reflector of Harvard Observatory. The definition was unimpaired, and after three months of regular service the mirror had only diminished slightly in brilliancy.

THE part of the Proceedings of the Physical Society of London dated June 15 has reached us. We note that the Proceedings are now issued at intervals of two months. The present part consists of more than ninety pages, and contains twelve papers communicated to the society between March 7 and May 8. Each paper is accompanied by an abstract and by a short account of the discussion which followed the reading of it. Mr. T.

Smith's contribution to the discussion of Mr. W. R. Bower's paper on a graphical method of optical imagery covers five pages, and contains all the essentials of Gauss's analytical method and an example of its use. A paper by Dr. W. H. Eccles deals with the important question of the cause of the behaviour of the light electrical contacts used as detectors in wireless telegraphy. Dr. Eccles shows that nothing further is required to explain the behaviour of the different types of contacts than the laws of generation of heat in conductors by electric currents and the laws of thermo-electricity.

IN a short note in the *Gazzetta Chimica Italiana* (vol. xliii., i., 197) Mr. A. Pieroni describes a new method of preparing colloidal solutions, which consists in dissolving, for instance, silver nitrate or copper sulphate in pyridine containing pyrogallol or tannic acid, and subsequently diluting with water. Under these conditions, colloidal solutions of copper or silver are obtained which are much more concentrated than colloidal solutions of the same metals in water only; in the case of silver, for instance, relatively stable solutions, containing 0·05 to 0·064 per cent. of the metal, can be obtained.

WE have received from the United Tanners' Federation of Great Britain and Ireland a copy of "The Tanners' Yearbook" (3s., post free), which, besides containing a report of the work of the central committee of the Tanners' Federation during 1912, contains statistics of leather and of materials employed in the leather industry, and a number of articles on matters of technical interest. Some of these are of scientific importance; for instance, the article on the mimosa-bark industry of South Africa, by Dr. J. Gordon Parker, and that on the new synthetic tannin, "Neradol D," manufactured by the Badische Co., Ltd.

THE Journal of the Marine Biological Association (vol ix., No. 4) contains an important paper by the late Mr. G. H. Drew on the precipitation of calcium carbonate by marine bacteria. Evidence is brought forward to show that the chalky mud flats forming the Great Bahama Bank and those which are found in the neighbourhood of the Florida Keys are now being precipitated by the action of a new bacterium, to which, owing to its power of precipitating calcium carbonate from dilute solutions of calcium salts, the name *Bacterium calcis* is given. The isolation and characteristics of the bacterium are described and the hypothesis put forward that in the formation of the various chalk and oolite strata the *Bacterium calcis* or similar bacteria have played an important part, as well as the Foraminifera and larger organisms; if such a view be correct these strata must have been deposited in comparatively shallow water, the temperature of which approximated to that of the modern tropical seas.

THE second Gustave Canet lecture, delivered by Dr. Dugald Clerk, before the Junior Institution of Engineers, on June 30, dealt with the present state of our knowledge of the working fluid of internal-combustion engines. The combined work of English and Continental physicists and engineers has thrown much light upon the physical and chemical behaviour of flame, and it is now possible to give an approximately accurate account of the leading phenomena of combustion, explosion, and expansion, so far as concerns the engineer. Dr. Clerk gave a useful summary, together with the principal results, of modern experiments on temperatures in the gas-engine cylinder, on the internal energy of gas-engine mixtures, on explosions in closed vessels, on turbulence, and on radiation. With the view of testing the accuracy of the data thus accumulated, there are several trials on gas-engines included, together with the reduction of the results. The information thus given presents a very full statement of our knowledge, as might be expected from Dr. Clerk's personal connection with the British Association committee formed in order to study this subject. In Dr. Clerk's opinion, practical men very greatly underrate their indebtedness to theory. Some practical men have gone so far as to say that gas-engine designers have brought internal-combustion engines to their present state of efficiency without any aid from scientific theory. The increasing efficiency of the internal-combustion engine has put great pressure upon steam-engine builders, and recent steam turbine efficiencies have attained such figures that it becomes necessary for the gas-engine designer to attempt further economies in order to keep ahead of his steam rival. This he can do only by exact knowledge of his heat losses and properties of his working fluid.

WE have received from Messrs. Gallenkamp and Co., 19 and 21 Sun Street, E.C., a catalogue of laboratory outfit for the bacteriological and pathological laboratory. All the general and special apparatus, as well as the necessary fittings, are included in the list, which is fully illustrated.

CATALOGUE No. 319, just issued by Mr. E. Baker, 14 and 16 John Bright Street, Birmingham, includes a number of rare and interesting works on many branches of science, offered at low prices. Librarians and others requiring volumes to complete sets or series, or papers on particular subjects, should see the catalogue.

THREE new volumes in Prof. Ostwald's series of scientific classics—"Klassiker der exakten Wissenschaften"—published by Mr. W. Engelmann, of Leipzig, have recently been received. No. 188 (price 1.80 marks) is entitled, "Die Druckkräfte des Lichtes," and contains two papers by P. Lebedew on the pressure of light, with notes by P. Lasareff. A translation into German of A. C. Clairaut's work, published in 1743, on the theory of the shape of the earth, based upon hydrostatic principles, appears as No. 189 (price 4.60 marks), under the title, "Theorie der Erdgestalt nach Gesetzen der Hydrostatik," with notes by P. E. B. Jourdain and A. v. Oettingen. Similar valuable notes are contributed by R. Anschütz to No. 190 (price 5 marks), which contains J. Loschmidt's "Konstitutions-Formeln der organischen Chemie in graphischer Darstellung." Each of the volumes has a portrait of the original author as a frontispiece.

OUR ASTRONOMICAL COLUMN.

THE HOTTEST STARS.—Under this heading, Dr. Ant. Pannekoek communicates a short note to the *Astronomische Nachrichten*, No. 4657. It relates to the list of spectral-photometric measures made by Herr H. Rosenberg (see this column, May 29) of the temperatures of the hotter stars. Dr. Pannekoek states that from this list a regular increase of the figures takes places with the class-number of the spectra according to Miss Maury's classification. Whether this increase commences at the beginning or in which class the helium or the whitest or hottest stars are to be found cannot be clearly stated in consequence of the few stars discussed. Dr. Pannekoek utilises the large quantity of material available in the catalogue of colour-estimations by Osthoff, and while they give no results of absolute temperature, they are of value from a relative point of view. The comparison of these values with Miss Maury's types brings out the result that lowest colour number corresponds with her class IV. or IV.–V., or the typical helium stars. On either side of these classes the colour numbers increase, and the temperature decreases not only on the side of the Sirian stars of the first type, but also towards the Wolf-Rayet stars. The following is the complete table which he gives in the paper, but here Miss Maury's classes are preceded by the equivalents in Sir Norman Lockyer's classification for comparison :—

Class (Lockyer)	Class (Miss Maury)	Colour	No. of stars
Argonian	I ...	2·47 ...	6
Alnitamian	II ..	2·36 ...	10
Crucian	III ...	2·30 ...	9
Crucian, Achernian ...	IV ...	1·94 ...	14
—	IV–V ...	1·62 ...	10
Taurian, Algolian	V ...	2·11 ...	9
Rigelian, Algolian	VI ...	2·16 ...	10
Algolian, Markabian ...	VII ...	2·27 ...	23
Cygnian, Markabian ...	VIII ...	2·37 ...	34
Sirian	IX ...	2·64 ...	20
Sirian	X	3·11 ...	14
Procyonian	XI ...	3·40 ...	9
—	XI–XII ...	3·41 ...	4
Polarian, Procyonian ...	XII ...	3·68 ...	17
Polarian, Procyonian ...	XIII ...	4·12 ...	13
Arcturian	XIV ...	4·45 ...	12
—	XIV–XV ...	5·09 ...	9
Arcturian	XV A ...	5·18 ...	18
Arcturian	XV B ...	5·35 ...	26
Arcturian	XV C ...	5·55 ...	31
—	XV–XVI ...	6·34 ...	5
Aldebarian	XVI ..	6·47 ...	17
Antarian	XVII ...	6·80 ...	15
Antarian	XVIII ...	6·74 ...	15
Antarian	XIX ...	6·67 ...	6

A PHOTO-VISUAL COMPARATOR FOR THE IDENTIFICATION OF MINOR PLANETS.—As the only means whereby a minor planet is distinguishable from a star of the same magnitude is its proper motion, its identification is often a matter of considerable labour proportional to the planet's magnitude and the uncertainty of the ephemeris. To this end M. J. Lagrula employs an ingenious arrangement which he describes in a note presented to the Paris Academy of Sciences (*Comptes rendus*, No. 15). It consists of a binocular combination of telescope and microscope, forming what is essentially a stereo-comparator, in which a coloured image of a photographic positive of the region to be examined is superposed on the image seen in the telescope. All objects visible in the field of the telescope, except small planets which have no counterpart on the photograph, are distinguished by the presence of a coloured disc. For use with the Gautier equatorial of the Nice Observatory copies of the photographic charts of MM. Palisa and Wolf have been found eminently suitable. As an example of the rapidity and efficiency of operating with the device the author instances detecting within five minutes an error in the published ephemerides of (233) Asterope.

METEOR DUST AS A MEASURE OF GEOLOGIC TIME.—In *Science*, No. 957, Prof. Alfred C. Lane directs attention to the possibility of using the proportion of contained meteor dust as a measure of the rate of formation of strata, and hence as a criterion of geologic time. He calculates that the earth gains 20,000 grams of cosmically derived nickel per square kilometre per annum. From this figure and the nickel content of the abysmal red clay he estimates that a layer one metre thick of the latter requires 8700 years to accumulate. The professor urges members of proposed polar expeditions to complete Nordenskjold's observations by determining the rate of deposition of cosmic dust, and optimistically anticipates that within this century there will be drilled a hole in the bottom of the sea which will give us the other datum to be determined.

THE ROYAL AGRICULTURAL SHOW.

THE extremely successful Royal Show held at Bristol, July 2–5, illustrated in a striking way the general progress being made in agriculture, horticulture, and forestry, but presented very little calling for comment from the scientific point of view. Among livestock, a remarkable novelty was the pen of primitive breeds of sheep—and crosses from the same—exhibited by Prof. Cossar Ewart and Mr. H. J. Elwes. This throws some light on the origin of domesticated sheep, and also suggests the possibility of establishing one or more new breeds capable of thriving on poor upland pastures in this country, and of yielding more valuable wool than that of the ordinary hill-breeds.

In the Agricultural Education Exhibition, Rothamsted showed an interesting series of tomato-plants in pots to demonstrate the advantage of partial sterilisation of soil in various ways. Wye College—as usual—exhibited a striking series of pests, fungoid (including a new disease of apple-buds) and insect (some in the living state). The University of Bristol was represented by the associated Royal Agricultural College (received in deputation by H.M. the King on July 4) and Long Ashton Fruit and Cider Institute. The chief feature of the former was a collection of wool-staples, including a series from the sheep in the above-mentioned exhibit of Ewart and Elwes. Long Ashton, as the chief British horticultural research centre, is evidently working with increased energy since its reconstitution and extension, and one of its most interesting exhibits consisted of specimens of a new disease of pear-blossoms, due to bacteria as yet unnamed, and causing the young fruits to fall early. The Nature-study Section, including exhibits from several western and south-western counties, was a decided improvement on past years, proving that school work is now more systematic than formerly. Gloucestershire is to be congratulated on classifying its material by subjects and not by schools.

The exhibit of British tobaccos attracted much notice, but most of those who sampled the specimens were not impressed by their quality, though no doubt home-grown material may prove useful for fumigation purposes. The Forestry Section was particularly

good, and demonstrated increasing interest in a neglected industry of national importance.

Among the implements, the increasing necessity for labour-saving contrivances is evidently continuing to produce continual improvements and new types. The set of milking machines attracted a great deal of attention, especially the Swedish Omega form, of vacuum type, which gained first place in trials held earlier in the year. The difficulty of cleansing milking machines has been one of their great drawbacks, but this is largely overcome in the Omega by employing short transparent celluloid tubes instead of long rubber tubes. Probably the most ingenious new appliance to be seen in the show was the "Erto" potato-planting machine. This, in one operation, digs trenches of the desired depth, plants the tubers at any distance apart, sows manure if required, and covers up the furrows. Novelties were not wanting among the exhibits of various well-known firms specialising in farm and garden plants. Suttons showed a new variety of sunflower with red centre, Marsters new varieties of wheat, and Gartons a new oat—the "Leader"—the first to yield five grains to a spikelet.

The most striking innovation on a large scale at the Bristol Show was the establishment of an Overseas Section, and it is to be hoped that this feature may be permanently retained. So many persons are emigrating overseas that it is important to give them every chance of seeing Colonial produce and studying Colonial methods. Readers of NATURE are mostly familiar with the kind of exhibits represented in this section, but large numbers of the populace last week were obviously keenly interested in the rubber series shown by the Federated Malay States, and the sugar samples from the West Indies and British Guiana, including food products for human and animal consumption, and even a sugar-cane plant in a living and healthy state. The time appears to have come when intending colonists should all have the opportunity of elementary instruction in Colonial or tropical agriculture before leaving the home country.

J. R. A.-D.

BEDFORD COLLEGE FOR WOMEN.

THE opening of the new buildings of the Bedford College for Women on July 4 by her Majesty Queen Mary was an important event in the history of university education.

A committee was formed in 1847 by Mrs. Reid and other ladies interested in women's education, lectures being given in Mrs. Reid's private house, and in 1849 the college was definitely started in a house of its own in Bedford Square, from which fact the college takes its name. In 1874 the college moved to Baker Street, and from that year its growth has been rapid. As time went on the accommodation at Baker Street was increased until every available square foot was covered; when it became evident that a move into larger and less noisy buildings was inevitable. For this purpose the council acquired the lease of South Villa, standing on land adjoining but outside Regent's Park. Three acres of the site were added to the park, about eight acres being left for the purpose of the college and its grounds. An appeal was issued for the necessary building fund, and a loyal response was given by old students and other friends of the college. Among other gifts may be mentioned a library and its furniture by Lady Tate, a dining-hall and common-rooms by Mrs. Oliver, a grant of 30,000*l.* from the London County Council, and an anonymous gift of 30,000*l.*

The new college accommodates some 500 students, and (except for the library) was designed by Mr. Basil Champneys. It consists of four parallel rows of buildings: the library, a science block for chemistry, physiology, and physics, another science block for zoology, botany, and geology, and the hall and rooms for about eighty residents. These rows are connected at one end by corridors, by the Sir Julius Wernher reading-room, and by a block of buildings for administrative offices and for the rooms allotted to arts subjects and mathematics. This "arts" block also contains a large hall for public lectures.

In erecting these buildings the council has assumed a heavy responsibility, and in order to provide scholarships, to maintain the departments at a high level, and to keep up the fabric, an adequate endowment is urgently needed. An appeal has been issued for an endowment fund of 150,000*l.* A far humbler but very necessary appeal was also issued about a year ago for 2000*l.* to put the athletic clubs on a sound financial basis. The value of outdoor recreation to women coming from London homes, and engaged in severe mental work, can scarcely be over-estimated.

The Queen, who was accompanied by Princess Louise Duchess of Argyll and the Duke of Argyll, was received at the entrance of the college, and conducted by the Earl of Rosebery to the lecture-hall, where the council and staff were presented. She then proceeded to the two science blocks, where she inspected the students at work, and took the keenest interest in their experiments and exhibits. Afterwards she walked to the Tate Library, and then to the residents' block, where she visited some of the rooms. Meanwhile some 600 guests were awaiting her arrival in the dining-hall, the time being filled up by several speeches. The President of the Board of Education expressed strong appreciation of the work done by the college, and hopes of a great development of both school and university education in the future. In the absence of Sir John Simon, Miss Edgell (head of the department of philosophy) spoke next, and in an interesting speech outlined the progress of women's education during the last sixty years, and emphasised the great part played therein by the University of London. The Archdeacon of London pointed out the value of university education in the formation of national character. Then Lord Rosebery spoke until the Queen, having completed her tour of inspection, arrived in the hall, where she listened to a college song and received a bouquet from the students. She then said: "I have great pleasure in declaring the new buildings of this college open"; and left the college, after receiving thanks from Lord Haldane.

RUSSIAN GEOGRAPHICAL PAPERS.

Lake Balkhash.—Mr. B. F. Meffert, who visited this lake during a journey in Russian Asia in 1910, has given an account of its basin in the *Izvestiya* of the Imp. Russ. Geogr. Soc., Nos. i.–v., 1912. The basin is intimately connected with those of the lakes Sasyk-kul, Ala-kul, and Ebi-nor. The rocks are chiefly Palæozoic and eruptive rocks of various ages. Deposits dating no further back than the Tertiary are rare, and occur only in the eastern part of the basin. At some time or other before the Tertiary period the Palæozoic rocks were folded in various directions, chiefly north-west and west. When the faulting and upheavals which formed the horsts and troughs of the Tarbagatai, Dzungarian Alatau, the Chu-Ili watershed, &c., took place is not known, but

in some parts they may be referred to the Tertiary period, and also the subsidence, at least of the western part of the basin, is probably of the same age. Mr. A. M. Nikolski has connected Balkhash with the Han-hai, not with the Turkestan basin, believing that the Han-hai with Balkhash was isolated before the separation of the Aralo-Caspian sea from the Siberian, and certainly no Aralo-Caspian deposits occur for some distance west of Balkhash. Marks of high water are found on the north-west of the lake 100 ft. above the present level, and therefore the lake must at one time have covered a large area to the south and east. According to Golubief, the lakes Sasykkul, Uyali, and Ala-kul formed one lake within the memory of man, and the difference of level between Ala-kul and Ebi-nor is only 25 ft. During last century there was a long period of desiccation, but for the last twenty years the lake has been rising. The water of the western part of the lake, into which the Ili pours considerable volumes, is quite sweet, but it is brackish in the small bays and channels.

Floral Regions of Siberia.—In the Bulletin of the Imp. Academy of Sciences in St. Petersburg, No. 14, 1912, Mr. N. I. Kuznetsof proposes a division of Siberia into floral regions, after discussing those of Ledebour, Korzhinski, and Tanfilyef. A line following the watershed between the Yenesei and Lena, approximately coinciding with geological and climatic boundaries, prolonged northwards to the watershed between the Khatanga and Anabara, and southwards to the mountains at the southern end of Lake Baikal, divides the principal regions into eastern and western parts. In the western section of the forest area arboreal species of the Altaic or western Mongolian centre prevail, in the eastern those of the Manchurian centre. Beyond the limit of arboreal vegetation determined by Siberian travellers, notably Middendorff, is the Arctic zone, its eastern part characterised by species and even families common to the Arctic regions and America, and also by representatives of the Alpine flora of the Stanovoi and Verkhoiansk ranges. Kamchatka and the Okhotsk coast down to the north of Sakhalin constitute a separate division, in which Altaic forms are absent, and peculiar species of trees, *Picea ajanensis, Abies nephrolepis,* and *Betula Ermanni,* occur. Foliage trees are seldom found in Siberia except in the Amur district, where Tertiary forms exist which perished in other parts of Siberia during the cold period contemporaneous with the Ice Age of Europe. The Alpine region is confined to islands and bare summits amidst the sea of coniferous forests, in the Verkhoiansk and other ranges. East of Lake Baikal *Pinus pumila* occurs, species which thrive on rocky peaks are few, and the flora passes at the north-eastern extremity of the Yablonovoi range into the Arctic flora. Lastly, there are two areas of steppe-lands, one in the west between the southern limit of the *taiga,* and the watershed between the Arctic ocean and the Aralo-Caspian depression, the other embracing the basins of the Shilka, Argun, and the Upper Amur, as far as Albazin.

Natives of Siberia.—According to Mr. S. Patkanof (*Zapiski* of the Imp. Russ. Geogr. Soc., Statistical Section, vol. xi., No. 1), the natives of Siberia number 870,536, of whom 442,459 are males. This sex generally preponderates, except in a few small tribes. The most numerous are the Buriats, who number 288,599. As regards governments, Yakutsk contains the largest number of natives, namely 235,623, and they constitute 87·5 per cent. of the total population. In Transbaikalia and Irkutsk they are also numerous, while they are few in the Amur province. There are, however, districts of Siberia where the natives are almost all the population. The other inhabitants of Siberia, chiefly Russians, number 4,889,633, so that the natives constitute only about 15 per cent. of the total population.

METEOROLOGICAL REPORTS AND SUMMARIES.

A USEFUL discussion of the cloudiness and sunshine of North America, by Mr. A. Gläser, is contained in *Aus dem Archiv der Deutschen Seewarte,* vol. xxxv., No. 1, based on published data from available sources. The subject is treated in considerable detail as regards time and place, and is illustrated by copious tables and diagrams. The few following points may be mentioned among the general features referred to. In the westward districts westerly winds bring most cloud, clear sky in summer being due to the higher saturation point of the air. Eastward of the Rocky Mountains the sky is clearer, but with northerly and southerly winds the spring is the most cloudy season. The winter barometrical minimum in the North Atlantic causes easterly winds in the eastern States, and these, mixing with the relatively warm air of the coast, produce a large amount of cloud. The high pressure in the south-east in autumn causes clear weather; in the south the greatest clearness occurs towards the end of winter. In the south-west of the United States and western Mexico the warm winds of the Gulf of California cause much cloud in summer; the clearest season is spring, and the dry northerly winds of the northern portions bring clear weather in autumn. The most bright sunshine is found in the south-west of the continent, and the least in the north-west and north-east, where the sun's power is naturally much weaker. In the region east of the Rocky Mountains there is comparatively little change in proceeding from south to north.

The Rev. L. Froc, S.J. (director of the Zi-ka-wei Observatory, near Shanghai), has issued the first part of a useful discussion of the rainfall in China during eleven years, 1900–10; the paper also includes data for a number of stations for shorter periods. Full particulars are given respecting the geographical position and surroundings of each station. In addition to the sums for individual months and years, and means for seasons and for the whole period, interesting details are given with reference to the variability of rainfall and unusual falls in the yearly, monthly, and daily periods, but the general discussion of the data and preparation of a rainfall map are reserved for the second part of the paper, to be published later on. It is remarked that the rainfall is not so excessive as in some neighbouring countries, *e.g.* the Philippine Archipelago. The following are among the heaviest of the yearly falls:—Hongkong, 2473 mm., in 1902; Fouchow, 2572 mm., in 1906; Sanchoei, 2760 mm., in 1907; Pakhoi, 2691 mm., in 1908; all in the south-east of China. The greatest daily fall was 320 mm. (12·6 in.) at Pakhoi. The diagrams show that in all districts the greatest rainfall occurs during the summer half-year.

The Commonwealth Central Weather Bureau has issued an average rainfall map of Tasmania, the fifth of the series showing the annual rainfall distribution of Australia. The most striking feature of the map is the great variation between the greatest and least average falls, viz. 17·9 in. at Beaufront, in the midland district, and 115·8 in. at Mt. Lyell, on the west coast. This coast is exposed to the moist westerly winds, and condensation is favoured by physiographic conditions, the result being a mean annual fall of 88·7 in. for the whole district generally. On the east coast the annual

mean is 32·7 in. For a large area (about 3000 square miles) no records are available.

The annual report of the meteorological observatory of the Government-General of Korea for the year 1911 (Dr. Y. Wada, director) contains valuable observations taken three times daily at ten stations, with carefully prepared summaries. Weather conditions and special occurrences are denoted by international symbols, and the instruments and methods of observation are similar to those at meteorological stations in Japan, and, consequently, are all that can be desired. The absolute maxima of air temperature ranged between 88·3° F. at Fusan and 92·8° at Chemulpo, both in August, and the absolute minima between −16·1° at Ping-yang and 15·3° at Mokpo, both in January. The yearly rainfall varied from 33·3 in. at Song-chin to 76·8 in. at Fusan. The largest amount of sunshine was 2642 hours, at Ping-yang, being 60 per cent. of the possible quantity.

A report on the Mariout district, by Mr. A. L. P. Weedon, in Nos. 72 and 73 of *The Cairo Scientific Journal*, is of much interest, both from an agricultural and from a meteorological point of view. The district, which consists of a long strip of land west of Alexandria, was in ancient times famous for its fertility, but at present it is for the most part barren and waste, barley being practically the only crop grown, in some parts only, and this is dependent on the somewhat precarious winter rains. The rainfall seems to differ but slightly from that of Alexandria, which averages 220 mm. (8·7 in.) per annum. The climate depends on the temperature of the Mediterranean and the general atmospheric circulation, and from numerous quotations from ancient and modern writers it is concluded that there is no reason to believe that either of those factors, or the rainfall, has changed since Roman times. The author states that the land is capable of producing more profitable crops in the hands of more efficient cultivators, who by the employment of scientific methods could either give it a better or more regular water supply, or make a better use of the existing moisture of the soil, *e.g.* by a system of dry-farming (economising the rainwater by digging trenches before the rainy season), assisted by wells and cisterns, many of which already exist.

The Austrian Meteorological Institute has published part v. of its valuable "Klimatographie" of that country, referring to the mountainous province of Salzburg. Climatologically, Salzburg belongs to the Central European district, but owing to the Alps it is subject to many marked modifications. The portion on the northern side of the limestone Alps, being exposed to the north and north-west winds, has a decidedly damp and rainy character, with the peculiarities of the West European climate. But between the limestone and central alpine chain lies a zone of a continental, dry character, with stagnant masses of air (*Luftseen*) in the valleys, in winter excessively cold, and relatively warm in summer. In the Lungau district, Salzburg participates in the rough, inhospitable climate of the upper Mur valley. The author, Dr. A. Fessler, adopts in the main this general subdivision of the climatic conditions in his elaborate discussion, dealing with each district in great detail, and with full consideration of the effects of aspect and altitude on temperature, rainfall, and climate generally. The discussion is based on observations made at stations connected with the Central Institute, but the author is handicapped by the paucity of data in many points of climatological importance; from this point of view Salzburg compares unfavourably with other alpine districts; complete observations for, say, twenty years and upwards only exist for comparatively few stations.

GREAT ADVANCE IN CRYSTALLOGRAPHY.[1]

CRYSTALLOGRAPHY has made such remarkable progress during the last few months, and the position at the present moment is so interesting, that it was considered opportune to review it in a discourse from this historic lecture-table.

Overwhelming evidence has now been brought forward that a crystal is endowed with a definitely organised structure.[2] In the crystal of a pure substance we are dealing with a chemical element or compound, and if with the latter it may be of any grade of complexity, from a very simple binary compound to a most highly complicated one composed of a large number of atoms. If the crystal be that of an element the structure is obviously composed of the similar atoms of that element, while if it be a compound we have a structure composed of atoms of as many kinds as there are chemical elements present combined in the substance, and in the same relative proportion as is expressed by the chemical formula of the substance. In the case of a compound, moreover, the structure may also be considered to be that of the molecules of the substance, for they or a simple arrangement of a small number (group) of them form the grosser units of the structure, whilst the atoms are the ultimate units.

Suppose we now represent this molecular or polymolecular grosser structural unit by a point, and that such point be analogously situated within each unit. The essence of crystal structure then is that these points are so arranged in space that if they are joined along the three directions of space by imaginary lines the latter form a "space-lattice" (German, "Raumgitter"), each unit cell of which may be conceived to be the "brick" already alluded to in the earlier part of the lecture, and the domicile of the chemical molecule or group of molecules (indeed, it is immaterial whether the points are considered as placed at the corners or in the centres of the cells) or, in the case of an elementary substance, of a group of similar atoms. We may, therefore, define a crystal as follows:—

"A crystal of any definite chemical substance consists of a homogeneous arrangement of grosser units of matter, each consisting of one chemical molecule or a small group of molecules of the substance, and the kind of arrangement is such that these grosser units are all identically (sameways, parallel-wise) orientated, and that their analogously chosen representative points, one from each such grosser unit, form a space-lattice (Raumgitter)."[3]

There are fourteen kinds of space-lattices, slides of several of which are exhibited on the screen. Three possess full cubic symmetry, two are tetragonal, four are endowed with rhombic symmetry, and two are monoclinic; while triclinic, trigonal, and hexagonal crystals have each one space-lattice corresponding to their type of symmetry. In every case it is the full (holohedral) symmetry of the system which is present, no space-lattice possessing merely the lower degree of symmetry corresponding to one of the so-called hemihedral or tetartohedral classes of the system in question.

Now in the solid crystal, not only are the grosser

[1] From a discourse delivered at the Royal Institution on Friday, March 14 by Dr. A. E. H. Tutton, F.R.S.

[2] This was very fully illustrated by numerous experiments during the first portion of the discourse.

[3] Since this lecture was delivered (March 14) and printed by the Royal Institution, a paper by Prof. Theodore W. Richards, of Harvard University, has appeared in the Journal of the American Chemical Society for April (vol. xxxv., p. 381), in which he shows that his theory of compressible atoms leads to "crystal units" of precisely the molecular or polymolecular character described in this lecture. He supposes such crystal units to be the entities necessary to relieve metastable supersaturation, and their centres to form the points of the crystal space-grating, assumptions with which the lecturer obviously fully concurs.

units arranged so that their representative points are repeated in space with extraordinary accuracy of position, with production of unit cells or "bricks" of absolutely identical dimensions throughout the crystal, but the shapes of the grosser units themselves are identically similar and identically similarly orientated in space. Suppose, however, that the force of crystallisation, the directive molecular force concerned in bringing the molecules together in this regular order of marshalling, is only adequate just to attain this marshalling of the grosser units into a space-lattice formation, without being able to fix the units about their own centres of gravity, a certain amount of wobbling about the latter being still permitted. We might, in such circumstances, expect that some of the properties of a crystal, dependent on the space-lattice formation on lines of definite symmetry, such as the optical properties of double refraction and polarisation of light, would be developed and exhibited, while the production of exterior plane faces would be either only partial, with rounded edges and the exhibition of plasticity and viscosity, or would not be achieved at all, the objects produced being still fluid. One cause of such a condition of partial success at crystallisation might well be that the substance was composed of a large number of atoms arranged in a long chain, such as the well-known "long chain compounds" of organic chemistry, which would offer considerable resistance to marshalling. The author believes that herein lies the explanation of the remarkable "liquid crystals" which Prof. Lehmann has made the subject of his particular study, many of which are of just such long-chain character.

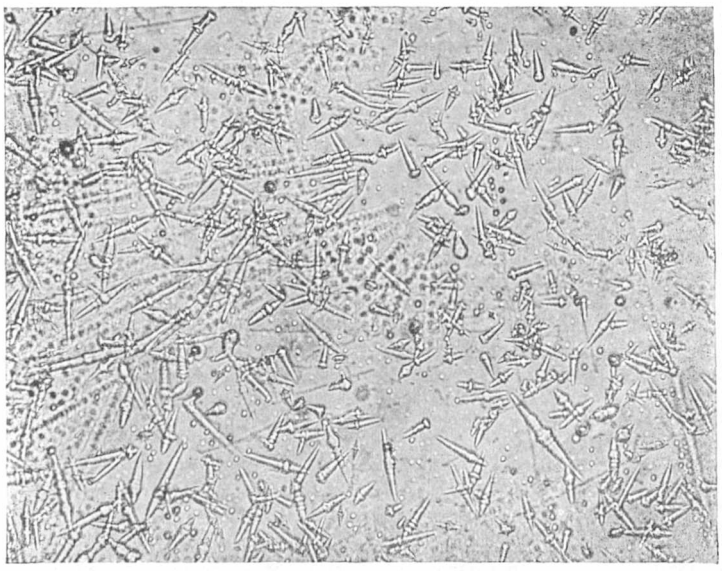

FIG. 1.—Liquid crystals of ammonium oleate.

By the kindness of Prof. Lehmann, who has sent over specimens of some of the most characteristic of his substances for the special purpose of this lecture, and of Mr. Poser, of Messrs. Zeiss, who construct an admirably convenient form of heating microscope and projection arrangement for demonstrating the formation of liquid crystals and their behaviour in polarised light, it is possible to exhibit some of the typical phenomena of these interesting objects on the screen. The substances in question are chiefly such as form two or more polymorphous forms, each stable within a limited range of temperature, and the liquid crystals are usually the second phase observed on allowing the truly liquid heated substance to cool; the liquid crystal phase is produced at a definite temperature during the cooling, and persists throughout a definite interval of temperature during the continued cooling.[4] The view here put forth is apparently in agreement with that of Lehmann himself, as most recently expressed both in letters to the lecturer and in a memoir of July 27, 1912, to the Heidelberg Akademie der Wissenschaften, in which he says that in all probability: "Die Rundung der Formen hänge zusammen mit der Plastizität der Stoffe und habe ihren Grund in unzureichender molekularer Richtkraft, welche wohl genügt, ein Raumgitter herzustellen, nicht aber regelmässige Treppenstufen, wie es nach Hauys Theorie zur Bildung ebener Krystallflächen nötig wäre." The formation of regular stepped faces (of invisibly minute steps, "Treppenstufen") the lecturer considers to occur only when the grosser units become fixed about their centres of gravity or representative points, with production of a truly solid crystal.

But now let us pass to the consideration of the internal structure of the grosser or space-lattice units themselves. Their symmetry may be, in simple cases, similar to that of the space-lattice, but in general this will not be so. Whatever the stereometric arrangement of the chemical atoms in the molecule may be, and, if more than one molecule goes to form the space-lattice unit, whatever their mutual arrangement, and therefore whatever be the outer configuration of the whole unit, when the crystal is a truly solid one, the force of crystallisation (now no longer denied) is adequate to fix each space-lattice unit, not only considered as a point with reference to its neighbours, but as regards its shape and its whole character, parallelwise and sameways orientated with respect to its adjacent fellows, and as close as possible to them. Also, if more than one molecule goes to each space-lattice unit, their mutual arrangement is achieved on a definite plan, and is the same for every space-lattice unit; these constituent molecules of the latter are also as closely packed as possible. The final result is thus to produce an assemblage of chemical atoms in which not only the demarcation frontier between the space-lattice units disappears, but also that between the constituent molecules in the cases of polymolecular grosser units. We come, ultimately, in consequence, to a structure of atoms each of which we may represent by a point.

Now, just as the genius of Frankenheim and Bravais revealed to us the fourteen kinds of space-lattices, so Sohncke made us acquainted with sixty-five regular systems of points, including many of the thirty-two classes of symmetry, but not all, which von Lang had shown crystals to be capable of possessing. Later the number was brought up to 230 by simultaneous and wonderfully concordant geometrical researches by Schönflies in Germany, von Fedorow in St. Petersburg, and Barlow in England, and among these 230 all the thirty-two crystal classes are represented, and no others.

Hence, we come to the conclusion that the skeletal framework of crystal structure is the molecular or polymolecular space-lattice, and the detailed ultimate

[4] Ammonium oleate (Fig. 1), para-azoxyanisol, para-azoxyphenetol, and cholesteryl acetate were illustrated on the screen.

structure the atomic point-system. The latter determines the class of symmetry (which of the thirty-two classes is exhibited), and therefore governs any hemihedrism or tetartohedrism, as the development of less than full systematic symmetry used to be called. But it is the space-lattice which governs the crystal system, that is, which determines whether the symmetry is cubic, tetragonal, rhombic, monoclinic, triclinic, trigonal, or hexagonal, and also determines the crystal angles and the disposition of faces in accordance with the law of rational indices, the law which limits the number of possible faces to those which cut off small whole-number relative lengths from the crystal axes. Indeed, it is because only those planes

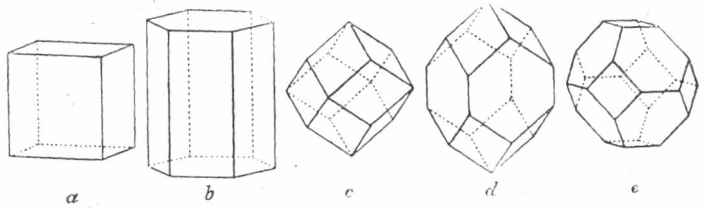

FIG. 2.—Fedorow's types of parallelohedra.

which contain the points of the space-lattice are possible as crystal faces that the law of rational indices obtains. For any three points of the space-lattice determine a plane in which similar points are analogously regularly repeated, and which is a possible crystal face obeying the law of rational indices. Moreover, those facial planes which are most densely strewn with points are of the greatest crystallographic importance, being what are known as the primary faces, either parallel to the crystal axes or cutting off unit lengths therefrom, as well as being usually the planes of cleavage.

As the space-lattice units are all sameways orientated, any one atom of the molecular or polymolecular grosser unit might be equally well chosen as the representative point of the lattice, so long as a similar choice were made in every space-lattice unit, and the resulting space-lattice would be the same whichever atom were so selected. Consequently, the space-lattice is afforded by the similarly (identically) situated atoms of the same chemical element throughout the crystal structure. The combined point-system (one of the 230 possible point-systems) may thus be considered to be built up of as many identical but interpenetrating space-lattices as there are atoms in the space-lattice grosser unit. These facts are concisely expressed in the definition of crystal structure which was stated as follows by Prof. von Groth at the Cambridge meeting of the British Association in 1904:—

"A crystal—considered as indefinitely extended—consists of *n* interpenetrating regular point-systems, each of which is formed from similar atoms; each of these point-systems is built up from *n* interpenetrating space-lattices, each of the latter being formed from atoms occupying parallel positions. All the space-lattices of the combined system are geometrically identical or are characterised by the same elementary parallelepipedon."

Having thus arrived at a comprehensive idea of crystal structure on the assumption of each atom and each grosser space-lattice unit being only a point, as far as which we are on safe and assured ground, we may proceed to the consideration of the various ideas advanced concerning the character of the units of structure thus represented by points; that is, concerning the mode in which the space around the point is more or less filled up.

The valency theory of Barlow and Pope considers the atomic point to be expanded into the sphere of the atom's influence, the relative size of which in any one substance is supposed to be proportional to the fundamental valency of the chemical element of which the atom is composed. The spheres are further assumed to be pressed together on crystallisation until they fill space, becoming thereby deformed into polyhedra. The theory of von Fedorow, on the other hand, considers the grosser or space-lattice units to be parallelohedra; besides those corresponding to the fourteen space-lattices there are nine other parallelohedra (making twenty-three in all) composed of simple Sohnckian point-systems compounded of interpenetrating space-lattices. All the twenty-three parallelohedra are arranged parallelwise, and fill space without interstices. There are, however, only four types, namely the cube, the rhombic dodecahedron (which has a second vertically elongated variety), the cubo-octahedron, and the hexagonal prism, the first three being all of cubic symmetry, and the fourth of obviously hexagonal symmetry. They are shown, including the second variety of the dodecahedron, in the next screen picture (Fig. 2). He further considers that all four may be homogeneously deformed into analogous parallelohedra of lower orders of symmetry, without ceasing to fill space when closely packed. Hence, von Fedorow concludes that all crystal structures are of either cubic or hexagonal type, including not only truly cubic and hexagonal crystals, but their deformed derivatives.

Unlike the atomic polyhedra of Pope and Barlow, these parallelohedra of von Fedorow are either molecular or polymolecular, in the latter event being made up of a small number of identically or symmetrically similar subpolyhedra, termed by him "stereohedra," which represent the chemical molecules, just as already explained, when the grosser space-lattice unit is polymolecular, the stereohedra being arranged to build up

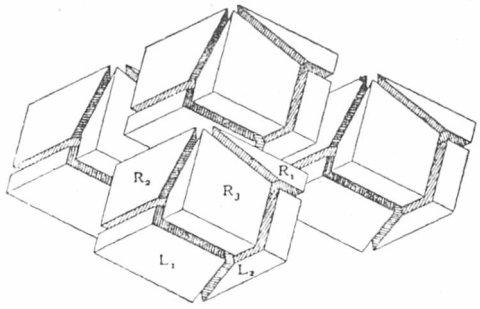

FIG. 3.—Fedorow's stereohedra.

the main parallelohedron (the space-lattice unit) on a definite plan, which may involve mirror-image juxtaposition. For example, a rhombohedral system of stereohedra is shown on the screen (Fig. 3), consisting of two kinds, R and L, one sort being the mirror-image of the other. Each rhombohedron representing the combined system is composed of six stereohedra, three of each kind, and a series of points, similarly situated one within each stereohedron R, would constitute a Sohncke point-system, while a "double-system" is obtained by adding a series similarly situated one within each stereohedron L. If a single point were taken to represent analogously each rhombohedral set of six stereohedra, we should have a rhombohedral space-lattice produced.

The valency theory of Barlow and Pope may or may not in the sequel prove to be correct, and some

facts have recently been brought forward by Barker which tend to show that it will not hold in many cases of inorganic substances. Barker, who has had the good fortune to have worked in St. Petersburg with von Fedorow for more than a year, shows that, as the lecturer has always held, the true unit of volume is the molecular or atomic volume, as determined for the particular substance itself. The molecular volume is determinable by dividing the molecular weight of the substance by the specific gravity of its crystals at a definite comparable temperature, such as 20° C., but the determination of the atomic volume offers peculiar difficulty, and so far only comparative and indirect methods have been employed, chiefly by Sollas. By taking the volumes of the spherical units to be proportional to the atomic volumes (not those of the element in the free state, as enormous compression occurs on combination), and also determining the amount of free interstitial space by comparative methods of calculation, Sollas has achieved some remarkable explanations of the crystallographic characters of the two polymorphous forms of silver iodide and of the three forms of titanium dioxide, rutile, anatase, and brookite. It would not be surprising if the valency volumes of Barlow and Pope, in the cases of those elements for which their theory appears to work in a satisfactory manner, turn out to be identical with the atomic volumes as determined by the method of Sollas. As regards the compounds of carbon and hydrogen, Barlow and Pope have been most successful in accounting for crystallographic and chemical relationships, and it is at least significant that both Le Bas, from experimental work on the molecular volumes of liquid hydrocarbons, and Traube from an entirely different point of view, concur in assigning the relative volumes 4 and 1 to carbon and hydrogen atoms in combination respectively. If Traube's results for carbon and hydrogen be acccepted, so must also those for the relative volumes of the atoms of the halogens, sulphur, oxygen, and nitrogen, his values being: F=1; Cl, Br, and I=7 each; S=6; O=2; and N=3. As regards oxygen and nitrogen, he agrees with Barlow and Pope, but the latter take all the halogens as of unit valency volume, and sulphur as of valency volume 2. Barker shows that while in the binary sulphides, such as zinc sulphide ZnS, the sulphur is probably of volume 2, in the sulphates, such as K_2SO_4 and $BaSO_4$, it is probably 6, as Traube insists; this conclusion is also in agreement with other work of Barker on some extraordinary cases of isomorphism, including that of barium sulphate with potassium perchlorate $KClO_4$, potassium permanganate $KMnO_4$, and the extraordinary compound potassium borofluoride KBF_4.

While it would thus appear that the atomic volume (in the substance itself, and including any interspace) is the true effective volume concerned in crystal structure, and that it may be only a coincidence that, in the cases of a few prominent elements, it happens to be approximately proportional to the valencies of those elements (as certainly appears to be true in the cases of hydrogen and carbon, and possibly oxygen and nitrogen), there is a very considerable amount of the joint work of Barlow and Pope which is of permanent value. Their explanations of the preponderating cubic and hexagonal crystalline forms of the elements themselves, and of binary compounds such as ZnS, are doubtless correct, and it will be of great interest, in view of the next development to which attention must be directed, to illustrate the case of zinc sulphide.

Barlow and Pope's idea of the structure of zinc blende, which merely assumes that the volumes of the atoms of zinc and sulphur are approximately equal, is that sixteen molecules ZnS go to form the grosser unit of the crystal structure, the combined system or space-lattice unit—that is, sixteen atoms of zinc and sixteen of sulphur. Only one zinc or one sulphur atom in every sixteen is sameways orientated, and if we adopt von Groth's definition, we may give the structure of zinc blende as follows:—The crystals of zinc blende consist of two interpenetrating regular point-systems, one formed from zinc atoms, and the other from sulphur atoms; each of these two point-systems is built up from sixteen interpenetrating space-lattices, each of the latter being formed from zinc atoms or from sulphur atoms occupying parallel positions. All the thirty-two space-lattices of the combined system are geometrically identical.

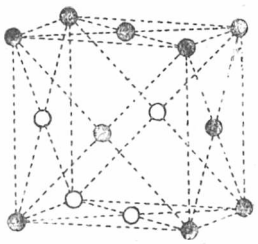

FIG. 4.—Space-lattice of centred-face cube.

Barlow and Pope have shown that the space-lattice in zinc blende is the third cubic one, in which a point is situated at each cube corner and also in the centre of each cube face. For this is the space-lattice corresponding to an assemblage of spheres of equal volume in closest packing. The space-lattice in question is shown on the screen (Fig. 4), and a pair of models of the arrangement are illustrated in the next two pictures, in the first of which the points are expanded into spheres of considerable size, and in the second they appear still further expanded into actual contact. The third stage, in which the expansion proceeds until all interstices are filled up and the spheres are converted into polyhedra, is left to the imagination. In the second picture (reproduced in black and white in Fig. 5) the mutual arrangement

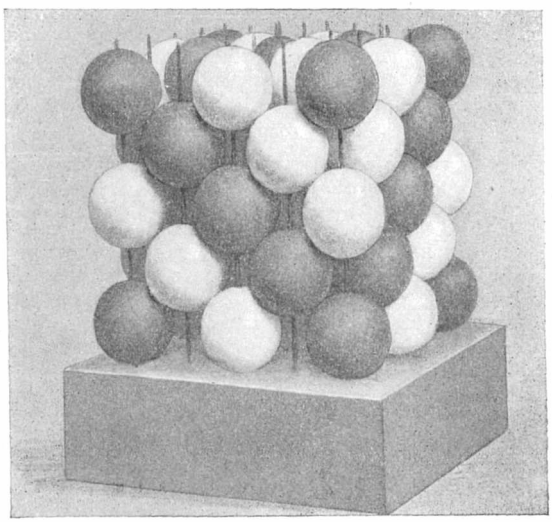

FIG. 5.—Model of arrangement of zinc atoms (shaded) and sulphur atoms (light) in zinc blende.

of the spheres of the two elements in zinc blende, zinc and sulphur, is indicated by the yellow colouring of the sulphur spheres and the grey tinting of those of zinc. The tetrahedral mode of derivation of the structure, accounting for the observed hemihedrism, is also shown in another slide (Fig. 6). The eight larger cubes which together form the grosser unit are each supposed to be occupied by four smaller cubes of the same element, arranged tetrahedrally, and of zinc and of sulphur alternately in different

larger cubes; on replacing the little cubes by spheres in contact the model represented in the second picture (Fig. 5) is produced.

Now this crystalline mineral, zinc blende, has been chosen advisedly as an example of crystal structure. For a remarkable series of experiments have recently been carried out by Laue, Friedrich, and Knipping at Munich, where the lecturer had the advantage of seeing some of the first photographic results last summer. In these experiments X-rays were passed through crystals of various substances, notably zinc blende, and, in more recent experiments by Laue at Zurich,

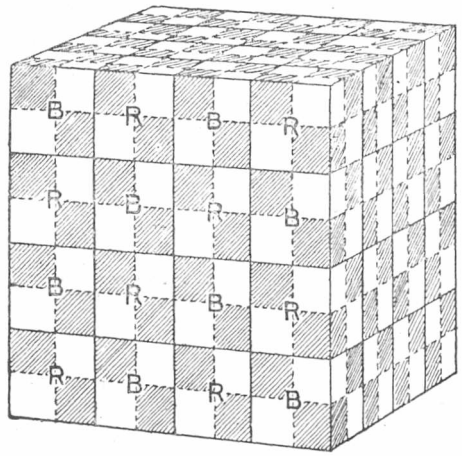

FIG. 6.—Scheme of tetrahedral arrangement of zinc (B) and sulphur (R) atoms in zinc blende. Unshaded cubes unoccupied.

quartz. The issuing rays were received on a photographic plate, on which they recorded a pattern of spots having the symmetry (full holohedral) of the space-lattice present as the foundation of the crystal structure. These interesting photographs thus afford the first experimental and visible proof of the truth of the structure assigned to crystals by geometricians and crystallographers.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the annual Degree Congregation the degree of Doctor of Science was conferred on the following:—E. E. Fournier d'Albe, Hamilton McCombie, George William Todd, and Donald Levy. The occasion was also marked by the unveiling of a fine portrait of the Chancellor (the Right Hon. Joseph Chamberlain), the generous gift of Mrs. Chamberlain, "as a token of my own interest in all that concerns the University, and my earnest hope that future generations will see it develop into all that its founders dreamed of when it was established."

EDINBURGH.—The honorary degree of LL.D. was conferred on July 4 by the University on Mr. H. A. L. Fisher, Vice-Chancellor of the University of Sheffield; Emeritus Professor Greenfield; Sir James Guthrie; Lord Justice Hamilton; Mr. John Stewart, Nova Scotia; Prof. F. Strassmann, Berlin; Prof. J. Arthur Thomson; the Hon. James Wilson, Washington, U.S.A.; and (*in absentia*) Prof. Thomas Gilray, University of Otago, N.Z.

Prof. C. G. Barkla, F.R.S., professor of physics in the University of London (King's College), has been appointed to the vacant chair of Natural Philosophy, in succession to the late Prof. J. G. MacGregor.

PROF. J. W. JUDD, C.B., F.R.S., has been appointed emeritus professor of geology in the Imperial College of Science and Technology by the council of the college.

MR. ANDREW CARNEGIE has intimated to M. Liard, Vice-Rector of the University of Paris, that he will give 4000*l.* towards the construction of the new chemical institute which is being erected in the Rue Pierre-Curie, Paris.

DR. L. H. BAILEY, widely known as the chairman of President Roosevelt's commission on country life, has resigned the post of head of the New York State College of Agriculture, Cornell University, after a tenure of ten years. He has held the professorship of agriculture at Cornell since 1883. Dr. Bailey is resigning in order to secure more time for research.

AMONG recent Irish appointments we notice that Prof. Gregg Wilson, professor of zoology in Queen's University, Belfast, has been appointed a member of the first Senate of the University in succession to the late Prof. John Park. Mr. Edgar H. Harper has been appointed professor of mathematical physics in University College, Cork, and Mr. E. W. Hoare lecturer in veterinary hygiene in the same college.

RECENT changes at Johns Hopkins University include the promotion of Dr. J. E. Gilpin, now associate professor of chemistry, to be collegiate professor, and of Mr. E. W. Berry, now associate in palæobotany, to be associate professor of palæontology. Prof. D. S. Johnson is appointed to the directorship of the botanical laboratory and the botanical garden, and Prof. Burton E. Livingston to the directorship of the laboratory of plant physiology.

COLUMBIA UNIVERSITY and Rutgers College receive bequests which may amount to 200,000*l.* each as principal beneficiaries under the will of Mrs. Mary B. Pell, the widow of John H. Pell. *Science* states that each beneficiary received a direct bequest of 40,000*l.* and an interest in large trust funds amounting to more than 400,000*l.* The fund for Columbia is to erect Pell Hall, in memory of the late Mr. Pell, who was a student of Columbia. From the same source we learn that Princeton University has received 20,000*l.* from Mrs. Russell Sage toward the construction of a dining-hall; and that the College of Agriculture of Cornell University has received a State grant of 90,000*l.*, and a grant of 14,000*l.* for the veterinary college. A part of the additional grant this year is to be used for increasing salaries.

RECENT correspondence between the Maharaja of Darbhanga, who is at the head of the movement to create a Hindu University in India, and Sir Harcourt Butler, the education member of the Governor-General's Council, has, we learn from *The Times*, been published. The Maharaja points out that the subscriptions promised amount to more than 533,333*l.*, of which about 140,000*l.* has been received. Taking into account the capital value of certain grants of property and annual payments in perpetuity granted by three ruling chiefs, he estimates the amount in hand, or which may be safely taken as already in hand, to be not far short of 400,000*l.*, exclusive of the value of the Central Hindu College at Benares. He claims that a good case had been made out financially for the Government to take into consideration the legislation necessary for bringing the University into being. Sir Harcourt Butler has replied that the matter is still under consideration; but he thinks it will be of assistance to the promoters to know the conditions which the Government of India regards as precedent to the introduction of any scheme. These are the provision of a suitable site; the transfer of the Central Hindu College to the University; and the

collection of not less than 333,333*l*. In this amount may be included the capitalised value of the property mentioned by the Maharaja, and the perpetual grants by three ruling chiefs, provided that the documentary title is satisfactory in the case of the latter, and the possession of the property has been made over in the case of the former. The further conditions are that the constitution of the University should proceed on lines to be indicated by the Government, and that a committee be appointed to report whether the Central Hindu College is fit to be developed into a residential and teaching university.

THE unusual increase in the number of women attending German universities, as shown by statistical returns recently issued in Germany, is of particular interest in view of the fact that women were only admitted as students in the summer of 1905. A note in the issue for July 4 of the Journal of the Royal Society of Arts states that during 1912 the number of women students in German universities has grown from 2795 to 3213, and the percentage of women now in the universities, as compared with the whole student body, is 5·4 per cent., as against 2·7 per cent. three years ago. Of the present body of women students the great majority—2900—come from Germany. Of the foreign women, Russia furnishes more than a third, America about a fourth, and other European countries most of the others. Few women students come from Asia, Africa, or Australia. The University of Berlin alone has more than one-fourth of the total women students of the Empire, the exact number of women in the large universities at present being:—Berlin, 904; Bonn, 289; Munich, 262; Göttingen, 237; Heidelberg, 219; Freiburg, 189; Münster, 172; Breslau, 150; Leipzig, 129; Marburg, 126; Königsberg, 107; Greifswald, 83; Halle, 81; Jena, 65; Strassburg, 52; Kiel, 40; Tübingen, 38; Giessen, 24; Erlangen, 21; Würzburg, 16; Rostock, 6; all others, 3. The departments of study to which the women students give preference are about the same as in former years, the enrolment in certain courses being:—Medicine, 702; mathematics and natural sciences, 579; economics and agriculture, 91; dentistry, 17; and pharmacy, 8.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 26.—Sir Ronald Ross, K.C.B., vice-president, in the chair.—F. S. **Phillips**: Phosphorescence of mercury vapour after removal of the exciting light.—Dr. G. J. **Burch**: Light sensations and the theory of forced vibrations.—P. W. **Burbidge**: The fluctuation in the ionisation due to γ rays.—J. G. **Leathem**: The force exerted on a magnetic particle by a varying electric field.—Dr. W. **Watson**: The luminosity curve of a colour-blind observer.—Prof. W. M. **Hicks**: A critical study of spectral series. Part iii.: The atomic weight term, and its import in the constitution of spectra.—L. C. **Martin**: A band spectrum attributed to carbon monosulphide. A complex band system occurring in the spectrum of the electric discharge through carbon disulphide vapour in addition to the bands due to sulphur, is also found in the spectrum given by sulphur in the carbon arc. These bands only occur in the presence of both sulphur and carbon, and are probably due to carbon monosulphide.—Igerna B. J. **Sollas** and Prof. W. J. **Sollas**: The structure of the skull of Dicynodon as revealed by serial sections. The structure of the skull has been demonstrated in a remarkably complete manner by reconstructions built up from serial sections. A single example has afforded nearly all the information which has been slowly accumulated from numerous specimens during the past half-century and has added the following facts, which are either new or were in need of confirmation:—(1) The vomer is grooved on its dorsal surface; (2) the basis cranii is continued forwards between the orbits as a median vertical plate, which lies in the groove of the vomer, and is itself grooved on the dorsal surface to receive the ventral edge of the mesethmoid; (3) the form of the mesethmoid is such as to suggest that it is an early stage in the formation of a cribriform plate; (4) septo-maxillary bones are present, lying within the internal nares without appearing on the face. They are not connected by suture with neighbouring bones and might easily be lost in fossilisation; (5) the preparietal bone is present, situated entirely in front of the pineal foramen and forming its anterior border; (6) a transverse bone exists, clearly marked off from the neighbouring bones by sutures; (7) the root of the tusk, invested by a thin layer of the maxillary bone, lies in a large cavity, to the walls of which the maxillary, lachrymal, jugal, and palatine bones contribute; (8) the sutures separating the pro-otic from neighbouring bones are clearly exhibited; (9) the labyrinth of the ear shows all the three canals with their ampullæ and a long vestibule; (10) the articular surface of the lower jaw is complex, there is a small inner portion which is concave—as in reptiles, and a large outer portion which is convex—as in mammals.—W. **Cramer** and R. A. **Krause**: Carbohydrate-metabolism in its relation to the thyroid gland. The effect of thyroid feeding on the glycogen content of the liver and on the nitrogen distribution in the urine.—Dr. G. W. C. **Kaye** and D. **Ewen**: The sublimation of metals at low pressures.—Dr. R. T. **Beatty**: The energy of Röntgen rays.—Dr. C. **Chree**: Some phenomena of sun-spots and of terrestrial magnetism. Part ii. The paper is a continuation of one termed for brevity S.M., which appeared in the Phil Trans., A. 212, p. 75. It is mainly devoted to the question of the existence of a period of approximately twenty-seven days in terrestrial magnetic phenomena. Independent studies of magnetic storms during a very long period of years at Greenwich and Toronto led Mr. Harvey and Mr. Maunder a good many years ago to the conclusion that an interval of about twenty-seven and a quarter days could be recognised between the commencements of successive magnetic storms in a greater number of cases than could reasonably be ascribed to pure chance. S.M. showed that whether one took the daily range of horizontal force at Kew, or the magnetic character of the day, there undoubtedly existed for the epoch 1890 to 1900 a period of twenty-seven days or slightly more, in the sense that if an individual day were highly or moderately disturbed, days twenty-seven or twenty-eight days later were on the average more disturbed than usual. The result was not peculiar to the large disturbances usually termed "magnetic storms," and appeared in all the years examined, whether quiet or disturbed. The present paper finds the same result to hold true of the years 1906 to 1911 when use is made of the magnetic "character" figures which have been published since 1906 at de Bilt, under international auspices. It is also found that the result is as true of quiet as of disturbed characteristics. The paper also investigates whether the phenomena presented by the twenty-seven-day period vary with the period of the year, and what the relationships are, if any, between magnetic "character" and Greenwich measures of sun-spot area and faculæ and Wolfer's sun-spot frequencies. The apparent sun-spot relationships are found to vary a good deal from year to year.—A. **Fowler**: New series of lines in the spark spectrum of magnesium. From experiments on the spectrum of the magnesium arc *in vacuo*, it has been

found that there are seven lines which are associated with the well-known spark line 4481·35, their wave-lengths being 3104·91, 2661·00, 2449·68, 2329·68, 2253·94, 2202·75, and 2166·35. The eight lines, taken alternately, fall into two series having their common limit at 49776 on the frequency scale. The series are analogous to the two principal series of hydrogen lines, which have recently been investigated by the author.—A. **Fowler** and W. H. **Reynolds**: Additional triplets and other series lines in the spectrum of magnesium. The paper gives particulars of eight new triplets which have been photographed in the ultra-violet spectrum of magnesium, and improved wave-lengths for some of the lines previously recorded. The Rydberg series of single lines has also been extended, and four strong solar lines of previously unknown origin have been identified with lines of this series. Attention is also directed to a probable second subordinate series of single lines. Formulæ representing the various series are given.—W. E. **Curtis**: A new band spectrum associated with helium. The paper describes a new band spectrum observed under certain conditions in vacuum tubes containing helium and hydrogen. The experiments suggest that the bands are due to helium, but until hydrogen can be more completely eliminated their origin cannot be regarded as definitely settled.—Sir W. de W. **Abney** and Dr. W. **Watson**: A case of abnormal trichromatic colour vision due to a shift in the spectrum of the green sensation curve.—Dr. E. F. **Armstrong** and Prof. H. E. **Armstrong**: Studies on the processes operative in solutions (XXX) and on enzyme action (XX). The nature of enzymes and of their action as hydrolytic agents.—Prof. H. E. **Armstrong** and H. W. **Gosney**: Studies of enzyme action. XXI. Lipase. III.—Prof J. S. **Macdonald**: Studies in the heat production associated with muscular work. Preliminary communication.—Prof. F. **Keeble**, Dr. E. F. **Armstrong**, and W. N. **Jones**: The formation of the Anthocyan pigments of plants. Part vi.—T. Graham **Brown**: The question of fractional activity ("All or None" phenomenon) in mammalian reflex phenomena.—J. H. **Andrew** and Dr. A. **Holt**: The thermal effects produced by heating and cooling palladium in hydrogen.—Hon. R. J. **Strutt**: A peculiar form of low potential discharge in the highest vacua.—A. **Mallock**: Note on copying machinery.—W. **Wahl**: The relation between the crystal-symmetry of the simpler organic compounds and their molecular constitution. Part ii.—G. A. **Shakespear**: Experiments on the temperature coefficient of a Kew collimator magnet.—W. **Jevons**: Spectroscopic investigations in connection with the active modification of nitrogen. III.: Spectra developed by the tetrachlorides of silicon and titanium.—Lord **Rayleigh**: The passage of waves through fine slits in thin opaque screens.—Prof. W. H. **Bragg**: The reflection of X-rays by crystals. II. In a previous communication (April, 1913) it was shown that the wave-lengths of homogeneous pencils of X-rays could be expressed accurately in terms of the space relations of a crystal. The formula $\lambda = 2d \sin\theta$ connected the wave-length λ with θ, the glancing angle at which the pencil was reflected in the crystal face, and d the distance between parallel reflecting planes. The angle θ could be determined with accuracy, but want of exact knowledge of crystal structure threw difficulties in the way of a complete evaluation of wave-length. W. L. Bragg, using two independent methods of research (those of the Laue diagram, and of reflection in the crystal face), has shown that in all probability the value of d is $2{\cdot}81 \times 10^{-8}$ cm. From this it follows that the wave-length of the "B peak" is $1{\cdot}10 \times 10^{-8}$. Characteristic radiations having wave-lengths $1{\cdot}25 \times 10^{-8}$ and $1{\cdot}66 \times 10^{-8}$ are emitted by bulbs having antikathodes of tungsten and nickel respectively. So far as it has been found possible to measure the absorption coefficients, they belong to rays which are characteristic of the antikathode metals, and the quantum energy—Planck's constant multiplied by frequency—agrees well with the energy of the kathode ray which, according to Whiddington, is required to excite the X-ray, or which the X-ray can excite.—W. L. **Bragg**: The structure of some crystals as indicated by their diffraction of X-rays. An analysis of the Laue diagram of sylvine (KCl) shows that the diffracting centres are arranged on a space-lattice of the simplest cubical form. The diagrams of potassium iodide and bromide show that the diffracting centres are arranged on a lattice the element of which is the face-centred cube. Sodium chloride is an intermediate case. From this and other features of the diagrams, it is concluded that in all these crystals the atoms of metal and halide are arranged in a simple cubic lattice, rows parallel to the axes containing alternate atoms of either kind. In sylvine the equal weights of the atoms render them equally efficient as centres; in KBr and KI the heavy halogen atoms alone act, and so the pattern is characteristic of the face-centred cube lattice. The diagrams of other crystals are discussed in reference to these conclusions. By means of the X-ray spectrometer, described in a previous paper, the dimensions of these lattices can be accurately compared; and the relative magnitudes of the different orders of spectra reflected from any face, and from different crystals, yield information which confirms the above conclusions. It also appears that the weight associated with each point of the lattice is proportional to the molecular weight of the substance. These conclusions yield the necessary information for the accurate calculation of the wave-length of the X-ray.—Leonard **Hill**, J. M. **McQueen**, and W. W. **Ingram**: The resonance of the tissues as a factor in the transmission of the pulse and in blood pressure.—G. F. **Davidson**: Experiments on the flow of viscous fluids through orifices.

Linnean Society, June 19.—Prof. E. B. Poulton, president, in the chair.—E. G. **Baker**: African species of the genus Crotalaria. Short descriptions are given of the 309 species known to the writer as occurring in Africa. These are arranged in the following groups:—Simplicifoliæ, 39; Sphærocarpæ, 65; Chrysocalycinæ, 7; Farctæ, 5; Spinosæ, 3; Eucrotalaria, subdivision Grandifloræ, 29; subdivision Mediocrifloræ, 61; subdivision Parifloræ, 49; subdivision Oliganthæ, 33; subdivision Stipulosæ, 18. The genus Crotalaria is allied to Lotononis, and it is generally easily distinguishable by the rostrate carina.—Dr. W. T. **Calman**: Aphareocaris, nom. nov. (Aphareus, Paulson), a genus of the Crustacean family Sergestidæ.—Dr. Agnes **Arber**: An anatomical study of the cone-genus Lepidostrobus.—G. H. **Wailes**: Freshwater Rhizopoda from North and South America. During the year 1912 gatherings from the States of New York, New Jersey, and Virginia provided records of twenty-four species and varieties of Rhizopoda, in addition to those enumerated in the paper read before the society in April, 1911. A number of gatherings received from Mr. James Murray and collected by him from various places on the east and west coasts of South America were examined, and provided records of seventy-five species and varieties of Rhizopoda, including three now described for the first time.—C. **Bucknall**: A revision of the genus Symphytum.—S. **Kemp**: Pelagic Crustacea Decapoda of the Percy Sladen Expedition in H.M.S. *Sealark*.

PARIS.

Academy of Sciences, June 30.—M. P. Appell in the chair.—Paul **Sabatier** and M. **Murat**: The preparation

of several diphenylpentanes and some corresponding di*cyclo*hexylpentanes. Three of the eighteen possible isomeric diphenylpentanes have been prepared, and these have been transformed by direct addition of hydrogen in presence of nickel into the corresponding di*cyclo*hexylpentanes, the physical constants of the latter being given.—M. de **Forcrand**: The hydrates of uranic anhydride and the heat of formation of uranyl nitrate.—R. **Lépine** and M. **Boulud**: The diminution in chlorides in urine secreted under pressure. Additional experiments confirming results published in previous papers.—M. **Arnaud**: Astronomical refraction under any angle whatever. In a previous communication a formula for refraction was given and the integration solved for the particular case of horizontal refraction. In the present paper this is extended, and practical formulæ deduced giving an accuracy of 0·1″.—A. **Korn**: Integral equations with asymmetrical nucleus.—Ed. **Sarasin** and Th. **Tommasina**: A new study of the Volta effect made with the aid of the induced radio-activity.—Pierre **Weiss**: The magnetic fields obtained with an electromagnet furnished with ferro-cobalt pole-pieces. By the use of ferro-cobalt pole-pieces in place of soft iron an increase of about 5 per cent. in the strength of the magnetic field is obtained, the ampere turns remaining constant.—C. **Chéneveau**: The optical properties of water and its physical constitution. The variations in the optical constants of water with temperature are in agreement with the hypothesis that liquid water is a mixture of two isomers, in proportion varying with the temperature, and possessing properties depending only slightly or not at all on the temperature.—M. **Guéritot**: A thermo-electric manoscope of great sensibility. A portion of the air in a tube connecting two reservoirs is continuously heated near a bend constituting the highest point of the system. The slightest motion of this heated air is shown by a thermo-couple; a displacement of gas amounting to only a tenth of a cubic millimetre is shown. Various applications of the apparatus are indicated.—Keivin **Burns**: A displacement of the lines of the spectra of certain metals produced by the presence of another metallic vapour. The cases of barium in an iron arc, manganese in an iron arc, and cadmium in a mercury arc have been studied, and it has been found that the lines of the metal present in small proportion are displaced by the vapour of the predominating metal (iron, mercury). This effect may account for some differences proved to exist between wave-lengths found in the arc and in the sun.—L. **Gay**: Adiabatic expansion in liquids. Data are given for the coefficient of adiabatic compressibility of eight liquids at 0° C. and at room temperatures.—Victor **Henri**: Chemical lability and absorption of the ultra-violet rays. Experimental results are cited in support of the proposition that bodies of which the molecules are labile, or which enter easily into reactions, absorb the ultra-violet rays strongly.—Witold **Broniewski**: The thermo-electricity of steel. It is shown that the thermo-electromotive force may give indications of the critical points of steels with equal or higher precision than the other methods in current use.—N. D. **Costeanu**: The action of carbon dioxide upon mineral sulphides. The sulphides of silver, copper, cadmium, bismuth, and antimony undergo no change when heated in a current of carbon dioxide; silicon sulphide gives carbon monoxide, sulphur, and silica under the same conditions.—P. **Lebeau** and A. **Damiens**: The composition of the gaseous mixtures resulting from the action of water upon the carbides of uranium and thorium. The method previously described by the authors for the analysis of complicated hydrocarbon mixtures, based on the use of low temperatures, has been applied to the analysis of the gases arising from the decomposition of uranium and thorium carbides by water. Five complete analyses are given.—Daniel **Berthelot** and Henry **Gaudechon**: The preparation of carbon oxycyanide. This substance is produced by the action of the silent discharge on a mixture of carbon monoxide and cyanogen.—André **Meyer**: The azoic colouring matters derived from phenylisoxazolone.—Léo **Vignon**: The composition of water-gas. A small proportion of methane appears to be normally present in water-gas; the amount of this gas is shown to increase with the amount of lime present in the coke.—J. **Clarens**: The existence of bromites. Evidence is adduced in support of the existence of a bromite in a solution of a hypobromite which has been heated for a short time to 80° C.—L. **Daniel** and J. **Delpon**: A grafted hybrid between the peach and the almond.—P. **Choux**: The genus Baseonema at Madagascar.—H. **Devaux**: The pressure of the air in the lacunæ of aquatic plants. The pressure of the internal atmosphere of an aquatic plant when submerged is equal to that of the dissolved gases.—M. **Wilmet**: The okapi. Study of an okapi kept in captivity for one month.—J. **Bounhiol**: New observations on the reproduction of the Algerian sardine.—H. **Bierry** and Mlle. Lucie **Fandard**: Variations of glycemia during inanition.—E. **Gley** and Alf. **Quinquaud**: The action of thyroid extract on the super-renal secretion.—R. **Robinson**: The genital glands and the dental system.—Albert **Robin**: Researches on the variations of phosphoric acid in the urine and liver of cancer subjects.—J. **Ville** and E. **Derrien**: Biochemical catalysis of a luminescent oxidation.—F. **Jadin** and A. **Astruc**: Arsenic and manganese in young and old leaves.—Pierre **Thomas**: The proteid substances of yeast. The albumenoid material derived from yeast is shown to be intermediate in properties between casein and egg albumen. It is provisionally named cerevisine.—Gabriel **Bertrand** and H. **Agulhon**: The presence of boron in milk and in eggs. The milk from four animals and eggs from five species of birds were proved to contain boron.—H. **Pottevin** and H. **Violle**: The comma bacillus and its toxins.—Alphonse **Berget**: A simplified barometric formula for the determination of heights. The formula proposed is $Z=D(t+269)/h$, in which Z is the difference of height, D the difference of pressures read on the barometer at the two stations, h the mean barometric pressure, and t the mean temperature. For heights below 3000 metres the agreement between this arithmetical formula and the usual logarithmic expression is shown by examples to be very close.

BOOKS RECEIVED.

Clinical Surgical Diagnosis for Students and Practitioners. By Prof. F. de Quervain. Translated by Dr. J. Snowman. Pp. xv+779. (London: J. Bale, Ltd.) 25*s*. net.

Report on the Progress of Agriculture in India for 1911–12. Pp. 65. (Calcutta: Superintendent Government Printing, India.)

Western Australia. Geological Survey. Bulletin No. 42. Contributions to the Study of the Geology and Ore Deposits of Kalgoorlie. E. Coolgardie Goldfield. Part i. By E. S. Simpson and C. G. Gibson. Pp. 198+49 plates+2 maps. (Perth, Western Australia: F. W. Simpson.)

Bureau des Longitudes. Conférence Internationale de l'Heure (Paris, Octobre, 1912). Pp. 282. (Paris: Gauthier-Villars.)

Mysore Government. Meteorological Department. Report on Rainfall Registration in Mysore for 1911. By N. V. Iyengar. Pp. xvi+49+plates. (Bangalore: Government Press.)

Canada. Department of Mines. Mines Branch. The Magnetic Iron Sands of Natashkwan, County of Sagvenay, Province of Quebec. By G. C. Mackenzie. Pp. vi+57+xxii plates+maps. (Ottawa: Government Printing Bureau.)

Annual Report on the Mineral Production of Canada. During the Calendar Year 1911. By J. McLeish. Pp. 316. (Ottawa: Government Printing Bureau.)

Meteorological Observations made at the Royal Observatory, Hong Kong, in the Year 1912. Pp. ii+114+2 plates. (Hong Kong: Noronha and Co.)

Bulletin of the Territory of Papua. No. 1, Notes on the Occurrence of Coal, Petroleum, and Copper in Papua. By J. E. Carne. Pp. viii+116+plates. (Sydney: W. A. Gullick.)

Resuscitation from Electric Shock, Traumatic Shock, Drowning, Asphyxiation from any Cause, by Means of Artificial Respiration by the Prone Pressure (Schaefer) Method. By Dr. C. A. Lauffer. Pp. v+47. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 2s. net.

Researches in Physical Optics, with especial Reference to the Radiation of Electrons. By Prof. R. W. Wood. Part i. Pp. vii+134+10 plates. (New York: Columbia University Press.)

Graphical Methods. A Course of Lectures delivered in Columbia University, New York, October, 1909, to January, 1910. By Prof. C. Runge. Pp. vii+148. (New York: Columbia University Press.)

Coöperation in Agriculture. By G. H. Powell. Pp. xv+327+xvi plates. (London: Macmillan and Co., Ltd.) 6s. 6d. net.

The Farmer of To-morrow. By F. I. Anderson. Pp. ix+308. (London: Macmillan and Co., Ltd.) 6s. 6d. net.

Practical Stone Quarrying. By A. Greenwell and J. V. Elsden. Pp. xx+564. (London: Crosby Lockwood and Son.) 12s. 6d. net.

Ueber die neuen Bestrebungen, das Los der Krebskranken zu verbessern. By Dr. V. Czerny. Pp. 18. (Leipzig and Berlin: B. G. Teubner.) 60 pfennigs.

Entwurf einer verallgemeinerten Relativitätstheorie und einer Theorie der Gravitation. I., Physikalischer Teil. By A. Einstein. II., Mathematischer Teil. By M. Grossmann. Pp. 38. (Leipzig and Berlin: B. G. Teubner.) 1.20 marks.

Didaktik der Himmelskunde und der astronomischen Geographie. By Dr. A. Höfler and others. Pp. xii+414. (Leipzig and Berlin: B. G. Teubner.) 12 marks.

Trigonometry. Complete Tables. By Profs. A. M. Kenyon and L. Ingold. Edited by E. R. Hedrick. Pp. xi+132+xviii+124. (London: Macmillan and Co., Ltd.) 6s. net.

Trigonometry. Brief Tables. By Profs. A. M. Kenyon and L. Ingold. Edited by E. R. Hedrick. Pp. xi+132+xviii+12. (London: Macmillan and Co., Ltd.) 4s. 6d. net.

Logarithmic and Trigonometric Tables, prepared under the direction of E. R. Hedrick to accompany a Plane and Spherical Trigonometry. By Profs. A. M. Kenyon and L. Ingold. Pp. xviii+124. (London: Macmillan and Co., Ltd.) 2s. 6d. net.

The Seine from Havre to Paris. By Sir E. Thorpe. Pp. xxi+493+maps. (London: Macmillan and Co., Ltd.) 12s. 6d. net.

Mitteilungen aus den deutschen Schutzgebieten. Erganzungsheft Nr. 7:—Wissenschaftliche Ergebnisse einer amtlichen Forschungsreise nach dem Bismarck-Archipel im Jahre 1908. III., Untersuchungen über eine melanesische Wanderstrasse. By Dr. G. Friederici. Pp. iii+182. (Berlin: E. S. Mittler und Sohn.) 3.60 marks.

Wild Flower Preservation. By M. Coley. Pp. 191+xxix plates. (London: T. Fisher Unwin.) 3s. 6d. net.

Report on the Danish Oceanographical Expeditions, 1908–10, to the Mediterranean and Adjacent Seas. No. 2. Vol. ii., Biology. Vol. iii., Miscellaneous Papers. By Dr. J. Schmidt. Pp. 150+iv plates+14+iii plates. (Copenhagen: A. F. Host and Son.)

Studies on the Influence of Thermal Environment on the Circulation and the Body-Heat. By Dr. E. R. Lyth. Pp. vi+72. (London: John Bale, Ltd.) 2s. 6d. net.

Board of Agriculture and Fisheries. Annual Report of the Intelligence Division. Part i. Pp. 93. (London: H.M.S.O.; Wyman and Sons, Ltd.) 5d.

Hamburgische Sonnenfinsternis-Expedition, 1905. Totale Sonnenfinsternis, 1905, August 30. Photographische Aufnahmen der Sonnenkorona ausgeführt in Souk-Ahras (Algerien). By R. Schorr. 9 plates. (Hamburg: Hamburger Sternwarte, Bergedorf.)

Abwehrfermente des tierischen Organismus gegen körper-, blutplasma- und zellfremde Stoffe, ihr Nachweis und ihre diagnostische Bedeutung zur Prüfung der Funktion der einzelnen Organe. By E. Abderhalden. Second edition. Pp. xii+199. (Berlin: J. Springer.) 5.60 marks.

CONTENTS.

	PAGE
Atoms and Molecules	473
The Cult of the Thunderstone	473
Pure and Applied Chemistry	474
Our Bookshelf	475
Letters to the Editor:—	
Radio-activity and the Age of the Earth.—Dr. L. L. Fermor	476
Pianoforte Touch.—Prof. W. B. Morton	477
The Reflection of X-Rays by Crystals.—Prof. W. H. Bragg, F.R.S.	477
Wireless Antennæ.—A. A. Campbell Swinton	477
A Mechanical Vacuum-Tube Regulator.—Dr. G. W. C. Kaye; Richard Whiddington	478
The Humphrey Owen Jones Memorial Fund.—Prof. W. J. Pope, F.R.S.	478
Smithsonian Physical Tables.—Dr. C. D. Walcott	478
Modern Views of Electro-therapeutics. By H. L. J.	478
International Fishery Investigations	480
American Universities and Colleges. By Prof. J. A. Green	481
Notes	482
Our Astronomical Column:—	
The Hottest Stars	487
A Photo-visual Comparator for the Identification of Minor Planets	487
Meteor Dust as a Measure of Geologic Time	487
The Royal Agricultural Show. By J. R. A.-D.	487
Bedford College for Women	488
Russian Geographical Papers	488
Meteorological Reports and Summaries	489
Great Advance in Crystallography. (*Illustrated.*) By Dr. A. E. H. Tutton, F.R.S.	490
University and Educational Intelligence	494
Societies and Academies	495
Books Received	497

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