THURSDAY, DECEMBER 18, 1913.

PRINCIPLES OF MATHEMATICS.

Principia Mathematica. By Dr. A. N. Whitehead, F.R.S., and Bertrand Russell, F.R.S. Vol. iii. Pp. x+491. (Cambridge: University Press, 1913.) Price 21*s.* net.

THE third volume of this work has followed very closely upon the second, which was only published last year, and is in every respect a worthy successor to it. It is mainly concerned with the theory of series, which was begun in the second volume, and then proceeds to the theory of measurement. A further and final volume will deal with geometry. To some extent the treatment has been influenced by the coming volume, especially in the section devoted to the theory of measurement. For the same reason, a special section is included, containing the theory of cyclic families, such as the angles about a given point in a given plane.

That the monumental task which the authors have undertaken should already have reached this stage is almost incredible. For they are in effect creating a new science, with a symbolism of its own, quite foreign to mathematics, which develops naturally as the work proceeds. It is scarcely necessary to point out that the Principia does not concern itself with the development of mathematics, as understood by the mathematician, but solely with the logical deduction of the propositions of mathematics from merely logical foundations. It represents, in one aspect, the culmination of the movement, which has swept over mathematics of late years, towards a rigorous examination of its fundamental premises. To such a work there is always the disadvantage inherent in a new symbolism, but a symbolism is essential to its development, and the authors employ the method which inflicts the minimum of labour on the reader: no symbol or abbreviation is employed until it becomes essential, and then its very recurrence fixes it in the mind of the reader.

The general scope of the volume has been indicated already, and it only remains to consider the detailed treatment adopted. Well-ordered series are considered first, as possessing many important properties not shared by series in general. In particular, they obey a process of transfinite induction, which is an extended form of mathematical induction, differing, however, in the fact that it deals with the successors of classes instead of single terms. On the whole, Cantor's treatment is followed closely, but an exception is made in dealing with Zermolo's theorem, and in the cases where Cantor assumes the multiplicative axiom. The writers emphasise the dubious character of much of the ordinary theory of transfinite ordinals, depending on the fact that it is founded on a proposition requiring this axiom. Ordinal numbers are defined as the relation-numbers of well-ordered series, after Cantor, serial numbers being the relation-numbers of series in general. Products of an ordinal number of ordinal numbers are not in general ordinal numbers, although the sums are. The treatment of sums and products contains much new matter. Perhaps the most interesting part of the work is the authors' solution of the paradox proposed by Burali-Forti in 1897, relating to the greatest ordinal number. It appears that in any one type there is no greatest ordinal number, and that all the ordinal numbers of a given type are exceeded by those of higher types.

An important section is concerned with the distinction of finite and infinite as applied to series and ordinals. The distinguishing properties of finite ordinals are then established. It does not appear that a proof can be found of the existence of alephs or ω's with infinite suffixes. For the type increases with each successive existence-theorem, and infinite types appear to have no meaning. The treatment of the theory of ratio and measurement is quite new. The quantities are regarded as "vectors" in a generalised sense, so that ratios can hold between *relations*. The hypothesis that the vectors concerned in any context form a *group* is not prominent. The theory of measurement is a combination of two other theories, one a pure arithmetic of ratios and real numbers, and the other a pure theory of vectors. If the axiom of infinity is assumed, great difficulties in connection with the existence-theorems are avoided. But the authors have endeavoured to get rid of the assumption, for, as they point out, it does not seem proper to make the theory of a simple ratio like $2/3$ depend on the fact that the universe contains an infinite number of objects.

The theory of ratio and measurement is actually the most important part of the volume, but it is impossible in a brief review to do justice to it. Yet it must be said that the publication of this volume is a landmark in the theory, and the authors have earned the sincere thanks of all mathematicians who are interested in the logical foundations of their subject. The printing must have been a peculiarly difficult task, on account of the nature of the symbols, and the Cambridge University Press is to be congratulated on the manner in which this work, like its predecessor, has been produced.

NEW BOOKS ON CHEMISTRY.

(1) *Preliminary Chemistry.* By H. W. Bausor. Pp. 106. (London: W. B. Clive, 1913.) Price 1*s.* 6*d.*

(2) *Manual of Qualitative Analysis. Reagent and Combustion Methods.* By W. F. Hoyt. Pp. vi+35. (New York: The Macmillan Co.; London: Macmillan & Co., Ltd., 1913.) Price 1*s.* 3*d.* net.)

(3) *A Course in General Chemistry.* By Prof. W. McPherson and Prof. W. E. Henderson. Pp. viii+556. (Boston and London: Ginn & Co., n.d.) Price 10*s.* 6*d.*

(4) *Treatise on General and Industrial Organic Chemistry.* By Dr. Ettore Molinari. Translated from the second enlarged and revised Italian edition by T. H. Pope. Pp. xix+770. (London: J. & A. Churchill, 1913.) Price 24*s.* net.

(5) *Qualitative Analyse vom Standpunkte der Ionenlehre.* By Dr. W. Böttger. Dritte Auflage. Pp. xvii+565. (Leipzig: W. Engelmann, 1913.) Price 11.20 marks.

(6) *Chemie. Unter Redaktion von E. v. Meyer. Allgemeine Kristallographie und Mineralogie. Unter Redaktion von Fr. Rinne.* Bearbeitet von E. v. Meyer, G. Engler, und L. Wohler, O. Wallach, and others. Pp. xiv+663. (Leipzig und Berlin: B. G. Teubner, 1913.) Price 21 marks.

(1) THE "Preliminary Chemistry" by Mr. Bausor, which is issued by the University Tutorial Press, provides, as the preface states, a course of simple experiments for beginners in chemistry, from which most elementary principles of the science are deduced. There are six chapters dealing with air, water, carbon dioxide and lime, salt and hydrochloric acid, sulphur and its acids, and, finally, carbon and combustion. Each chapter is furnished with a summary, a set of questions, and some practical exercises. The experiments are simple in character so as to be well within the capacity of a schoolboy, and the sequence is so arranged as to illustrate fundamental ideas in a clear and logical fashion. For the most part they run on familiar lines. It may be pointed out that the definition of one term by using another, which is left undefined, does not leave the matter much clearer. "If by its conversion into ice or into vapour a new body had been produced differing in *constitution* from the water, we should no longer have been dealing with a physical change." No doubt the orthodox way of beginning a book on practical chemistry is to direct attention to the fundamental distinction between chemical and physical changes; but is it really essential to start with it? Could not the question be more easily answered after a certain number of chemical changes had been observed?

(2) Mr. Hoyt's manual of qualitative analysis is a small volume of 36 pages. Though small and cheap, it is crammed with facts, so crowded, indeed, that the author has recourse to a kind of shorthand in addition to the ordinary chemical formulæ in order to compress his materials. To take one example, the confirmatory test for iron by the action of potassium hydroxide is expressed thus: conf. 2 = sol + KOH = precip. white to dirty green (if Fe'') or brown (if Fe''').

There are few or no explanations, and the whole compilation is that of a mere mechanical guide-book interspersed with a few moral and practical precepts. No one can grumble with the statement that "most laboratory accidents are avoidable" or the advice to be "cleanly in person and work"; but what precise meaning is conveyed by "Nature thinks in the molecule only, and you should learn to do the same" it is difficult to say. The student is further enjoined to "ask himself constantly what? how? and why?" We can only trust that he will have something more substantial than the manual for supplying the answers.

(3) The course on general chemistry by McPherson and Henderson forms an excellent introduction to a more elaborate study, or, in terms of the usual examination standards, would be a useful text-book for a student at the intermediate stage of his chemistry course.

Although the subjects are treated in an elementary fashion, no facts or theories of real importance are omitted, whilst at the same time the text is not overloaded with the description of an unnecessary number of compounds.

The book is written in a clear and simple style, the illustrations, though not so abundant as are sometimes found in American chemical books for elementary students, are well and neatly drawn, so that all the essential details are apparent, an effect partly due to the excellence of the paper. It has evidently been compiled by thoughtful and experienced teachers, who have spared no trouble in the treatment of their subject. It is, in short, a book that may be safely recommended as a text-book for a first year college course.

(4) Molinari's organic chemistry is mainly descriptive of the organic industries, that is to say, theoretical considerations are largely subordinated to the industrial applications of this branch of the science. For example, *tautomerism* occupies half a page, and *stereoisomerism* five pages, whereas the manufacture of explosives and the sugar industry cover about 40 pages each, the brewing of beer and the gas manufacture extend to more

than 20 pages each, and many other technical processes, such as the manufacture of soap, starch, and paper, are treated in the same detailed fashion. We have no desire to underrate the value of a book which devotes the greater part of its space to technology. On the contrary, the excellent and copious illustrations of plant and machinery, the clear exposition of the processes and the carefully compiled statistics will appeal to many students of organic chemistry, who will look in vain for practical information of this character in the ordinary text-book.

But they must bear in mind that the description of operations, which are often merely mechanical and in no sense chemical, cannot replace the principles of the science, which should be carefully studied and assimilated in advance.

Whilst, therefore, strongly recommending the book to the English student, we must warn him that he cannot afford to neglect the theoretical side, and that details of any technical process, however elaborate, will not make him a technologist. We must also point out that he is placed at some disadvantage by reason of the book having been written by an Italian for Italians. The apparatus and methods of technical analysis are often not those recognised as standard methods in this country. Moreover, the rather indiscriminate mixing of English and foreign weights and measures is a little confusing.

Thus, we are told on page 69 that in desulphurising petroleum 4500 kilos of iron oxide are mixed with 200 tons of petroleum; on page 72 it is stated that the value of Bakoum petroleum is about 7*s.* 2*d.* per quintal; on page 532 the quantity of tar treated in England is given in tons; whilst that of creosote oil extracted from it is put down in hectolitres. Moreover, the ton is the metric ton (1000 kilos) and not the English weight. If, in a future edition, the technology could be edited by the translator and English money, weights, and measures introduced so as to conform with English practice, the utility and interest of the volume for English readers would be greatly enhanced. As it is, the volume is a distinct addition to chemical literature, and the translator, Mr. T. H. Pope, may be congratulated on the ability with which he has carried out a task which must have entailed an enormous amount of assiduous application.

(5) Dr. Böttger's qualitative analysis based on the ionic theory is too well known to need a special notice. The present volume is the third edition. The principal changes are corrections and emendation of the text and the addition of microchemical reactions, which have been specially studied for the new edition by his collaborators, R. Heinze and R. Griessbach. The chapters on oxidation and reduction have been thoroughly revised, and a section on autoxidation has been added.

Qualitative analysis is a branch of practical chemistry which is so frequently presented in the form of small books adapted for examination use, that it is a satisfaction occasionally to meet with one in which the subject is raised to something like its proper dignity; and no justification for such a book is needed. It is interesting, nevertheless, to read Dr. Böttger's apologia; for it expresses views in which many teachers of chemistry will entirely concur. The following is a rough translation:—"The preference for short and elementary text-books, whereby a working mastery of analytical technique can be achieved, stands in direct opposition to the views attached to other branches of study in institutions for higher education and to the system of instruction current in the higher secondary schools. It is obvious that so large a mass of material as that included in analytical chemistry cannot be mastered in the short time devoted to the study of qualitative analysis. But it is unquestionably more important and educative for the beginner to learn to use at the outset a book which may act as a guide in his later researches, even if it involves a little more labour, than to study analysis from elementary books which must fail him when more difficult problems present themselves."

(6) The volume under review is on chemistry and crystallography, and is one of nineteen, which include mathematics, the natural sciences, and medicine. They form together one section of a series, which, when completed, will comprise upwards of sixty volumes dealing with what is termed "Modern Culture."

The present volume contains an account of the development of different branches of chemical science, such as inorganic, organic, and physical chemistry, thermochemistry, photochemistry, electrochemistry, physiological chemistry, agricultural chemistry, and crystallography, all within the space of 650 pages.

The names of the contributors are sufficiently well known in the chemical world to ensure that each subject is adequately treated so far as space permits. E. von Meyer has written a general, historical introduction, and among other writers are Wallach, Luther, Nernst, Le Blanc, Kossel, Witt, &c. Each subject is introduced by a brief historical review, with an account of its later progress and development. The book is, in short, a history of the science brought down to modern times.

It is not quite easy to determine for what class of readers the book is intended. It is far beyond

the grasp of the scientific tyro, and a well-informed chemist would probably find little that was new to him. Nevertheless it is not without a certain fascination, if only by the mere perusal of a record which exhibits in a striking manner the wonderful fertility of the science and its extraordinary growth in recent years. Moreover, it is well written, well printed on good paper, and handsomely bound.

Anyone who succeeds in assimilating a fraction of the contents of the other fifty-nine volumes, in addition to this, may indeed claim to have reached a condition of modern culture of unexampled thoroughness. J. B. C.

GAS, LIGHT AND AIR.

(1) *Gas Testing and Air Measurement.* By C. Chandley. Pp. vii+77. (London: Methuen and Co., Ltd., n.d.) Price 1*s.* 6*d.*

(2) *Light, Radiation, and Illumination.* Translated from the German of Paul Högner by Justus Eck. Pp. xii+88. (London: *The Electrician* Printing and Publishing Co., Ltd., n.d.) Price 6*s.* net.

(1) THE title of the first of these books is somewhat misleading. In these days of high-pressure gas and the use of burners in which the adjustment of the induced air is of the first importance, it is very natural to suppose that a work entitled "Gas Testing and Air Measurement" has something to do with gas burners. This is not the case. By gas is meant fire-damp in mines, and the air measurement refers to the ordinary practice in mines of measuring the ventilating currents.

The author deals with the indications of the safety lamp as an indicator of the proportion of fire-damp if this is not outside the limits of 2 and 5 or 6 per cent., and of the effect of quantities above the explosive limit in putting out the flame. He does not refer to any of the devices that have been used for showing smaller quantities, as, for instance, Prof. Clowes's hydrogen lamp or Liveing's fire-damp indicator. The book is intended primarily for candidates for certificates under section 15 of the Coal Mines Act, 1911. It should serve this purpose well, as the discussion of the all-important cap of the flame of the safety lamp is very clear; some attention is given to the legal requirements and official regulations relating to coal mines, and the methods used for measuring ventilating currents are very fully explained.

(2) "Light, Radiation, and Illumination" is an admirable exposition of the science which forms the basis of the practice of the illuminating engineer. It is the object of the members of this recently organised profession to apply light so as to obtain economical and satisfactory illumination, and not merely to place so many hundred candle-power of illuminating means in a room or a street. The scheme of the book is not unlike that of Euclid, but using the methods of trigonometry and the calculus and geometrical illustrations of a series of propositions following in logical sequence the demonstrations are as clear as any in Euclid, but the time and space required are vastly less than that which would be necessary with a purely geometrical method.

Beginning with a flat element of surface of a given luminous intensity, the author shows that the light radiated in different directions in space is proportional to the chords of a sphere to which the flat surface is tangent at the element. Then gradually sources of other geometrical forms are considered, and such real sources of light as filaments and arc light carbons. The illumination of surfaces and spaces, the effect of light-coloured walls, the curves of illumination from different sources, the uniformity of illumination with many lamps, and many other branches of the subject are treated fully and convincingly, and numerous tables for facilitating calculations in real cases are found as they are required.

While the forms of the illumination curves given by incandescent electric lamps and three kinds of arc lamps receive their full share of attention, no reference whatever is made to gas lighting. Now that the most beautifully lighted streets in London—Victoria Street, Pall Mall, and other streets in the West End, covering some miles—are lighted by high-pressure incandescent gas, it seems rather an omission not to have any statement even of the nature of the illumination curve of this type of burner. While the publishers may persuade themselves that electric illumination now is, after daylight, the only kind that matters, this is not the fact, and the author might with advantage have given the illumination curve of one type of high-pressure gas burner. In spite, however, of this omission, the book is a splendid example of science applied to an art which has been too long neglected.

OUR BOOKSHELF.

The Place of Climatology in Medicine: being the Samuel Hyde Memorial Lectures, 1913. By Dr. W. Gordon. Pp. v+62. (London: H. K. Lewis, 1913.) Price 3*s.* 6*d.* net.

AT a time when the broad features of the climate of civilised countries are well established through long series of exact observations, it is well to be reminded that an accurate knowledge of the local variations, especially of wind and rainfall, are of vital importance in medical climatology. We have yet to produce properly contoured large-scale maps of climate, even for well-populated districts,

and these are necessary for the medical expert in those investigations which are essential if the practising physician is to be enabled to base his prescription of climate upon knowledge rather than hearsay and hypothesis. Dr. Gordon gave a new impetus to such research by his inquiry into the effect of rain-bearing winds upon the prevalence of phthisis, and in these lectures he emphasises the need for further detailed investigations of this character; he instances in particular cancer and rheumatic fever as suitable subjects owing to the considerable local variations which he has observed in the distribution of these diseases. The information to be derived from such researches would be useful to the physician in diagnosis and prognosis, as well as in its more obvious applications.

The main thesis of the lectures is the explanation of the origin of the theory that altitude, *per se*, affected the prevalence of phthisis, and the elucidation of the real factor. If the crude death-rate from phthisis is considered, it appears usually that up to about 5000 feet the disease becomes continuously less prevalent as the height increases, even if only an agricultural population is considered. Dr. Gordon has re-examined the statistics in detail, and has arrived at the conclusion that the decrease is mainly due to the more sheltered situations sought by the mountain-dweller for his habitation. He finds that for places exposed to rain-bearing winds the death-rate may even increase with altitude. The differences in the death-rate between places with different exposures are remarkable; in the Grisons the rate is *three to four times* as great in places exposed to W. winds as in sheltered places, and *two to three times* as great as in places exposed only to E. winds. Such results are of the first importance, and Dr. Gordon is to be congratulated on the success of an arduous piece of research.

E. G.

The "Wellcome" Photographic Exposure Record and Diary, 1914. (London: Burroughs Wellcome and Co., 1913.) Price 1*s*.

THIS neat, handy, and useful little pocket-book contains the concentrated essence of photographic practice, and anyone who has used it once will no doubt, like the writer, continue to secure it annually. The issue for 1914 does not materially differ from that published last year, except that everything is brought up to date. The great success of the tabloid form of developers, &c., is acknowledged by its most general use, and this issue gives, among others, one illustration of Mr. H. G. Ponting using the "Rytol" developer in the hut at the winter quarters, and another by him of the *Terra Nova* off Cape Evans. The special device attached to the cover, which tells the correct exposure at one turn of the disc and the light tables for each month, and factors for plates, films, &c., are special and valuable features of the publication. Ample space is provided for logging the details of each plate or film exposed, and the usual diary portion obviates the necessity of having to carry any other pocket-book for other memoranda, engagements, &c., Three editions are published, one for the Northern hemisphere, another for the Southern, and a third for the United States. The price of one shilling brings it within the reach of everyone, and the book is well worth the money.

Chemical Technology and Analysis of Oils, Fats, and Waxes. By Dr. J. Lewkowitsch. Fifth edition, entirely re-written and enlarged. Vol. i. Pp. xxiii+668. (London: Macmillan and Co., Ltd.) Price 25*s*. net.

THE well-known work of the late Dr. Lewkowitsch was reviewed at some length in these columns on the appearance of the fourth edition some four years ago (NATURE, August 19, 1909). In view of the stage of transition through which the subject of fat analysis is now passing, the author would have preferred to wait a little longer before bringing out the present edition, but the exhaustion of the previous issue precluded further delay.

The arrangement of the subject-matter remains much as before, but its bulk has increased considerably, in spite of every endeavour to compress it and eliminate what has become antiquated. Due note has been made of recent progress in the chemistry and technology of fats and oils, so far as the scope of the present volume allows. Attention may be directed, for instance, to the discussions upon the causes of rancidity, the limitations of colour reactions in the examination of oils, the synthesis of glycerides, the hydrolysis of fats by ferments and by chemical catalysts, and the production of "hardened" or "hydrogenised" fats by the reduction of various oils. In short, there is evidence that the volume has undergone a thorough revision in bringing it up to date.

It is to be hoped that the lamented decease of the author will not necessitate any considerable delay in the completion of the new issue. The work was his *magnum opus*, and will remain a worthy memorial of his industry and knowledge.

The British Empire Universities Modern English Illustrated Dictionary. Revised under the chief editorship of Edward D. Price and Dr. H. Thurston Peck. Pp. lxxx+1008. (London: The Syndicate Publishing Co., 1914.) Price 20*s*.

THE illustrations form a noteworthy characteristic of this dictionary; for, as the title-page states, there are coloured plates, monotones, duograph charts and maps. The dictionary proper is preceded by a number of articles by well-known writers designed to promote the intelligent use of the volume; and at the end of the book are many useful and interesting addenda. The type of the dictionary itself is excellent, making reference to it easy and pleasant. With readers indifferent to the price of books the dictionary is likely to become popular, for it is not only trustworthy and exhaustive, but its handsome appearance will make it an ornament to the library table.

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.]*

Reflection of Light at the Confines of a Diffusing Medium.

I SUPPOSE that everyone is familiar with the beautifully graded illumination of a paraffin candle, extending downwards from the flame to a distance of several inches. The thing is seen at its best when there is but one candle in an otherwise dark room, and when the eye is protected from the direct light of the flame. And it must often be noticed when a candle is broken across, so that the two portions are held together merely by the wick, that the part below the fracture is much darker than it would otherwise be, and the part above brighter, the contrast between the two being very marked. This effect is naturally attributed to reflection, but it does not at first appear that the cause is adequate, seeing that at perpendicular incidence the reflection at the common surface of wax and air is only about 4 per cent.

A little consideration shows that the efficacy of the reflection depends upon the incidence not being limited to the neighbourhood of the perpendicular. In consequence of diffusion [1] the propagation of light within the wax is not specially along the length of the candle, but somewhat approximately equal in *all* directions. Accordingly at a fracture there is a good deal of "total reflection." The general attenuation downwards is doubtless partly due to defect of transparency, but also, and perhaps more, to the lateral escape of light at the surface of the candle, thereby rendered visible. By hindering this escape the brightly illuminated length may be much increased.

The experiment may be tried by enclosing the candle in a reflecting tubular envelope. I used a square tube composed of four rectangular pieces of mirror glass, 1 in. wide, and 4 or 5 in. long, held together by strips of pasted paper. The tube should be lowered over the candle until the whole of the flame projects, when it will be apparent that the illumination of the candle extends decidedly lower down than before.

In imagination we may get quit of the lateral loss by supposing the diameter of the candle to be increased without limit, the source of light being at the same time extended over the whole of the horizontal plane.

To come to a definite question, we may ask what is the proportion of light reflected when it is incident equally in all directions upon a surface of transition, such as is constituted by the candle fracture. The answer depends upon a suitable integration of Fresnel's expression for the reflection of light of the two polarisations, viz. :—

$$S^2=\frac{\sin^2(\theta-\theta')}{\sin^2(\theta+\theta')}, \quad T^2=\frac{\tan^2(\theta-\theta')}{\tan^2(\theta+\theta')}, \quad . \quad . \quad (1)$$

where θ, θ' are the angles of incidence and refraction. We may take first the case where $\theta>\theta'$, that is, when the transition is from the less to the more refractive medium.

The element of solid angle is $2\pi \sin\theta\, d\theta$, and the area of cross-section corresponding to unit area of the refracting surface is $\cos\theta$; so that we have to consider

$$2\int_0^{\frac{1}{2}\pi} \sin\theta\cos\theta\,(S^2 \text{ or } T^2)d\theta, \quad . \quad . \quad . \quad (2)$$

[1] To what is the diffusion due? Actual cavities seem improbable. Is it chemical heterogeneity, or merely varying orientation of chemically homogeneous material operative in virtue of double refraction?

the multiplier being so chosen as to make the integral equal to unity when S^2 or T^2 have that value throughout. The integral could be evaluated analytically, at any rate in the case of S^2, but the result would scarcely repay the trouble. An estimate by quadratures in a particular case will suffice for our purposes, and to this we shall presently return.

In (2) θ varies from 0 to $\frac{1}{2}\pi$ and θ' is always real. If we supppose the passage to be in the other direction, viz. from the more to the less refractive medium, S^2 and T^2. being symmetrical in θ and θ', remain as before, and we have to integrate

$$2\sin\theta'\cos\theta'\,(S^2 \text{ or } T^2)d\theta'.$$

The integral divides itself into two parts, the first form 0 to α, where α is the critical angle corresponding to $\theta=\frac{1}{2}\pi$. In this S^2, T^2 have the values given in (1). The second part of the range from $\theta'=\alpha$ to $\theta'=\frac{1}{2}\pi$ involves "total reflection," so that S^2 and T^2 must be taken equal to unity. Thus altogether we have

$$2\int_0^{\alpha} \sin\theta'\cos\theta'\,(S^2 \text{ or } T^2)\,d\theta'+2\int_{\alpha}^{\frac{1}{2}\pi} \sin\theta'\cos\theta' d\theta', \quad (3)$$

in which $\sin\alpha=1/\mu$, μ (greater than unity) being the refractive index. In (3)

$$2\sin\theta'\cos\theta' d\theta'=d\sin^2\theta'=\mu^{-2}d\sin^2\theta,$$

and thus—

$$(3)=\mu^{-2}\times(2)+1-\mu^{-2}$$

$$=\frac{1}{\mu^2}\left\{\mu^2-1+\int_0^{\frac{1}{2}\pi} \sin 2\theta\,(S^2 \text{ or } T^2)\,d\theta\right\}, \quad (4)$$

expressing the proportion of the uniformly diffused incident light reflected in this case.

Much the more important part is the light totally reflected. If $\mu=1{\cdot}5$, this amounts to 5/9, or 0·5556.

With the same value μ, I find by Weddle's rule—

$$\int_0^{\frac{1}{2}\pi} \sin 2\theta\,.\,S^2 d\theta=0{\cdot}1460, \quad \int_0^{\frac{1}{2}\pi} \sin 2\theta\,.\,T^2 d\theta=0{\cdot}0339.$$

Thus for light vibrating perpendicularly to the plane of incidence—

$$(4)=0{\cdot}5556+0{\cdot}0649=0{\cdot}6205;$$

while for light vibrating in the plane of incidence—

$$(4)=0{\cdot}5556+0{\cdot}0151=0{\cdot}5707.$$

The increased reflection due to the diffusion of the light is thus abundantly explained, by far the greater part being due to the total reflection which ensues when the incidence in the denser medium is somewhat oblique. RAYLEIGH.

The Pressure of Radiation.

THE theory of radiation at present accepted is based on Maxwell's result that the pressure of any component frequency is one-third of its energy density, which appears to result from an assumption analogous to Boyle's law, according to which the excess pressure due to vibration, in the case of a gas, would be one-third of the energy density of the vibration.

Lord Rayleigh (*Phil. Mag.*, 1905) has shown that this cannot be true in the case of a gas, since the vibrations are adiabatic, and Boyle's law does not hold. For a monatomic gas, where the reasoning based on the kinetic theory is fairly certain, he deduces that the excess pressure should be two-thirds of the energy density.

In a recent note on radiation and specific heat (*Phil. Mag.*, October, 1913) I gave an outline of a new theory, showing good agreement with experiment, from which I deduced the result that "the total pressure of full radiation should be one-third of the intrinsic energy density, but this could not be true for

the partial pressure of each component taken separately." So many of my correspondents, including Lord Rayleigh, have questioned the grounds of this statement, which is the crux of the whole problem, that it may be of interest to explain my reasons more fully.

Arguing on the analogy of a gas, it is evident that the vibrations of radiation must be regarded as adiabatic, and cannot satisfy pv=constant, unless the value of the index γ (the ratio of the total energy $E+pv$ to the intrinsic energy E) is equal to unity, which is impossible. We conclude either that the analogy is false, or that, if the vibrations are adiabatic, the ratio may have different values for different frequencies. Since the index γ is equal to $(E+pv)/E$, it is obvious that, to be consistent, we must have $p=(\gamma-1)E/v$, which agrees with Lord Rayleigh's result for monatomic gases, and may be true generally for the pressure of adiabatic vibrations.

According to my theory, radiation consists of the vibration of equal elementary units (Faraday tubes associated with ionic pairs) each possessing the same angular momentum, but having intrinsic energy proportional to the frequency ν and independent of the temperature T. The pressure is assumed to be equally divided between the molecular units according to the gas law $pv=RT$, because this gives the simplest possible explanation of the exponential term $e^{-b\nu/T}$ in the radiation formula as a direct consequence of Carnot's principle, and because equipartition of pressure is the most universal condition of equilibrium in physics.

It follows that the ratio of the pressure to the energy density, denoted by $\gamma-1$, must be of the form $T/b\nu$, which is different for different frequencies at the same temperature, but gives the mean value $1/3$ for full radiation. The possibility of having different values for this ratio is explained by the fact that the vibrations are adiabatic, and the correction thus introduced into the theory of radiation is in this respect analogous to that introduced by Laplace into the Newtonian theory of the propagation of sound.

The assumption here made admits of a fairly simple experimental test, such as the following. Divide the radiation from a source, such as an arc light, into two parts of different frequencies. Compare the total energies and pressures by suitable means. The ratio of the pressure to the energy should be the same for each part on Maxwell's theory. On my theory, the part of lower frequency should have the higher pressure in a determinate ratio. I hoped to be able to try this crucial test before publishing even an outline of my theory, but the rapid extension of the Imperial College in recent years has left me insufficient leisure for so exacting an experiment, though it might not present serious difficulty to an expert in the measurement of radiation pressure.

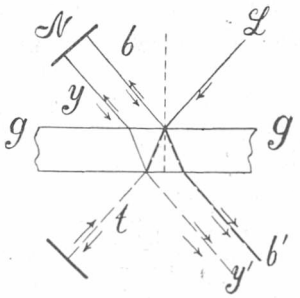
There are many other points in so brief a sketch which may require further elucidation, but these must be postponed. In the meantime I hope I have succeeded in demonstrating at least the possibility, if not the probability, of the fundamental assumption of my theory.

H. L. CALLENDAR.

Imperial College of Science, S.W., December 10.

Scattering in the Case of Regular Reflection from a Transparent Grating: an Analogy to the Reflection of X-Rays from Crystals.

1. *The Phenomenon.*—No doubt the following phenomenon has been noticed before, but I have seen no description of it. If a vertical sheet of white light L from a collimator is reflected from the two faces of a plateglass grating, having about 10,000 or more lines to the inch, g being the ruled face, the two beams b and y going to the opaque mirror N are respectively vividly blue and brownish-yellow. In other words, more blue light is regularly reflected from the ruled surface than is transmitted, and more reddish light transmitted than is reflected. Since the plate grating is not quite plane parallel, two of the four rays, b^1 and y^1, are seen in the same colours in the telescope. This is a great convenience in adjusting the displacement interferometer, where the spectra from b alone are wanted, and the y ray may be screened off at N, while the other y^1 has no spectrum.



The transmitted rays, t, after reflection show very little difference, the one reflected at g being perhaps slightly yellowish as compared with the other.

The spectra from b and y, if compared one above the other, are practically identical. The difference is not sufficiently marked to be discerned by the eye. Multiple reflection from the two faces gave no further results.

Finally, to be coloured blue, the beam must be reflected from the air side and not from the glass side, where but little appreciable effect is produced. If the grating is turned 180°, both the b and y rays are nearly white, while the t rays now correspond to the b and y rays, and are vividly coloured.

Outside the ruled surface and with any ordinary unruled plate of glass, all images are, of course, white. I mention this merely since one might suppose the absorption or colour of the glass to have something to do with the experiment. The film grating, where sharp reflection takes place from the glass and not appreciably from the film, does not show the phenomenon.

2. *Explanation.*—Scattering is usually and perhaps essentially associated with diffuse reflection. The present phenomenon, however, is strictly regular reflection—*i.e.* there is a wave front, for the blue and yellow slit images are absolutely sharp in the telescope. This is the interesting feature of the phenomenon, which associates it at once with the recent famous discovery of Friedrich, Knipping, and Laue relative to the reflection of X-rays from the molecules of crystals, and it is for this reason that I direct attention to it.

In case of the grating the sources of scattered light waves are not only identical as to phase, but these sources are at the same time equidistant. Hence collectively they must determine a wave front of somewhat inferior intensity, but otherwise identical with the wave front of normally reflected or diffracted light—*i.e.* the wave fronts of regularly reflected and scattered light are superposed.

Moreover, if the grating is turned in azimuth even as much as 45° on either side of the impinging beam (after which the many reflections and diffractions seriously overlap), the blue and brown colorations are distinctly intensified. This also is in accordance with anticipations; for the number of lines which are comprehended within the lateral extent s of the narrow beam L, as the angle of incidence i is varied, increases as $s \sec i$; whereas the lateral extent of the reflected beam is no larger than that of the impinging beam. Hence there should be increased intensity of scattered light in the ratio of sec i, or increasing markedly with i from 1 for $i=0°$, to ∞ for $i=90°$. In other words, the scattering lines of the grating are virtually more densely disseminated when i increases.

For the case of light reflected from the inside of the glass plate the evidence to be obtained from colour is too vague to admit of definite statements. I have not therefore attempted it.

Brown University, Providence, U.S.A. CARL BARUS.

Fractured Flints from Selsey.

I AM astonished to read in the abstract of the Proceedings of the Geological Society of London, No. 947, giving an account of the meeting held on November 19, 1913, the following statement:—

"Prof. Sollas exhibited a series of specimens to illustrate the production of 'rostro-carinate' forms of flint by natural agencies. . . . The great majority were obtained by Mr. E. Heron-Allen from the beach of Selsey Bill, and it was to these that attention was especially directed. If they were all of human workmanship—Sir E. Ray Lankester's contention—there would be no difficulty in accounting for the characters which they possess in common."

I do not know whether Prof. Sollas is responsible for these words or not. But, in any case, I must state in the most unqualified way that they contain an assertion which is absolutely contrary to fact. I have never published any "contention" about flints from Selsey Bill, excepting a brief description in my paper in the Phil. Trans., Series B, vol. 202 (read on November 16, 1911), of one large rostro-carinate implement and one large pyramidal hammer-stone from that locality. To this brief description follows the remark: "Other specimens of a less decisive character have been found."

The assertion that it is my contention that any of the flints (much less "all") obtained by Mr. Heron-Allen, which I have examined, excepting the two briefly described by me, are of human workmanship is the creation of Prof. Sollas's imagination. I should be glad if Prof. Sollas would state where and when I have been guilty of the contention which, according to the Geological Society's report of his communication, he does not hesitate to attribute to me. I, of course, do not suppose that Prof. Sollas attributes a rash "contention" to me in order that he may have the satisfaction of showing it to be rash, and such as to render what I really have said unlikely to be well founded. At the same time, I think I am entitled to call upon Prof. Sollas either to cite "chapter and verse" in which I have made the specific contention which he supposes I have made, or to express some regret for a misrepresentation which I can only account for by a regrettable lapse of attention on his part in the conduct of an important scientific discussion. E. RAY LANKESTER.

December 3.

I HASTEN to express my extreme regret at having attributed to Sir E. Ray Lankester an opinion which he does not hold.

In the quotation he gives from his paper in the Philosophical Transactions, Sir E. Ray Lankester omits the concluding sentence, "I hope to publish figures of the Selsey Bill specimens at no distant date." I understood this (naturally it seems to me) to apply to all the specimens, and thus concluded that the difference between the more and the "less decisive" was not so important as, upon the omission of the concluding sentence, it appears to be.

When I selected from Mr. Heron-Allen's collection some of his best specimens, by no means all, he assured me that they had been examined by Sir E. Ray Lankester, and pronounced by him to be of human workmanship, a judgment which appeared to me so natural and consistent with Sir E. Ray Lankester's point of view that no suspicion of a misunderstanding crossed my mind. Had I been in doubt I should have taken the precaution to ascertain from Sir E. Ray Lankester his opinion beforehand.

I am glad that Sir E. Ray Lankester acquits me of any intentional unfairness. I thought, and still think, that of the alternatives I proposed, the one I unfortunately attributed to him was the more logically defensible, but in this again I may be mistaken.

I have written to the secretary of the Geological Society requesting him to correct my statement and to add an expression of my regret to be published in the Quarterly Journal of the society.

December 7. W. J. SOLLAS.

The Structure of the Atom.

I CONCUR with Prof. Rutherford (NATURE, December 11, p. 423) that the work by Moseley in the current number of the *Philosophical Magazine*, which was not published, and was quite unknown to me when I wrote my letter (NATURE, December 4, p. 399), is an important independent confirmation by new physical methods of van der Broek's suggestion. As, however, in a paper published eight months previously (*Jahr. Radioaktivität und Elektronik.*, 1913, x., 193), I had represented in a diagram the places in the periodic table from uranium to thallium, with the mass as the ordinate and the charge as the abscissa, showing that there is unit difference of charge between successive places, I wish to take exception to Prof. Rutherford's statement "that the strongest and most convincing evidence" in support of van der Broek's hypothesis will be found in Moseley's paper. The view had already been far more simply and convincingly established from the chemical examination of the properties of the radio-elements, notably by A. Fleck in this laboratory. Moseley's conclusions are a welcome confirmation, by an independent method, for another part of the periodic table. It can only be described as the strongest and most convincing evidence if the prior chemical evidence is altogether ignored.

FREDERICK SODDY.

Physical Chemistry Laboratory, University of Glasgow, December 12.

The Occurrence of Pilchards in the Eastern Half of the English Channel.

IT is now generally recognised by those who have been interested in the question, that the inshore migration of pilchards in the western fishery area during the summer and autumn of the present year, has presented certain features, which may possibly be attributed to somewhat unusual conditions of food supply and other determining factors. It is therefore a matter of some importance to note that according to the statement of local fishermen, occasional catches of some thousands of pilchards have been made in drift nets off Brighton, Ramsgate, Deal, &c., for several months past.

In the early part of September we examined at Brighton some specimens taken from a catch of about four thousand, and now within the past fortnight, by the courtesy of Mr. E. W. Cowley, the superintendent of the Brighton Marine Aquarium, we have been enabled to ascertain that the fish were still present in the same area. For according to the statement of this gentleman a catch of three thousand was made by a local drifter about two miles off Brighton on November 27, three specimens of which we examined and found to be males with generative organs in "half-ripe" condition. HAROLD SWITHINBANK.

G. E. BULLEN.

London, December 10.

THE INTERNATIONAL ASSOCIATION OF CHEMICAL SOCIETIES.

THE science of chemistry has some 20,000 adherents at least. Chemical journals are very numerous, and it would be impossible for any one man to read current chemical literature, were he to read for twenty-four hours a day. The investigations of chemists are published, for the most part, in transactions of chemical societies, and until recently these societies lived apart, having merely a bowing acquaintance with one another. "Union is strength," and in default of union, cooperation lends a strengthening hand. Hence a proposal which originated in the winter of 1910–11 with Profs. Ostwald and Haller to form an association of chemical societies was regarded with favour by the three great chemical societies of London, Berlin, and Paris.

To organise this association, a preliminary meeting was held in Paris in April, 1911, at which were present three Frenchmen, MM. Béhal, Haller, and Hanriot; three Germans, Herren Jacobson, Ostwald, and Wichelhaus; and two Englishmen, Dr. Percy Frankland and Sir William Ramsay, as delegates of the three national societies. It was there resolved that all chemical societies should have the right to demand admission to the association, provided their proceedings were published in a journal; and also that each country should be represented by only one society.

At this meeting, too, questions in regard to which the association might do useful work were indicated. Among these are: Nomenclature and classification of chemical compounds; atomic weights; the unification of the notation of physical constants; the editing of indices and summaries of chemical work; consideration of the possibility of utilising a universal language; unification of the size of pages of chemical literature; means to be taken to prevent the re-publication of papers in different journals; and publication of a complete record of chemistry. Statutes were also drawn up; the object of the association is defined as "forming a link between the chemical societies of the world, which shall deal with questions of general and international importance for chemistry." The constitution of the council is also defined in the statutes; there shall be a president, a vice-president, and a secretary, chosen from the same nation, who shall be an acting committee for the period of one year.

During this preliminary meeting, the chair was occupied by each delegate in succession; but Prof. Ostwald was elected president for the meeting in 1912, Prof. Wichelhaus, vice-president, and Prof. Jacobson secretary.

In April, 1912, the first statutory meeting was held in Berlin. The Swiss Chemical Society had joined in the meantime, and was represented by MM. Fichter, Guye, and Werner; the American Chemical Society, by Prof. W. A. Noyes; and the Russian Chemical Society, by MM. Kurnakow, Tschugaeff, and Walden; while M. Marie represented the Société de Chimie-physique of Paris; Hr. Auerbach, the Bunsen-Gesellschaft; Prof. Cohen the Netherland Chemical Union; Hr. Goldschmidt, the Norwegian; and Hr. Biilmann, the Danish Chemical Society. The Italian societies, although they had applied and been received as members of the association, were unrepresented on this occasion.

At the first meeting in Berlin, Great Britain was chosen as the next place of meeting; and Sir William Ramsay was chosen to be president, Prof. Frankland vice-president, and Prof. Crossley was subsequently appointed secretary.

During the meeting the projects suggested were further discussed, and committees were appointed to consider and report on nomenclature, on abbreviated titles for chemical journals, on the size of pages of journals, and on means to overcome the difficulties caused by a multiplicity of languages. It was also announced that the chemical societies of Madrid and of Tokyo, and the Union of Austrian Chemists had applied for admission to the Association. It was arranged that the meeting in 1913 should take place in England in August or September, so as to suit the convenience of American chemists.

This resolve, however, was changed, for the following reason. M. Ernest Solvay, the great Belgian chemical manufacturer, declared his intention of assisting this international movement by a large donation. Hitherto, the expenses had been defrayed by the participating societies. But M. Solvay informed the officers that he wished to place unreservedly at the disposal of the association a sum of 250,000 francs, and that he desired also to set apart a sum of 1,000,000 francs, under such conditions that the capital would be exhausted in twenty-nine years. He ear-marked one-third of the interest of this sum to be devoted to scholarships for Belgian students, while the remaining two-thirds were to be placed at the disposal of the association. This fund is to be administered by a commission, consisting so far as the scholarships are concerned, of M. Solvay himself, or his nominee; of a member nominated by H.M. the King of the Belgians; and lastly, by a member nominated by the University of Brussels. These members, together with three representatives of the council of the association, viz., MM. Haller and Ostwald, and Sir W. Ramsay, are directors of an "International Institute of Chemistry." M. Solvay also signified his intention to provide the association with a secretariat at Brussels, which should serve as a permanent abode.

It was therefore thought advisable to abandon the intention of meeting in England, and to hold the meeting for 1913 in Brussels, so as to have an opportunity of thanking Monsieur Solvay for his generous gift. A further reason for meeting in Brussels lay in the fact that the days appointed coincided with the date of M. Solvay's golden wedding, as well as the fiftieth anniversary of the foundation of the industry which bears his name. The date was accordingly September 19 to 23.

At this meeting the Chemical Society of Belgium was represented; there were present besides

delegates from Germany, England, Austria, Denmark, Spain, France, Holland, Italy, Norway, Russia, and Switzerland; the United States and Japan were unrepresented. In all, seventeen chemical societies are affiliated to the international association, representing nearly 20,000 members. Much valuable assistance was received from M. Tassel and from M. Heger in arranging for the meetings.

It was agreed that the place of meeting for 1914 should be Paris, with M. Haller as president. The business done at the Brussels meeting was satisfactory; steps were taken to affiliate the committee on atomic weights; to unify the methods of abbreviating the names of journals; to secure publication of important memoirs which have appeared in one of the less known languages in English, French, or German; to open negotiations to diminish the multiplicity of abstracts, by cooperation among the various bodies which publish extracts; and some important resolutions dealing with nomenclature, and with symbols for physical constants, were adopted.

The need of such an association has now been amply shown. Much can be done to simplify methods, and, by cooperation, to diminish labour, and increase convenience. There is still much to be done, however, and the usefulness of the association will doubtless survive the period at which Monsieur Solvay's gift will be exhausted. The assembling of chemists from various nations, with free interchange of ideas, cannot fail to stimulate all working at the science of chemistry, and cannot fail to promote cordial international relations. "La Science est sans patrie!"

WILLIAM RAMSAY.

HEALTH IN INDIA.

UNDER the title, "A Modern Miracle," *The Pioneer Mail* of September 12 gives some striking figures of the improvement of health among the European troops in India—these figures being taken from the Army Medical Report for last year. With a strength of more than 71,000 British troops in India, there were positively only 328 deaths during the year, equal to 4·62 per 1000. This is really a remarkable achievement; and the smallness of the death-rate is not due in any way to an increase in the invaliding to England—as shown by the fact that the invaliding also fell markedly during the year to 6·68 per 1000, compared with 23 per 1000 in 1892. These are by far the lowest rates on record, and are comparable with the great decrease in the death-rate and the invaliding among non-native officials in West Africa, as disclosed by recent Colonial Office Reports.

Enteric fever, which was once such a terrible pest in India, has now decreased so much that there were only 118 admissions to hospital for it among the whole British garrison. This is undoubtedly due partly to the very great care now exercised in dealing with potential carriers of the disease, both human carriers and flies, and also to anti-typhoid inoculation. Malaria also has shown a very marked decrease during the year, though, as *The Pioneer Mail* points out, this may possibly be partly due to the usual fluctuations in the prevalence of the disease caused by variations in climate. Cholera and plague have also diminished.

Those who are interested in the subject would do well to compare with this fine record a remarkable paper by Sir Charles Pardey Lukis, Director-General of the Indian Medical Service, in the October number of *Science Progress*, entitled "The Sanitary Awakening of India." Sir Pardey Lukis describes the whole position of sanitation in India, and also the very extensive advances which are now being made in the investigation of disease, and the practical application of preventive measures there. Since he has occupied his important post, energy has been redoubled in all these directions. The whole Indian Medical Service, and the Officers of the Royal Army Medical Corps now serving in India, must all be heartily congratulated for the splendid work which they are now doing. Of course, there are ideals still before us; but the old apathy which used to exist in many quarters seems now to be a thing of the past.

Vaccination in India is also doing extremely well. Nearly two million vaccinations were performed in the Bengal Presidency alone during 1912–13, and the total number of deaths from smallpox in that Presidency during the year was only 0·21 per thousand of the population—a very good figure for a country where vaccination has been much opposed on account of "religious" scruples. The lanoline lymph, which I believe was originally invented by Colonel King, is principally responsible for this good state of affairs, and Colonel King is to be much congratulated upon it.

RONALD ROSS.

THE PROBLEM OF THE UNIVERSITY OF LONDON.

SINCE the article in our issue of December 11 was written, further events of importance have taken place. We referred in that article to the proposal of the Higher Education Sub-Committee of the London County Council to recommend the London County Council to invite the Senate of the University of London to express approval of Somerset House as a place for the further development of the University. The recommendation in favour of this site was adopted by the Council at Tuesday's meeting, after discussion. The Council agreed, without a division, to an amendment proposing that, if the Government could not consent to the Somerset House suggestion, the Education Committee should be instructed to report on the proposal to establish the university on a site on the south bank of the river, "where it would form an important feature in the beautifying of London." This proposal has something to be said for it from the point of view of the improvement of

the amenities of London, but from the point of view of university policy it has nothing to commend it. If the south side of the river were chosen, nothing whatever would be achieved beyond the possible erection of a fine building for the university offices. No concentration of teaching institutions could possibly take place there, and, consequently, no university quarter could be created. The establishment of a university quarter is of the essence of the matter.

The speech of the Minister for Education at the Birkbeck College on December 10 further strengthens the view that the Government is in earnest in carrying through this important educational reform. The Minister dealt on that occasion with the recommendation of the Royal Commission for the establishment of an evening constituent university college by the development and re-organisation of the Birkbeck College. With this proposal we are in full sympathy.

Considerable care will be required in dealing with the question of the continuation of the external degree. Signs are not wanting to indicate that some members of the external party conceive that their future would lie in some kind of alliance with those institutions that are not accepted as constituent colleges. Such a device would merely set up a sort of second, and inferior, internal side. The only justification for the continuance of the external degree is that it should be truly and genuinely *external*. Every care must be taken in the efforts that are being made to secure agreement not to destroy the well-thought-out proposals of the commission. No one would think of instituting an external side at the present time; it exists and appeals, apparently, to a large number of people. If it is to be continued, it should be as a purely external and impartial examining board, unconnected with any particular educational institution.

NOTES.

THE President of the Board of Education has promoted Mr. G. W. Lamplugh, F.R.S., to the post of assistant director of the Geological Survey of Great Britain, and Mr. T. C. Cantrill to that of district geologist, the appointments to take effect on January 6, 1914.

WE notice with much regret the announcement of the death on December 15, at thirty-eight years of age, of Dr. P. V. Bevan, professor of physics at the Royal Holloway College, and formerly demonstrator in physics in the Cavendish Laboratory, Cambridge.

DR. R. R. GATES has received from the Royal College of Science, South Kensington, the Huxley gold medal and prize for research in biology.

A REUTER message from Melbourne on December 15 states that the steamer *Pacifique*, which has arrived at Noumea, reports that the volcano in Ambrym Island, one of the New Hebrides, has for many days been in active eruption. On December 6 six new craters were formed on the west coast, and on the following day Mount Minnie collapsed in the centre.

THE Board of Agriculture and Fisheries is engaged in an inquiry, through its horticulture branch, into the failure of fruit-trees to set properly through insufficient pollination. The Board will be glad to be put in communication with the occupier of any orchard of five acres and upward who has reason to believe that his trees are bearing less than the normal crop over a series of years. Fruit-growers who are planting new orchards are also invited to communicate with the Board.

THE Italian Meteorological Society has decided to arrange an international congress to be held in Venice in September next. Prominence is to be given to the discussion of problems in connection with the higher atmosphere, and there are to be sections concerned particularly with climatology, aërology, and pure and maritime meteorology. The price of a member's ticket is to be 10 lire, and special railway facilities are to be offered to those attending the congress. All inquiries and applications should be addressed to the general secretary, Barene Emile D. Henning O'Carrel, director of the Patriarchal Observatory in Venice.

AT a meeting of the executive committee of the British Science Guild held on December 9, it was announced that a permanent paid secretary had been appointed. It was resolved to support the movement which is being taken to induce the British Government to be represented officially at the San Francisco Exposition of 1915. Lord Sydenham, Sir Francis Laking, Sir John Cockburn, and others were added to the medical committee, and it was decided that the subject of reference to the Royal Commission of which Lord Sydenham is chairman should be considered by the medical committee. The subject of the charges made by the Postmaster-General to persons using the wireless time-signals sent out from the Eiffel Tower in Paris has been considered by the committee on the synchronisation of clocks, and it was resolved to approach the Government upon the subject.

BY the regulations for the protection of wild birds and mammals in Egypt, referred to by Sir H. H. Johnston at the end of his article in last week's NATURE, the following kinds of birds useful to agriculture are not allowed to be shot, captured, destroyed, exposed for sale, sold, or purchased:—Egrets, larks, pipits, wagtails, warblers, wheatears, flycatchers, orioles, bee-eaters, hoopoes, green plovers, spur-winged plovers, and winged plovers. Permission to collect or keep any of these birds for scientific purposes rests with the discretion of the Minister of Public Works. All shooting is forbidden on Lake Menzala, and gazelles are protected in certain districts. Governors of cities and Mudirs of provinces have the right to refuse to issue game licences, should they see fit to do so, and to make regulations within the limits of their jurisdiction concerning close seasons, reserves, the kinds of animals that may be shot, and special conditions. The virtual effect of the proclamation is that henceforth the killing of any bird but a hawk, kite, or crow is illegal throughout the Khediviate. It is most satisfactory to note that the Egyptian Government protects by these regulations

not only the birds of Egypt, but also the rarer mammals. Its example should at once be followed in British India, in British Guiana, and in British Honduras.

MR. HUGH PHILLIPS, The Manor House, Hitchin, Hertfordshire, stated in *The Times* of December 4 that Newton's house in St. Martin's Street, W.C., was being taken down carefully, after every detail of its construction had been noted and a plan of the structure made by a firm of London architects, with the view of re-erecting the house elsewhere at some future date. In reply to an inquiry, he informs us that at present he has not been successful in finding anyone who will help him to re-erect the house. He says:—"It would be necessary to spend about 10,000*l.* to rebuild and endow it as a museum, and this sum would pay for its upkeep, and its interest would leave a small annual purchasing fund for the acquisition of relics of Sir Isaac Newton and the other inhabitants of the house."

THE Russian Supplement of *The Times* for December 15 contains an account of M. Vilkitski's exploration with the ice-breakers *Taimyr* and *Vaigatz*. On the outward voyage, as the vessels were sailing westwards, a new island some miles in circumference was discovered south-east of New Siberia. Nothing was seen of Sannikof Land. About thirty nautical miles north-east of Cape Cheliuskin the expedition found a new island, free of ice, lying along the parallel. Its eastern end was seven miles broad. Thirty miles from the eastern point of this island land was again sighted on September 3, and the explorers reached the shore at lat. 80° 4′ N., and long. 97° 12′ E. They raised the Russian flag and gave to the newly discovered land the name of the Emperor Nicholas II. It is of volcanic origin, is lofty, and contains extensive glaciers. The coast was then traced north-westwards for a distance of twenty miles up to lat. 80° N., long. 96° E., when further progress was stopped by compact ice. On the way back the expedition called at Bennett Island, raised a monument to Baron von Toll, and took on board his collections, weighing 242 lb. The same publication reports the discovery of prehistoric remains on the shores of Lake Baikal, opposite Olkhon Island. Here M. Petri found eleven successive abodes of primitive man. Flint implements occurred in the lowest layer, and in the higher pottery, with designs becoming more artistic towards the upper levels.

A PROVISIONAL committee, formed of representatives of the Illuminating Engineering Society, the Institution of Electrical Engineers, the Institution of Gas Engineers, and the National Physical Laboratory, held a meeting on November 29 at which arrangements were made for the formation of a National Illumination Committee, to be constituted according to the statutes of the International Illumination Commission, with the primary object of affiliating Great Britain to that commission. The provisional committee recommended that the National Committee should consist of five representatives of each of the three technical societies, and two representatives of the National Physical Laboratory. This recommendation has been adopted, and the following have been nominated as members of the committee:—By the Illuminating Engineering Society: Mr. Leon Gaster, Mr. F. W. Goodenough, Prof. Silvanus P. Thompson, and Mr. A. P. Trotter (this society has not yet nominated its fifth representative); by the Institution of Electrical Engineers: Mr. F. Bailey, Mr. W. Duddell, Mr. K. Edgcumbe, Mr. Haydn Harrison, and Prof. J. T. Morris; by the Institution of Gas Engineers: Mr. E. Allen, Mr. J. Bond, Mr. W. J. A. Butterfield, Dr. H. G. Colman, and Mr. H. Watson; and by the National Physical Laboratory: Dr. R. T. Glazebrook, C.B., and Mr. C. C. Paterson. The first meeting of this National Committee took place on December 2, when the following were chosen as officers:—*Chairman*, Mr. E. Allen; *Vice-Chairmen*, Mr. W. Duddell and Mr. A. P. Trotter; *Honorary Secretary and Treasurer*, Mr. W. J. A. Butterfield. Great Britain is entitled to two delegates on the executive committee of the International Illumination Commission, and Dr. H. G. Colman and Mr. W. Duddell were accordingly appointed by the committee as the delegates from this country.

MR. MARTIN JOHN SUTTON, who died on Sunday, December 14, in his sixty-fourth year, was for many years the head of the seed establishment of Messrs. Sutton and Sons, Reading. He was a man of great energy and sound judgment; he had strong convictions and possessed the courage of them. Despite his long connection with the Royal Agricultural Society, on the council of which he served for nearly twenty-five years, he opposed strenuously the proposal to substitute a fixed show at Park Royal for the perambulating show which had done such fine service for agriculture. The event justified his opposition and approved his foresight. Notwithstanding the imperative claims of his business—claims which he never ignored—Mr. Sutton found time to take a prominent part in the agricultural, educational, and religious life of the country, as well as the civic life of his native town. Soon after the establishment of the college at Reading he became and remained a member of the council of that institution. He watched its growth with interest, and helped it with generous gifts, but not a few of those engaged in research in Reading count the kindly help and wise counsel which he bestowed so unstintingly among the greater of his gifts to the college. Like his co-partners and his successors, Mr. Martin John Sutton was willing always to place the vast resources of the Reading house and trial grounds at the disposal of those engaged in the investigation of plants and their uses. Mr. Sutton published several important papers on scientific subjects, and his volume on "Permanent and Temporary Pastures," which is a standard work, shows the great amount of exact and strictly scientific knowledge which may be amassed by men primarily engaged in business, and leads the merely scientific man to regret that this knowledge is not more often put into general circulation.

CAN any evidence be found of a change in the climate of Europe during the last thousand years before the Christian era? This question is discussed

in the *Naturwissenschaftliche Wochenschrift* (No. 44, pp. 689–93) by Mr. Ernst H. L. Krause. It has been prompted by the attempt of Sernander and others to prove that the last marked post-glacial change in the climate of Europe, when the mean annual temperature was about 5° C. lower than now, set in about 500 B.C. This era witnessed the Persian invasion of Greece, the return of the Jews from captivity, and some other national movements, which often are consequences of changes in the productiveness of a region. But contemporary writers, in their geographical descriptions, ought to afford some evidence of so considerable a variation of temperature, and on this point Herr Krause states the result of his investigations. Beginning with Homer, whose age probably corresponds with that of the best bronze work in the north (in which Sernander holds that the climate of Stockholm was dry and warm), he finds nothing to imply any difference in the eastern Mediterranean from its present mean temperature. Hesiod's writings (perhaps a century later) afford no hint of any alteration in the seasons, yet they deal with these and their relation to agriculture. Between his days and those of Aristotle, the temperature of Sweden must have fallen five degrees, yet the writings of the latter, though dealing with natural history, afford no sign of such a change. Theophrastus, Aristotle's pupil, writes on botany without giving any hint of such an occurrence. Herr Krause therefore concludes that this hypothesis has no historical basis, and that any slight alteration, if such there be, can be otherwise explained.

WE have received a copy of an article by Mr. E. Heller, published in the Smithsonian Miscellaneous Collections, vol. lxi., No. 1, on the northern, or Lado, race of the white rhinoceros (*Rhinoceros simus cottoni*), based on the large series of specimens obtained in the Lado Enclave during the Roosevelt expedition. The author believes that there really is good reason for the name "white" bestowed on the southern race of the species by the Boers. Full details of the distinctive characters of the skull and teeth are given in the article, of which a full summary will be found in *The Field* of November 15.

TO *The American Museum Journal* for November Dr. W. D. Matthew contributes an interesting notice of the vertebrate remains found in the well-known asphalt-springs of Rancho-la-Brea, California, which formed during the later part of the Tertiary period a veritable death-trap for the fauna of the adjacent country. Even now, when the springs are comparatively inactive, the animal that sets its foot on the apparently sound but really treacherous ground is as good as lost, but in the Pleistocene matters were ten times worse. Remains of more than fifty species of birds have been identified, and there were probably at least as many mammals. "Wolves, lions [?=pumas], and sabre-toothed tigers, eagles, and vultures are the most common of the remains found; next to them stand the larger Herbivora, bisons, horses, ground-sloths, and larger ruminants and wading-birds; while remains of smaller quadrupeds and perching or ground-birds are comparatively rare. This is a fact of grim significance, for it indicates that the larger quadrupeds, venturing out upon the seemingly solid surface, and caught in the asphalt, served as a bait for animals and birds of prey, luring them from all the country round about, and enticing them within the treacherous clutch of the trap; these in their turn falling victims, served to attract others of their kind."

THE latest issue (part 3 of vol. viii.) of Records of the Indian Museum is entirely occupied by reports on the zoological collections made by Mr. S. W. Kemp, assistant-superintendent of the museum, in the course of the punitive expedition against the Abors in 1911–12. One of the most interesting of Mr. Kemp's discoveries in the Abor country—of a species of Peripatus—is not, however, here described. Most of the reports are merely lists of species with exact records of times and places of capture; but several of them are of wider interest. Mr. Ekendranath Ghosh contributes an excellent and well-illustrated paper on the anatomy of slugs of the genera Atopos and Prisma. Mr. B. L. Chandhuri, who describes the fishes, brings an old controversy regarding McClelland's *Barbus spilopholus* to a satisfactory conclusion. And Mr. Kemp, in an interesting account of the river crabs and prawns, reiterates the extraordinary difficulty of dealing with the Potamonidæ in approved systematic fashion. The beautiful plates by A. C. Chowdhary and S. C. Mondul are a prominent feature of the volume.

THAT much-investigated animal, Amphioxus, still continues to provide material for elaborate anatomical memoirs, and will probably continue to do so for a considerable time. It is certainly very desirable that our knowledge of this most important type, which stands so near to what must have been the origin of the vertebrate series, should be as complete as possible, and two recently published memoirs set an admirable example of thoroughness in dealing with special systems of organs. In the first part of a memoir entitled "Untersuchungen über das Gefässsystem der Fische." (*Mitteilungen aus der Zoologischen Station zu Neapel,* Bd. 21, No. 4, 1913), B. Mozejko demonstrates the existence in Amphioxus of an elaborate subcutaneous blood-vascular system. The other paper referred to is Miss H. L. Kutchin's "Studies on the Peripheral Nervous System of Amphioxus" (Proc. American Academy of Arts and Sciences, vol. xlix., No. 10, 1913), in which the author describes, with great elaboration, the beautiful results obtained by *intra vitam* staining of the peripheral nerves with methylene blue. Both memoirs are admirably illustrated, and in both the amount of detail observed as the result of very skilful technical manipulation is highly remarkable.

AN important further contribution to the series of "Studies in Indian Tobaccos" has been published by Gabrielle L. C. Howard, in the Memoirs of the Department of Agriculture in India (vol. vi., No. 3). The author points out that though most of the varieties of tobacco at present grown in India give large yields and are therefore very profitable, the cured leaf produced from them is usually of very poor

quality, and is coarse and deficient in texture, flavour, and aroma, hence only available for Indian consumption, and bringing a low price. Improvements in quality of tobacco may be obtained (1) by the discovery of new cultivation methods ensuring a larger yield and a better quality of leaf; (2) by the introduction of improved methods of curing; (3) by the growth of superior kinds. The present paper deals with the third aspect of the question, the immediate problem being the production of a good cigarette tobacco, and details are given of the extensive experiments which have been made in the attempt to build up, by hybridisation, new kinds of tobacco suited to Indian conditions of growth, and possessing the qualities necessary to obtain a better price. The author has made a thorough investigation of inheritance in tobacco, with special reference to the morphological characters which are of economic importance, namely those concerning the habit of the plant and the leaf, but points out that it will probably take some years to obtain a complete knowledge of the subject, which has proved far more complicated than was at first supposed. The paper is illustrated by numerous plates.

THE valuable series of reports issued in connection with the Clare Island Survey is now approaching completion. We have just received a copy of the latest issue, No. 64 of the series. This deals with the Foraminifera, and the authors—E. Heron-Allen and A. Earland—are to be complimented on the exhaustive character of their report, which is illustrated on a most liberal scale. Besides being the longest report yet issued in connection with the survey, it is the largest single contribution to the literature of the British Rhizopoda since the publication of Williamson's monograph in 1858, and pending the issue of the new monograph on which the authors are now engaged, the Clare Island report should prove a useful handbook to workers in this order. No fewer than 299 species and varieties are recorded from thirty-seven shore sands and dredgings made in the Clare Island area, a surprising number in view of the general uniformity of depth and bottom conditions reported. Fourteen species and varieties new to science are figured and described in the report, which also records thirty-two other forms for the first time in Great Britain in the recent condition. Many of them are already known in Britain as fossils. Among other outstanding features of the report we notice with pleasure an exhaustive and up-to-date bibliography and an analysis of the important genus Discorbina, which is illustrated by a diagram of the affinities of the principal species. The publication of similar analyses as regards other genera would be of permanent advantage to the science.

THE United States Department of Agriculture has sent us the first number of the *Journal of Agricultural Research*, a periodical which will partly supersede the bulletins and circulars hitherto issued by the various bureaus and offices of the Department. The new journal—a large octavo—is well printed and illustrated, affording a worthy channel for the publication of valuable researches. The first number contains three papers. Mr. W. T. Swingle describes *Citrus ichangensis*, a new species from south-western China, which bears a fruit known as the "Ichang lemon"; it is believed that the plant is hardy and might be advantageously introduced into North America. Mr. B. H. Ransom describes in detail *Taenia ovis* (Cobbold), hitherto known only in the cysticercus stage from sheep. The adult tapeworm, now discovered in the dog, is compared with *T. marginata*, and other allied forms. The concluding paper, by F. M. Webster and T. H. Parks, deals with *Agromyza pusilla*, Meigen, the maggot of which mines in the leaves of clovers and many other plants, both in Europe and America.

IN the monthly chart of the Indian Ocean issued by the Meteorological Office for December some very interesting notes are given relating to the aurora in both hemispheres, selected from reports contained in ships' logs and other sources. Among the latter some valuable observations by Dr. C. Chree are especially noteworthy. Among these he mentions that in the north the latitude of maximum frequency is believed to vary from 55° in long. 60° W., to fully 75° in long. 90° E.; aurora is seen at least five times as often in the north of Scotland as in the south of England. There seems to be a fairly well-marked eleven year period, closely connected with the sun-spot period. The phenomenon is generally considered to be caused by electric currents in the atmosphere, but opinions differ widely as to the origin of these currents. Some of the best-known recent theories are quoted.

IN the Proceedings of the Cambridge Philosophical Society (xvii., 3, 1913) Prof. A. C. Dixon applies integration by parts to several well-known trigonometric expansions in powers of the sine of an angle, and he is thus able to write down the remainders after any number of terms.

IN reading a review in the Bulletin of the American Mathematical Society (xix., 10) of Dr. Gerhard Kowalewski's recent Calculus, we find quoted some interesting French verses from which, by counting the letters of the words, the ratio of the circumference to the diameter may be written down to thirty decimals. They are as follows:—

"Que j'aime à faire apprendre un nombre utile aux sages!
Immortel Archimède artiste ingénieur
Qui de ton jugement peut priser la valeur!
Pour moi ton problème eut de pareils avantages."

It is much easier to remember these verses than the numbers, derived from counting the letters, namely—

3·14159265358979323846264338 3279.

A SEPARATE copy has reached us of Prof. Millikan's paper on the elementary electric charge and the Avogadro constant which appeared in *The Physical Review* for August. It deals with an improved series of observations of the atomic charge of electricity by the method of falling oil drops. The improvements consist in a better optical system for observing the rates of fall of the drops, an arrangement for working in air at different pressures not exceeding atmospheric, a better method of eliminating convection in the air,

and the use of a more trustworthy value of the viscosity of air. The author also examines the correctness of the assumptions: that the viscosity effect is uninfluenced by the oil drops being charged electrically, that the drops are spheres, and that their density is the same as that of the oil in bulk. Prof. Millikan's final value for the atomic charge of electricity is $4{\cdot}774 \times 10^{-10}$ electrostatic units, the probable error being 1 in 500. From this value of the charge the author calculates the following constants: number of molecules per gram molecule, $6{\cdot}062 \times 10^{23}$; number of gas molecules per cubic centimetre at normal temperature and pressure, $2{\cdot}705 \times 10^{19}$; kinetic energy translation of a molecule at 0° C., $5{\cdot}621 \times 10^{-4}$ ergs; coefficient of the absolute temperature in the expression for the energy at any temperature, $2{\cdot}058 \times 10^{-16}$; coefficient of the logarithm in the expression for the entropy according to Boltzmann, $1{\cdot}372 \times 10^{-16}$; mass of the hydrogen atom, $1{\cdot}662 \times 10^{-24} g$; Planck's "quantum" of energy, $6{\cdot}620 \times 10^{-27}$ ergs; constant of the Wien displacement law, 1·447.

AT a meeting of the Alchemical Society on December 12 Prof. Herbert Chatley, of Tangshan Engineering College, North China, read a paper dealing with alchemy in China. Views similar to those of the medieval alchemists of Europe had been current, Prof. Chatley said, in China since 500 B.C. or even earlier. The Chinese alchemists regarded gold as the perfect substance, and believed in the possibility of transmuting base metals thereinto. They also agreed with European alchemists in employing bizarre symbols in their writings, in using mercury as the basis in attempting to prepare the philosopher's stone, in believing in the slow natural development of gold from other metals, and in postulating a sexual generation for all things. Many interesting particulars concerning this last tenet of the Chinese alchemists, the doctrine of Yin and Yang, were given, as well as others respecting their views concerning the elixir of life, in the possibility of obtaining which they firmly believed.

Engineering for December 12 contains an illustrated description of the Hamburg-American Co.'s T.S.S. *Konigin Luise*, which is fitted with Föttinger's hydraulic transformer for reducing speed between the turbine and propeller shafts. Sir John H. Biles attended the trials of this vessel, and his report is reproduced in our contemporary. Of special interest in the report is a complete table of comparison of the results for this ship and those for the *Caesarea* (turbine direct-driven) and for the *Normannia* (turbine mechanical-gear). At full power, the steam used per shaft-horse-power per hour, excluding auxiliaries, is 15·1, 12·2, and 12 lb., for the *Caesarea, Normannia,* and *Konigin Luise* respectively; the coal consumption per shaft-horse-power per hour for all purposes, stated in the same order of vessels, is 1·72, 1·34, and 1·31 lb. A special claim for the Föttinger transformer is ease in manœuvring; this claim is fully maintained in Sir J. Biles's report. Thus, in one experiment the engines were running at about 430 starboard and 410 port. In three seconds from delivery of the order the engines were stopped; after an interval of some seconds they were put to full speed astern, and in four seconds from the time the valve was opened the speed was 370 revolutions per minute. The complete time required to stop the ship was 1 minute 17 seconds, and she stopped in about a length and a half. It may be added that the total orders in hand for Föttingen transformers make an aggregate of 245,000 shaft-horse-power, including a 20,000 shaft-horse-power liner, two cruisers of 45,000 and 30,000, and several destroyers, each of 25,000 shaft-horse-power.

WE have received a copy of the first number of a new monthly Italian journal devoted to the automobile, under the title, *H. P.* It is excellently printed, copiously illustrated, and contains interesting articles of technical and general interest. Amongst these may be noted a description of the "Fiat" works at Turin, and an article on rubber culture and manufacture. At the present moment no similar journal exists in Italy, and the new venture will doubtless fill a real want.

MESSRS. G. ROUTLEDGE AND SONS, LTD., will publish in January a "Handbook of Photomicrography," by H. Lloyd Hind and W. Brough Randles.

MANY old and rare works on mathematics, physics, chemistry, and kindred subjects, including a large collection of works by Newton and de Morgan, are comprised in a catalogue just issued by Messrs. H. Sotheran and Co., 140 Strand, W.C. A number of copies of Newton's "Principia" is included in the list, and we notice particularly a copy of the first edition of that immortal work offered at the price of eighteen guineas.

MESSRS. J. AND A. CHURCHILL are about to publish the following new books and new editions:—"A Manual for Masons," by Prof. J. A. van der Kloes, revised by A. B. Searle; "Modern Steel Analysis," by J. A. Pickard; "The Story of Plant Life in the British Isles," by A. R. Horwood; "Materia Medica, Pharmacy, Pharmacology, and Therapeutics," by Dr. W. Hale White, thirteenth edition; "Elementary Practical Chemistry," part i., by Dr. Frank Clowes and J. Bernard Coleman, sixth edition; "The Medical Directory, 1914."

OUR ASTRONOMICAL COLUMN.

A REFRACTION ACTING RADIALLY FROM THE SUN.—In the expression for the variation of latitude, a term exists which is independent of the position of the observing station and which has a periodic character. M. L. Courvoisier has suggested that either the sun has an atmosphere which extends to very great distances or that the æther is denser nearer the sun, causing a small refraction in the light of stars, and thus producing this periodic variation in their positions. M. L. Courvoisier's paper, entitled "Ueber systematische Abweichungen der Sternpositionen im Sinne einer jährlichen Refraction" (*K. Sternwarte,* Berlin, No. 15), indicated that many series of observations pointed towards the existence of this refraction varying in amount with the angular separation, according to a formula which he deduced. His observations included a number of stars at different distances, both in right ascension and declination from the sun. The amount of this refraction near the sun he derived from observations of Venus near upper culmination between the years 1858 and 1909. Mr. F. E. Ross points out a correction to Courvoisier's

yearly refraction in *Astronomische Nachrichten*, No. 4699, due to the observations of Venus being compared with an ephemeris computed from Leverrier's tables, which, as he says, are in error in a respect important in a discussion of this kind. The result of the correction is greatly to increase the refraction in the neighbourhood of the sun found by Courvoisier.

RESEARCHES AT THE ALLEGHENY OBSERVATORY.—No. 4, vol. iii., of the Publications of the Allegheny Observatory contains an account of the orbit of λ Tauri by Prof. Frank Schlesinger. The variable nature of this star was originally discovered by Baxandell in 1848, and it was the second star, Algol being the first, that was recognised as an eclipsing variable. In this research eighty-nine spectrograms of the star were utilised, and from these the definite elements are given in the paper with the velocity curve corresponding to them. Certain residuals indicate the presence of some disturbing element in the system the nature of which is unknown. Mr. Frank C. Jordan, in No. 5 of the Publications, deals with the spectrographic observations of ϕ Persei, a variable which has received considerable attention by a great number of observers. The special character of the spectrum and velocity curve, coupled with the changes which take place in the spectrum of this star at different parts of its orbit, and in its velocity curve in different cycles, presents a problem yet unsolved. Mr. Jordan's investigation adds another research to the star's credit, but he finds that no single orbit or combination of orbits will satisfy the conditions required. In No. 6 of the Publications Mr. A. H. Pfund describes a very satisfactory result to his preliminary thermo-electric measures of stellar radiation. While the conditions under which he had to employ his apparatus were by no means very favourable to secure the best results, yet the magnitudes of the deflections he obtained were very promising. In his paper he describes the general arrangement of the apparatus and the thermal junctions used, and gives the deflections due to Vega, Jupiter, and Altair. Mr. Jordan suggests the desirability of developing thermo junctions of still higher sensitiveness, and galvanometers of greater sensitiveness, and uses them in conjunction with the largest reflectors, so that stars down to even the 4th magnitude may be studied.

ZODIACAL MATTER AND THE SOLAR CONSTANT.—In citing four cases where zones of asteroids have been hypothecated to explain planetary and cometary perturbations and lunar inequalities, Mr. E. Belot, in a note in *Comptes rendus* (No. 18) points out that he published in 1905 a formula to take the place of Bode's law, and that certain of the five zones of asteroids this formula predicts supply just the material in just the right positions. He proceeds further, and makes the suggestion that the transit of these zones across the sun's disc may be found to supply the probable cause of variation of the solar constant established by the work of Abbot, Fowle, and Aldrich.

THE PHYSICAL SOCIETY'S EXHIBITION.

THE ninth annual exhibition of the Physical Society of London was held in the Physical Department of the Imperial College of Science on Tuesday, December 16, and attracted the usual large attendance at both afternoon and evening sessions. In addition to the short discourses which have for some years formed a popular feature of the exhibition, a new departure was made by the introduction of several interesting experiments illustrative of recent research. In the exhibition proper about thirty firms showed their most recent forms of apparatus.

The first discourse was given by Mr. Louis Brennan, C.B., who exhibited and described a simple apparatus for making large soap films, and demonstrated their properties. The film was formed on a frame of elastic which was capable of considerable extension, thus reducing the thickness of the film and showing the consequent change of the colour of the reflected light. The second discourse was by Prof. J. A. Fleming on the vibrations of loaded and unloaded strings. The string was caused to vibrate by means of a motor, to the shaft of which one end was excentrically attached. The tension could be adjusted by moving the pillar to which the other end was fixed. The effect of loading was shown by using strings twisted together, and also by the addition of beads. The reflection which takes place when the wave-length is reduced to the distance between successive beads was clearly shown, as was also the difference between the effect of a single large load and that produced by a load distributed over some distance, gradually increasing in amount and then diminishing. Prof. Fleming pointed out the application of these experiments to the case of the reflection and transmission of light at the boundary of two media, and to the more important case of loaded telephone cables.

Among the experiments already mentioned, Mr. W. E. Curtis exhibited the band spectrum of helium. A vacuum tube at a pressure of several millimetres was excited by an induction coil, a condenser and spark-gap being included in the secondary circuit. With suitable capacity and length of gap, the spectrum shows a number of bands in addition to the ordinary helium lines. An experiment illustrating ionisation by collision was shown by Mr. F. J. Harlow. An electrodeless discharge was excited in a spherical bulb and the pressure reduced. It was found that the discharge could be continued at a much less pressure than usual if heated lime or aluminium phosphate was present to produce ionisation. The phosphorescence of mercury-vapour in a vacuum excited by light from a mercury lamp was exhibited by Mr. F. S. Phillips. Prof. J. T. Morris and Mr. J. F. Forrest showed an electric arc which they suggest for use as a standard of light, the light from the positive crater being quite unobstructed. Messrs. C. C. Paterson and B. P. Dudding had a simple device on exhibition for reducing the glare from motor headlights by confining the light to the region below the horizontal on the right-hand side as seen from the car. An indicator for use with high-speed internal-combustion engines was shown by Dr. W. Watson, and also an arrangement for studying the spectrum of a burning mixture at different stages of the combustion. An experiment on the interference of X-rays by a crystal of rock-salt through which they were passed was shown by Dr. G. W. C. Kaye and Mr. E. A. Owen, the crystal patterns being visible on a fluorescent screen.

THERE was a large number of interesting features among the exhibits of the firms. The Cambridge Scientific Instrument Co. had on view an electrostatic oscillograph designed by Prof. H. Ho and S. Kotô, of Japan, which possesses important advantages over the electromagnetic oscillograph for high-voltage work. A contact-breaker for physiological work which could successively interrupt two circuits with an intervening period of from 0·0002 second to 0·04 second was also shown. An inexpensive form of independent plug contact for resistance boxes was shown by Messrs. Gambrell Bros. A simple apparatus for measuring the pressure of light, designed by Mr. G. D. West, was exhibited by Messrs. J. J. Griffin and Sons. Mr. R. W. Paul exhibited a large number of electrical laboratory instruments, including a simple device for projecting an image of the scale and pointer of an instrument on a screen for lecture

purposes. Among the exhibits of Messrs. Isenthal and Co. was a collection of pladuram products, a form of tungsten specially treated, which it is hoped to apply to purposes where a hard, inert metal is required. Radio-active preparations were shown by Mr. F. Harrison Glew. The principal exhibit of Messrs. Muirhead and Co. was a Heurtley magnifier for use in cable telegraphy or wireless telegraphy, or wherever it is required to magnify the effect of small mechanical movements. Instruments connected with wireless telegraphy were shown by the Marconi Company, the Ludgate Wireless Company, and Messrs. Graham and Latham, while very complete exhibits of projection apparatus and microscopes for all purposes were shown by Messrs. Carl Zeiss, Messrs. E. Leitz, Messrs. Newton and Co., and other firms. The instruments of Messrs. H. Tinsley and Co. for colour measurement and for lens testing, and the new miniature precision instruments of the Weston Co., are also worthy of mention.

THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE.

THE first International Congress of Tropical Agriculture was held in Paris in 1905, and was organised by a number of French men of science interested in this subject. At its close the Association Scientifique Internationale d'Agronomie Coloniale et Tropicale was founded, to promote in every possible way scientific work in tropical agriculture. Branches of this association were gradually founded in Belgium, France, Germany, Great Britain, Italy, Portugal, and elsewhere, until at present practically every country interested, either on its own account or through its colonies, in tropical agriculture, is represented on the Central Bureau of the association, which has its headquarters in Paris. In 1910 a very successful second Congress of Tropical Agriculture was held in Brussels. At the close of that congress M. de Lanessan, formerly Governor-General of Indo-China, who had up till that time been president of the association, retired, and was succeeded by Prof. Wyndham Dunstan, C.M.G., F.R.S., director of the Imperial Institute.

The International Association has decided to hold the third Congress of Tropical Agriculture in London, at the Imperial Institute, on June 23–30 next year, under the presidency of Prof. Dunstan. A strong organising committee, including Sir D. Prain, director of the Royal Gardens, Kew; Sir S. Stockman, chief veterinary officer to the Board of Agriculture and Fisheries; Mr. Bernard Coventry, Agricultural Adviser to the Government of India; Dr. F. Watts, Imperial Commissioner of Agriculture for the West Indies, and other eminent authorities on tropical agriculture, has been at work for some time in preparation for the congress.

It is proposed to devote the afternoon meetings of the congress to papers, and the morning meetings to a series of discussions on important problems of special interest, such as technical education and research in tropical agriculture; outstanding scientific problems in rubber production; methods of developing cotton cultivation in new countries; problems of fibre production; agriculture in arid regions; and hygiene and preventive medicine, in their relation to tropical agriculture. The organising committee will welcome contributions on these or allied subjects.

For further information regarding the arrangements for the congress, the communication of papers, &c., application should be made to the organising secretaries (Dr. T. A. Henry and Mr. H. Brown), Third International Congress of Tropical Agriculture, Imperial Institute, London, S.W.

PHYSICAL CHEMISTRY OF SOLUTIONS.

AS is well known, the progress in the physical chemistry of solutions which has been made during the last thirty years, though extensive and detailed in a certain sense, has nevertheless suffered not a little from the fact that fully 90 per cent. of the investigations have been restricted to the study of the behaviour of substances dissolved in *water*. At the present time, therefore, whilst a very large amount of data has been accumulated upon the subject of aqueous solutions, our knowledge of the behaviour of non-aqueous solutions and solutions formed in mixed solvents is deplorably scanty. Of course, here and there the subject has been attacked, especially within the last decade, and a few general conclusions have been laboriously attained. Many of the rules, however, which serve as a trustworthy guide in the case of aqueous solutions have to be considerably modified or even discarded altogether when we come to non-aqueous solutions. At the same time, it is clear that the problem of solution in general cannot be regarded as in a satisfactory state, so long as generalisations applicable to a large number of solvents at least are wanting.

It is for this reason that we welcome the monograph published by Prof. H. C. Jones, entitled "The freezing point-lowering, conductivity, and viscosity of solutions of certain electrolytes in water, methyl alcohol, ethyl alcohol, acetone, and glycerol, and in mixtures of these solvents with one another" (Publication No. 180, Carnegie Institution of Washington). The present work is to be regarded as supplementary to Publication No. 80 of the same institution. The actual experimental work has been carried out by several investigators, under the direction of Prof. Jones. Each of these investigators, after giving an account of the experimental methods and results obtained for various salts—inorganic salts—in various solvents, pure and mixed, makes a very brief summary of conclusions, the whole field being finally reviewed by Prof. Jones himself in a general discussion, which occupies the last dozen pages or so of the book. As was to be expected, great stress is laid upon the generality of the phenomenon of solvation and much of the work is devoted to the elucidation—naturally with varying success—of the three fundamental factors:—(1) Change in solvation, which changes the mass and size of the ion; (2) change in the viscosity of the solution with change in temperature thereby affecting the friction of the ions in moving through the solution; and (3) change in the number of dissolved particles—molecules and ions.

The publication as a whole is a monument of industry which reflects the greatest credit upon the laboratory from which it emanates. It is sincerely to be hoped that the systematic accumulation of similar data will become much more general than has hitherto been the case.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THIS has been a year of congresses for physiologists. The International Congress of Medicine, the International Congress of Physiology, and the British Association all took place during August and September. In spite of the fact that the British Association came last, the section of physiology had a very successful meeting.

The president's address was especially interesting, as it gave the views of an organic chemist on the physico-chemical aspect of his work. The address has already appeared in NATURE (October 16, p. 213).

On Monday morning, September 15, the section of physiology held a joint meeting with the section of agriculture. A paper by Prof. Sörensen and a discussion on the physiology of reproduction occupied the attention of the two sections.

Prof. Sörensen dealt with the measurement and the significance of the hydrogen ion concentration in biological processes. He began by pointing out that the hydrogen ion concentration gives more information than the statement of the amount of acid in the solution. Some of the acid may be neutralised or unionised, and hence it does not exert its full acidic power. A similar relation holds between hydroxyl ion concentration and alkalinity.

As the product of hydrogen and hydroxyl ion concentrations is constant at a given temperature, the most convenient method of expressing acidity or alkalinity is in terms of hydrogen ion concentration. Owing to the hydrogen ion concentration in biological processes being very small, he uses the sign p_H to indicate the negative exponent of the normality in respect to hydrogen ions. Thus $2 \times 10^{-6} = 10^{-5 \cdot 69}$; therefore $p_H = 5 \cdot 69$.

The electromotive measurement of hydrogen ions is the standard method, but the colorometric indicator method is more convenient for many purposes.

The use of "buffers," by which acid or alkali formed during a reaction is neutralised without an appreciable change in hydrogen ion concentration, enables one to study the effect of the hydrogen ion concentration on various processes. The cases illustrated were invertase and other enzymes, hæmolysis, and phagocytosis.

The discussion on reproduction was opened by Mr. K. J. J. Mackenzie, who pointed out that the stock-breeder was well trained and ready to absorb sound knowledge, but that the knowledge was not there for him to have. There are many problems of a practical nature and of great financial importance in regard to stock-breeding, but he spoke mainly about two of them.

The first was the problem of the "Free Martin." A heifer born twin to a bull is said to be sterile. Several cases were investigated, and it was found that some were sterile and others fertile. If it could be predicted which are the fertile ones, this knowledge would make a considerable difference to the prices obtained at sales of pedigree stock. Mr. Mackenzie pointed out that twins may result from the fertilisation of two eggs or by the division of one fertilised egg into two individuals. The former would possess two separate amnions, whilst the latter would be contained in a common amnion. Observation at birth of the presence or absence of two amnions and correlation of the observations with the subsequent histories of the offspring might solve the problem which heifers would be fertile. In reply to a question he said that sterility of the bulls was much less important, as they were usually castrated.

The second problem was that of "black belly" in swine. It was considered that this was due to œstrus, and that bacon made from such animals was unwholesome. Investigation showed that the pigmentation is due to skin pigment, and that œstral changes are so slight as to be overlooked in slaughter-houses. If the prejudice to the pigment cannot be overcome, the remedy is to breed swine without mammary pigment.

Problems in milk production and sterility in bulls and stallions were also quoted as subjects requiring investigation.

Mr. Geofrey Smith sent in an abstract dealing with the glycogen and fat metabolism of crabs. The males and females present striking differences. Males have less fat and more glycogen in their livers than do the females. The blood of the male is pink, whilst that of the female is yellow. Infection with sacculina causes disappearance of sexual changes, and the males become like the females in composition.

Dr. L. Doncaster mentioned other cases in which the males and females differ. For instance, in caterpillars, by the precipitin test, the two sexes can be shown to differ more than the same sexes but of different species. He suggested that male and female characters are present in both cases, but that some factor, by influencing metabolism, determines which sex develops. Sacculina apparently causes the same type of metabolism as does the female factor.

A combined meeting with the sections of zoology and botany was held on Tuesday morning, September 16. Prof. B. Moore, F.R.S., gave a communication entitled "Synthesis of Organic Matter by Inorganic Colloids in presence of Sunlight, considered in relation to the Origin of Life."

His view is that the first organisms would not contain chlorophyll, and hence there must have been a supply of organic matter before the organisms could flourish. He demonstrated that from water containing carbon dioxide and colloid, formaldehyde is produced by ultra-violet light.

He then outlined the scheme of development whereby increasing complexity causes instability, and that regions of stability occur by the formation of a new order of substance. As the material becomes more complex, its properties alter. Therefore, although one can trace the relationships from one to another, objects widely separated behave differently.

Æther and energy give rise to the electron, and the electron to the atom. When the atom becomes too large and unstable, the molecule is formed. Combinations occur between molecules by molecular affinities, *e.g.*

$$Na_2SO_4 + 10H_2O \rightleftharpoons Na_2SO_4.10H_2O.$$

Molecular combinations form colloids, which are unstable substances, resembling the instability of living organisms, and finally living cells are formed. Social organisation such as that of the hive bees may be the next step, when the individual has reached its highest possible development.

Sir Oliver Lodge agreed with Prof. Moore that new possibilities enter matter with increase in complexity, and that complexity and instability are necessary for life. He also stated that the synthesis of potentially living matter is not the same as the origin of life.

Prof. Armstrong stated that it is not possible to arrive at the production of life. He gave instances of several other ways in which formaldehyde can be synthesised in the laboratory. He did not consider that colloid was necessary for the synthesis. His opinion is that the asymmetry of the chemical composition of living organisms is the only difficult point to understand, but that once asymmetry has been produced, enzymes can direct the asymmetrical synthesis.

Dr. Hopkins, Prof. Leonard Hill, and Prof. Hartog criticised various points, and agreed with Prof. Armstrong and Sir Oliver Lodge in several of their statements.

Prof. Priestley gave several instances of synthesis of formaldehyde without colloids, but he claimed that colloids were important for energy changes in cells. Sugar can be produced by bubbling carbon dioxide through alkali in the light of a mercury lamp. He suggested that asymmetry might be produced by the action of polarised light which is found in the surface layers of the sea.

Prof. Rothera said that the discussion took two divisions: criticism of details and criticism of generalisations. He believed the sequence outlined in Prof. Moore's statement to be quite correct.

Prof. Moore, in replying, said that he did not claim

that the synthesis is new, but he knew that formaldehyde had been produced by ultra-violet light. Prof. Armstrong's examples were mainly reactions, which could be brought about by human agency in the laboratory, but that the conditions were unlikely to occur naturally at an early stage of the world's history. Because Prof. Armstrong has difficulty in understanding the production of asymmetry, this does not obscure the point that energy can be accumulated by synthesis without chlorophyll. The problem of asymmetry would *follow* the production of organic matter.

The new idea is not the synthesis but the point of view, and he considers that under the natural conditions synthesis would be aided by colloids even if the colloid were not absolutely necessary. In many cases, such as synthesis in presence of uranium, colloid would also be present.

Friday, September 12, was devoted to a joint sitting with the subsection of psychology, and the proceedings will be recorded in the report of that subsection.

On one of the reports there was a general discussion, in which Dr. A. D. Waller, F.R.S., Sir Frederic Hewitt, Prof. Gilbert Barling, Dr. McCardie, Mr. F. J. Pearse, Prof. Saundby, and Prof. Vernon Harcourt, F.R.S., took part. These speakers unanimously agreed that there should be some State regulation of anæsthesia.

The present position is that anyone can administer anæsthetics such as chloroform, ether, cocaine, &c., without any restriction. Sir Frederic Hewitt pointed out that a railway accident was followed by an inquiry, but there was no inquiry after a death from anæsthesia. Porters and cloak-room assistants do not drive engines, yet anyone can administer an anæsthetic to another person. The object of this discussion was to urge on the Government the necessity of regulating the administration of anæsthetics. Motions to this effect have been passed by the British Medical Association, the Medico-Legal Society, the International Congress of Medicine, &c.

Dr. Duffield explained the report on calorometric observations on man, by lantern slides illustrating the work done. The carbon dioxide output has been especially studied. During the early stages of work carbon dioxide accumulates in the body, and hence the output rises slowly. At the end of ten minutes the output becomes uniform, showing that the body is sufficiently saturated to give off the carbon dioxide as rapidly as it is formed. After the end of the work the excess of carbon dioxide must escape, and hence there is a slight continuation of the increased output.

Prof. E. Wace Carlier described the histological structure of the post-pericardial body of the skate. It is a small body the size of a grain of rice. The structure resembles that of the carotid gland in mammals, and he considers that it is a chromaffin gland.

Prof. Leonard Hill, F.R.S., gave two communications. The first was a demonstration of his katathermometer, which consists of two thermometers heated to about 120° F. The time necessary for them to cool from 110°–100° F. is recorded; one has a dry bulb and the other has a piece of moist cloth round the bulb. These give an indication of the physical condition of the air, and this physical condition is, in ordinary circumstances, of far greater importance to well being than the presence or absence of respiratory waste products.

His second communication (with Dr. McQueen) was on the pulse and resonance of the tissues. Where the arteries are superficial, the blood pressure, as measured by the sphygomanometer, is lower than where the arteries are surrounded by the tissues. The tissues resonate with the arterial pulsations, and thus the pressure appears higher.

Prof. A. B. Macallum, F.R.S., and Dr. J. B. Colip described the blackening of nerve cells, but not nerve fibres, with silver nitrate. The change is not due to chloride, phosphate, or protein. It is due to some reducing substance which they believe to be an oxyphenol allied to adrenaline. The medulla of the suprarenal bodies gives a similar reaction.

Dr. F. W. Mott, F.R.S., read a paper on the biochemistry of the neurone. He commenced by pointing out that the Nissl granules disappear from the nerve cells of animals fed on white bread and from cells of which the axons have been cut. These appearances can be seen only in fixed cells. Living cells suspended in lymph or cerebro-spinal fluid show no Nissl granules, but the contents appear like an emulsion. With dark ground illumination the emulsion particles appear luminous, but show no brownian movement. No particles are visible in the axon where it is surrounded by the mycelin sheath. Dilute ammonia causes the cells to become irregular, the particles to escape, and to show brownian movement. Acids and some dyes cause appearances like Nissl granules.

Cells placed in methylene blue stain but show no granules. If deprived of oxygen, the cells do not stain blue as the leuco base is formed. On allowing oxygen to enter the tube, the cells stain, showing that the leuco base had been absorbed by the cells.

Dr. J. Tait described experiments on blood coagulation, in which he observed agglutination of corpuscles to the edges of the wound in Gammarus and in tadpoles. Some crustacea have blood which does not coagulate, yet hæmorrhage is stopped as rapidly as in those whose blood does coagulate. It is difficult to understand the advantage of coagulable blood.

Dr. J. Tait and Miss Macnaughton demonstrated the advantages of the heart of the hedgehog for perfusion experiments. It can be removed and kept beating by perfusion with Ringer solution at any temperature between that of the body and ordinary room temperature.

Dr. J. Tait and Mr. R. J. S. McDowall: The muscles which extend from the skeleton to the skin of the back of hedgehogs will contract at temperatures from 0°–40° C., and they require no oxygen supply. A muscle placed in a narrow glass tube filled with Ringer's solution will remain active for hours even if repeatedly stimulated.

Dr. Dawson Turner read a paper describing the effect of treating exophthalmic goitre with radium. He found that the treatment was beneficial.

The following three papers are of cognate interest, and they are therefore described together.

Prof. Georges Dreyer and Dr. E. W. Ainley Walker read two papers on the relation of organs to the general body weight. The normal relation is important, as variations are of interest in studying abnormal conditions. These authors find that the relation of the blood volume to body weight is given by the formula: Blood volume $= \frac{(\text{body weight})^n}{K}$, where n and K are constants. For birds and mammals n is approximately 0·72, and for cold-blooded animals n is 1·3. Therefore, for the former, the determining factor is the body surface, and for the latter the weight of the muscles. Similar relations hold for the area of the aorta and of the trachea.

Altitude affects the blood volume by a variation in the constant K. On going to high altitudes the blood volume decreases and the hæmoglobin content increases, pointing to concentration by removal of water. The hæmoglobin is slightly increased after severa

days, and the blood volume also slightly increases. On returning to lower levels the blood volume rises and the hæmoglobin percentage decreases, but neither returns to its original level until several days later.

Dr. H. E. Roaf found, when the weight of the kidneys is expressed by a similar formula, that n is approximately 1·5, and hence the body surface does not regulate the kidney weight. Possibly there is some reciprocal relation to the skin; or, like the blood volume of cold-blooded animals, the kidneys depend upon the mass of muscle in the body.

In concluding this account of the section of physiology, we feel that some reference should be made to a new feature. The section was strengthened by having associated with it the first subsection of psychology. H. E. ROAF.

GEODETIC OBSERVATIONS AND THEIR VALUE.[1]

IT is not always the greatest inventions, or those which come most prominently before the public, which effect the greatest revolutions in the field of practical science; it is often the perfecting of instruments that have been long in use which is chiefly responsible for progressive results of startling significance. For instance, in the scientific researches of chemical investigators, or in matters relating to pathology and meteorology, it is seldom that a fresh discovery is due to the invention of a new instrument; it is almost invariably the development of the power of assisting observation already existing in the old instruments which has effected new discoveries. This is peculiarly the case with modern instruments used in connection with geodetic work. It is the perfection with which the metal arc can now be graduated with equal divisions representing degrees, minutes, and seconds which has so greatly altered the conditions under which geodetic triangulation can be extended. The improvements effected in base measuring apparatus is another factor in the rapid evolution of earth measurement and map-making all over the world; whilst the improved pendulum for the registration of the varying force of gravity, corresponding to the varying conditions of density which obtain in the earth's crust, renders investigations into the science of isostasy more simple and more certain than could possibly have been anticipated, say, fifty years ago.

These developments in the processes of advancing the practice of geodetic measurement over the surface of the earth are of more importance than is generally recognised, because the direct connection between geodesy and geography is not rightly understood. Geodesy is not a mere abstract science dealing with the shape of the earth and solving mathematical problems connected with its eccentricity, or determining the variable density of the earth's crust by careful investigations into the force and direction of gravity; it furnishes the basis and the framework of all that extension of earth measurement of which the final outcome is the map. Geodesy offers but little field for such form of illustration as will readily fix it in the minds of men as a sound practical everyday working science essentially necessary for the economic and political advancement of civilisation.

Geodesy began with the measurement of arcs on the earth's surface in various parts of the world by the process of extending a series of triangles along that arc from a measured base at one end of it. Rigorous accuracy was the dominant feature of such measurements. The measurement of a base a mile or so in length was effected formerly by means of "compensation bars" of a given length, which were designed with infinite care and armed with mechanism for longitudinal, vertical, and transverse adjustment, and it was a most elaborate and lengthy process. The process was repeated at intervals, if the triangulation series was a long one, in order to ensure results as near absolute accuracy in linear measurement as was possible. It took months to measure a base. Now it is found that by using a wire composed of "compensating" metals and stretched along a series of cradles or supports, the same result can be obtained in about one-tenth the time. The Jaderin apparatus, which includes a wire 25 metres in length, affords the simplest means of obtaining accurate base measurement; but there is still an appreciable defect, due to varying conditions of temperature, which renders it necessary to compare the wires before and after use with a standard measurement. The Eötvös torsion balance represents, perhaps, the latest improvement in apparatus for the measurement of base lines.

Independently of the base, however, the real secret of the facility with which strictly scientific geodetic triangulation can be carried over large areas of new country lies in the improvement in the art of graduating metal arcs, which has rendered the comparatively light and portable 12-in. theodolite equal for purposes of rigidly accurate observation to the old 2-ft. or 3-ft. instrument of the past. In India, where one of the first and most perfect systems of geodetic triangulation has been carried out, it used to be necessary to call quite a large number of carriers into the field to convey the clumsy old instruments from one observing point to the next. Paths had to be cut with much labour and patience through the jungle; roads had to be smoothed out and carried up the sides of the hills. The expense would have been prohibitive but that labour was cheap in those days. The time occupied over the process of completing observations, even at only one station, frequently lengthened out into months. Nowadays there is a new generation of scientific observers educated in English schools, who need lose no time in carrying first-class work through the wild tangle of African hills and forests to determine a boundary; or in threading their way with infinite patience by the rock-bound defiles and snowy heights of the Himalayas to a junction with Russian Surveys on the Pamirs.

It has always been the aspiration of English surveyors to link up the magnificent survey system of India with that of Russia. To a certain extent this was effected by methods which cannot be accepted as scientifically regular during the progress of the Pamir Boundary Commission in 1895. The surveyors did, however, actually close on a determined point common to both surveys (it was the first boundary pillar at the eastern end of Lake Victoria) after carrying an irregular triangulation across the great snowy ranges of the north-west, and the resulting agreement between the two values was almost too good to be altogether satisfactory. The means did not justify the end. It was impossible to ascend the gigantic peaks of the intervening ranges within the limits of the time available, and it was necessary, therefore, to be content with seeing across them here and there, under specially favourable conditions, instead of observing from them. Lately, however, a more regular and systematic attempt has been made to turn those ranges which cannot be crossed, and a direct series has actually been driven round these gigantic buttresses of the north on to the Pamirs. The results of this extraordinary feat are not yet published, but they furnish an example of what may be attempted in these days by the introduction of an improved class of comparatively small instruments.

[1] Abstract of an address delivered at the opening of the 160th session of the Royal Society of Arts on November 19, by the chairman of the council, Sir Thomas H. Holdich, K.C.M.G.

Reference was made in the address to the widespread increase of geographical knowledge during the last twenty-five years, and to the appreciation of geography as a leading subject for education in the universities and schools of England. This was not to be accepted as entirely due to an appreciation of the fact that the study of geography is an absolute necessity in face of the world-wide competition for commercial supremacy, or of political discussions involving the destiny of nations, or even in the field of the military campaign where geographical knowledge spells success. The effect of new facilities in the matter of locomotion counts for much in this stirring up of public interest in geography. People move rapidly, and they move widely and in ever-increasing numbers, and, to a great extent, they now study the map to know how and where they are going. The motor-car and the bicycle are responsible for much of this newly acquired interest in geography, and the mapping of the British Isles, and, in a less degree, of the Continent, is now familiar to thousands who would never have looked at a map fifty years ago. It is satisfactory to observe that the widespread knowledge thus distributed amongst the millions has become specialised with those whose business it is to conduct either political or military campaigns.

The very first element in the acquisition of geographical knowledge is the proper and correct use of technical geographical terms. In the course of the address instances were given of the disastrous results which may follow the use in political agreements of vague and loose geographical definitions or of the names of places the existence of which was not properly authenticated. The Russo-Afghan boundary settlement of 1884 was cited as an instance of the latter error. That boundary commission has become historical owing to the occurrence of the "regrettable incident" at Panjdeh, when a Russian force displaced the Afghans and secured an advance of the Russian frontier thereby which was never disputed by our Government, in spite of the fact that the joint commission was to effect a peaceable settlement of an international question. The Gladstone Government came to an end, and Lord Salisbury became Prime Minister just at the critical juncture when the success or failure of the mission hung in the balance. The Russian Commission took the field, and the settlement of the boundary proceeded. Then there ensued a useless and most expensive hunt, which lasted for months, in order to determine where on the Oxus a certain "post" existed, which was rendered an obligatory point in the boundary agreement, and which was nowhere to be found. Thousands of pounds were spent over that futile quest, which ended in the discovery that if such a "post" as that described in the protocol had ever existed at all it had disappeared long ago into the river-bed—so long ago as to be beyond the recollection of the oldest local authority. The prolongation of the Commission's stay in Afghanistan was not only expensive; it was dangerous, inasmuch as the temper of the Amir at that time was most uncertain. Moreover, the Russian Government was then to be as little trusted as that of Afghanistan. Useless delay was on every account to be avoided.

A wrong application of elementary geographical terms was instanced in the settlement of the eastern end of the same Russo-Afghan boundary in 1895. It was a matter of urgent importance that this boundary should be settled in the Pamir region in the short season which elapsed between the opening of the passes in the spring and the closing of them by snow in autumn. There was no reason to anticipate delay or difficulty arising from the determination of the geographical position set out in the political agreements. As in the case of the "Penjdeh" boundary, a scientific basis for that position had been carried from India to the scene of action, and the Russian men of science accepted the data of the English surveyors. Trouble came only when the boundary as defined in the agreement was to be carried in an easterly direction from a certain ascertained point to the Chinese frontier. This was the crucial point of the boundary inasmuch as it covered those passes which were supposed to lead from Russia Indiawards. It was the "easterly direction" which caused the trouble. Was it to be accepted as a little east of north, a little east of south, or due east? No agreement with the Russian representatives could be arrived at, and business came to an end. There was every prospect of a long and risky winter sojourn on the "roof of the world" for the Commission. Luckily the possible deadlock had been foreseen, and the political translation of the term "easterly direction" had been requested in advance. The answer came just in time to save the situation. The Commission was withdrawn (not without risk) over the passes, and the boundary region left to winter solitude. The expression "foot of the hills" proved to be a stumbling-block in the way of another important boundary settlement. What constitutes the "foot of the hills"? Is it where steep slopes end and the more gentle glacis, or fan, reaching down to the drainage line of the valley, commences, or is it that drainage line itself where all slopes end? The latter was once adopted as the free translation of that term, and so great was the indignation stirred up by that translation that it seemed likely to end in war.

Instances of want of appreciation of the slight elementary knowledge of geographical definitions such as would save similar mistakes might be multiplied, but, after all, the greatest losses in territory, or financially, have accrued from the actual want of properly authenticated map information when determining international boundaries. No instance perhaps exists of a more forcible character than that of the boundary dispute between the two great South American Republics, the Argentine and Chili. Here a boundary dispute resulted from the framing of an agreement between the political representatives of the two countries without any preliminary examination of the geographical features of the country concerned. The boundary, according to this agreement, was to follow the main range of the Cordillera of the Andes which parted the waters of the Pacific from those of the Atlantic. There are "main" ranges in the southern Andes of quite sufficient importance to justify the conditions required, if they did but part the waters of the Pacific from those of the Atlantic. But the great rivers that emptied themselves into the Pacific had their sources in the flat plains of Argentine Patagonia, and traversed the Andes from side to side. The dispute involved quite a library of learned treatises on the subject, and cost the two countries quite 120 millions in preparation for war before it was referred to British arbitration.

It is therefore of universal national importance that means should be provided for the determination of certain absolutely fixed positions in their coordinate values of latitude and longitude if international boundaries are to be preserved. Great and impassable ranges and rivers (if the rivers flow through permanent and rocky channels), broad deserts, and certain other natural features, such as well-marked water partings, may stand well enough for the dividing wall between contiguous countries, where they exist; but over flat and cultivated plains the only lasting artificial boundary mark must be one the position of which is

so determined that there can be no room for dispute about it, even if it should be removed or perish through age. This is only to be effected by accurate survey work based ultimately on geodetic triangulation, and it is this work carried out by British officers in so many parts of the world, with the aid of modern light and efficient instruments, which is gradually working out the boundaries of nations, and, incidentally, carrying geographical mapping into the remotest regions of the world. The invention of a portable receiver for the transmission of signals by wireless telegraphy is likely to be of the greatest importance to these workers in remote geographical fields. Here again the perfecting of a minor form of installation for wireless telegraphy is rapidly leading to developments of which we are at present only dimly conscious.

What the Society of Arts can do in this special field of activity, after teaching people to believe in science, is to foster by all means in its power such aids to the progress of knowledge as are to be found in new inventions, new developments, and adaptations of instrumental means for observation and measurement in the endless process of collecting information.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Sir Arthur Evans has presented to the museum the last instalment of an interesting set of objects selected from the collections of his father, the late Sir John Evans. The gift consists of 121 specimens ranging in date from prehistoric times to the eighteenth century. The value of the collection is greatly enhanced by the fact that all the specimens composing it were found in Cambridgeshire and the adjacent counties.

Mr. C. S. Wright has been appointed University lecturer in surveying and cartography (Royal Geographical Society lecturer).

Dr. Assheton has been appointed University lecturer in animal embryology.

THE new Gresham College in Basinghall Street, London, E.C., was formally opened by the Lord Mayor on December 15. Mr. Sheriff Painter, chairman of the City side of the Gresham Committee, gave a history of the Gresham Trust, which, he said, came into operation in 1596 after the death of the founder, Sir Thomas Gresham, and his widow. Under Gresham's will seven lectureships were founded in divinity, astronomy, music, geometry, civil law, physic, and rhetoric. For the first 200 years those lectures were delivered at the mansion of Sir Thomas Gresham, in the parish of St. Helen's, Bishopsgate, where Gresham House stood. The first Gresham College was opened in 1843, and the lectures were delivered there until a few years ago, when as it became inadequate to present-day uses, it was demolished and the new building was erected. The building, which is larger than the old college, has a frontage to Gresham Street of about 71 ft. and to Basinghall Street of 58 ft. The lecture hall and gallery will seat about 430 persons. The hall is lined throughout with oak. Provision is made for a complete kinematograph apparatus for use in the scientific and medical lectures. The building has cost about 34,000*l*.

SPEAKING at the National Liberal Club on the subject of Liberalism and education, Lord Haldane said that when this nation came into existence as a great industrial nation it had practically no competitors. At that time dash and "go" and practical skill alone were required. Now the art of manufacture is linked with the science of education. It is a business which is controlled by scientific principles, and woe will befall the country which is lacking in the scientific equipment necessary to enable it to compete with its more favoured rivals. In Germany and America great progress is being made in the realisation of the truth that, not only must young men and women be prepared from an early age if they are to be made experts in their vocations in life, but that in their vocational training a large amount of general education must be given. The question will have to be faced in this country, and the only point is whether the public will give to the educational movement that support without which no Chancellor of the Exchequer can make headway. An effort in the direction of higher education is necessary if this nation is to hold its own. Upon the same occasion Mr. J. A. Pease said that the view that education should be made compulsory up to the age of sixteen is an ideal which it is impossible to attain; but he hopes that the present limit may be raised to fourteen years.

ARRANGEMENTS have been made for a large number of educational conferences in London early in the new year. Twenty-one educational associations are co-operating in a conference to be held in the University of London on January 2–10, which will be opened by an address by Mr. James Bryce on "Salient Educational Issues." Among the associations taking part may be mentioned the Geographical Association, of which Dr. J. Scott Keltie is the president, whose address will be, "Thirty Years' Progress in Geographical Education"; the School Nature Study Society; the Association of Science Teachers; the Child Study Society; and the Associations of Teachers in Domestic Subjects and in Technical Institutions. The London County Council has arranged another conference of teachers, to be held at Birkbeck College from January 1 to 3. One of the six meetings is to be devoted to a consideration of the subject of mental fatigue, another to memory drawing, and two others to educational experiments in schools. The Mathematical Association will hold its annual meeting at the London Day Training College on January 7. Among the papers to be read in the morning we notice one by Prof. J. E. A. Steggall on practical mathematics in school. In the afternoon the president of the association, Sir George Greenhill, will give an address on the use of mathematics, and Dr. W. N. Shaw will speak on "Principia Atmospherica."

THE governors of the Imperial College of Science and Technology, at their meeting on Friday last, constituted two new chairs of chemistry, and appointed two new professors—Dr. Jocelyn Field Thorpe, F.R.S., professor of organic chemistry, and Dr. James C. Philip, professor of physical chemistry. Four years ago Dr. Thorpe was elected to the Sorby research fellowship of the Royal Society, which he has held at the University of Sheffield. He was formerly research fellow and lecturer in chemistry at the University of Manchester, and received his earlier training partly in London, at the Royal College of Science, and partly in Germany, where, at Heidelberg, he studied under Victor Meyer and Prof. Auwers. Dr. Philip has been on the staff of the Imperial College for some years latterly as an assistant professor. He is well known for his work on physical chemistry, and is now one of the secretaries of the Chemical Society. He is a graduate of Aberdeen and Göttingen Universities. The department of chemistry in the Imperial College has now four professors—Prof. H. Brereton Baker, F.R.S., who is professor of chemistry and director of the laboratories; Prof. W. A. Bone, F.R.S., professor of chemical technology (fuel and refractory materials), together

with the two new professors. At present there are 117 students working specially at chemistry, including its technological applications, of which number thirty-six are engaged in research. In addition, the department provides the subsidiary training in chemistry for about 329 other students.

THE annual prize distribution of the Sir John Cass Technical Institute was held on Wednesday, December 10, when the prizes were distributed by Sir Thomas H. Elliott, K.C.B., Deputy Master and Comptroller of the Royal Mint. The chair was taken by Sir Owen Roberts, chairman of the governing body of the institute. Sir Thomas Elliott, in addressing the students, spoke of the desirability of keeping in view the aim of the instruction provided at the institute, the object of its work, and the extent to which this object was being accomplished. He was himself disposed to say that the primary purpose for which the institute exists is to assist students to do justice to themselves and to those who may be or become dependent upon them, to enable them to perform services which the community requires and for which the community is prepared to pay, and to pay well, to increase their earning powers, and so to help them to secure a better livelihood for themselves than would otherwise be theirs. He counselled the students not to be afraid of selecting a manual occupation and in connection with it to endeavour to learn all the facts connected with the material used, the machinery employed, and the scientific principles upon which the work is based. The Rev. J. F. Marr, chairman of the institute committee, gave a summary account of the work of the institute during the past session, in which he referred especially to the increasing number of students, the research work that had been carried on in the institute, both by students and by members of the staff, and the several developments in the courses of instruction provided. In the latter connection details were given of the work on colloids, on the theory and applications of mathematical statistics, on the fermentation industries, on mine sampling and valuing, on metals used in the motor-car industry, and on the casting of metals, all subjects which had received the special attention of the governing body during the past session.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 28.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—Prof. H. L. **Callendar**: The expansion of silica. In attempting to deduce the expansion of mercury by the weight thermometer method with silica bulbs it was necessary to determine the expansion of specimens of silica from the same source as the bulbs, and to extend the observations of expansion over the range 0° C. to 300° C. Specimens which had been exposed to high temperatures appeared to give lower results over the range 0° C. to 300° C. than specimens which had not been heated above 300° C. during the measurements. Specimens of the same material, (1) in the form of rods were obtained and were heated and tested by the Newton ring method over the range 0° C. to 300° C.; and (2) in the form of tubes, which were tested by the Fizeau method over the range −20° C. to 150° C. The difference between the axial and radial coefficients of the tube specimens had also been tested. The expansion of the silica rod gave results agreeing with the extrapolation of the curve representing the original observations between 300° C. and 1000° C. The silica rods showed at first some peculiarities due to intrinsic strain, but settled down into a cyclic state which could be represented over the range 0° C. to 300° C. by the formula $10^8 \times$ mean coefficient 0° to $t = 78{\cdot}0 - 8650/(t+175)$, but the variation of the coefficient with temperature was rapid and peculiar over this range and could not be represented by a formula of the usual type. The axial expansion of four different specimens had been measured, and could be represented between −20° C. and 150° C., with a little divergence by the formula, $10^8 \times$ mean coefficient 0° to $t = 29{\cdot}0 + 0{\cdot}250t - 0{\cdot}00070t^2$, which agreed over this range with the formula found for the rods, but was inadmissible for extrapolation to 300° C. The difference between the radial and axial coefficients was tested. Differences of the order of 5 or 10 per cent. in the expansion in different directions appeared to be persistent, and were not removed by heating the specimens to 1000° C. or cooling in liquid air. It was concluded that the differences in the radial coefficient might be due to distortion of the ring. It was considered that the most probable result for the cubical coefficient would be obtained by assuming it to be three times the linear. Owing to the smallness of the expansion of silica, and its comparative freedom from hysteresis, the possible uncertainty with the silica bulbs was probably less than 1 in 1000, in spite of the imperfect annealing.—F. J. **Harlow**: The thermal expansions of mercury and fused silica. A more complete set of observations of the relative coefficients of expansion of mercury in silica than those previously published are obtained by the use of an electrically heated oil bath. The observations comprise readings at frequent intervals up to 300° C., and are in good agreement with the earlier observations. Tables are included giving representative observations and the final results. From the values of the coefficients of expansion of silica determined by Prof. Callendar, the coefficients of absolute expansion of mercury are calculated.—Prof J. A. **Fleming**: An experimental method for the production of vibrations on strings. An apparatus for the production of vibrations of strings loaded or unloaded was shown. The vibrations are produced on a string by attaching one end to the shaft of a small continuous-current motor of about $\frac{1}{8}$ h.p. The other end of the string is attached to a fixed point which can be moved by means of a screw, in some cases a spring balance being interposed to measure the tension. When the motor is started the string has a circular motion given to its end which is equivalent to two simple harmonic motions at right angles to each other. If the tension is adjusted rightly the string then vibrates in sections, and the number of sections can be adjusted. The distance from node to node can then be measured easily, and the frequency determined from the speed of the motor. In this way the velocity of the wave is measured, and can be compared with the velocity determined by taking the square root of the quotient of the tension by the linear density of the string. This method is useful in studying the properties of loaded strings. When the wave-length on the string extends over a distance of more than eight or ten loads, the string vibrates as if the loading matter were distributed uniformly, but the string cannot propagate vibrations when the half wave-length approaches equality to the distance between two loads. It is possible to show the reflection of a wave at a load placed at any point on the string, and also that this reflection is reduced by tapering off the loading. With this loaded vibrating string all the phenomena of inductive loading in telephone cables on the Pupin system can be imitated.

Geological Society, December 3.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. E. A. Newell **Arber**: A contribution to our knowledge of the geology of the Kent Coalfield. An account of the

Carboniferous rocks of Kent is given. The Mesozoic cover of the coalfield is ignored. The proved area is 200 square miles. The general strike is about 30° south of east and north of west, and the dip of the Transition Coal Measures is 2° to 3°. The area is a syncline, limited on the north and south by Armorican folds, of which the northern has been located. It is maintained that the Kent Coalfield is not continuous with that of the Pas de Calais. There are reasons for believing that the western boundary is a great fault. The chief surface-feature of the Coal Measures is that of an inclined plane, sloping westwards and south-westwards from an elevated region near Ripple and Deal. The Lower Carboniferous rocks exceed 450 ft. in thickness, and were denuded before the Coal Measures were deposited. The Coal Measures consist of the Transition Series (1700 to 2000 ft. thick), and the Middle Coal Measures (2000 ft.). No Lower Coal Measures or Millstone Grit occur. The coals are well distributed, and are often of considerable thickness. Steam and household coals predominate. The most productive portions of the measures are the higher part of the Transition and the lower part of the Middle Coal Measures.—Dr. E. A. Newell **Arber**: The fossil floras of the Kent Coalfield. The floras of ten further borings in Kent are recorded, and the number of species known from the Kent Coalfield is raised to ninety-six, as compared with twenty-six in 1909. As regards the horizons present in Kent, the plant-remains indicate that, in the area so far proved, only Middle or Transition Coal Measures, or both, occur.

Linnean Society, December 4.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Jane **Longstaff**: A collection of non-marine Mollusca from the southern Sudan. With descriptions of three new species by H. B. **Preston**; and notes on *Veronicella nilotica*, Cockerell, by G. C. **Robson**. This records the Mollusca taken during two visits to the Sudan in February, 1909 and 1912. About fifty-three species were taken, thirty-four Gasteropoda and nineteen Lamellibranchiata, the aquatic, of course, having a wider range than the terrestrial forms. The only terrestrial gasteropod found alive was a *Veronicella nilotica*, Cockerell, the second recorded example.—A. S. **Horne**: A contribution to the study of the evolution of the flower, with special reference to the Hamamelidaceæ, Caprifoliaceæ, and Cornaceæ.

Mathematical Society, December 11.—Prof. A. E. H. Love, F.R.S., president, in the chair.—Prof. E. W. **Hobson**: The linear integral equation.—H. E. J. **Curzon**: Generalised Hermite functions and their connection with the Bessel functions.—J. **Proudman**: Limiting forms of long-period tides.—Lieut.-Col. **Cunningham**: The number of primes of the same residuacity.—R. H. **Fowler**: Some results on the form near infinity of real continuous solutions of a certain type of second order differential equation.—S. **Brodetsky**: The potential of a uniform convex solid possessing a plane of symmetry with application to the direct integration of the potential of a uniform ellipsoid.—G. R. **Goldbrough**: The dynamical theory of the tides in a polar basin.—Prof. J. C. **Fields**: Proof of the complementary theorem.

CAMBRIDGE.

Philosophical Society, November 24.—Prof. Newall in the chair.—Prof. A. S. **Eddington**: The distribution of the stars in relation to spectral type. It is well known that the concentration of stars to the galactic plane is not shown equally by the different spectral classes. Type B is the most condensed, and the others follow in the order A, F, G, K, M, *i.e.* the sequence coincides with the usually accepted order of evolution. Formerly it seemed probable that this result was due to a progression in the average distance of these classes of stars, for, on the hypothesis that the stellar system is of oblate form, the greater the distance the greater will be the concentration to be expected. Recent determinations by Boss and Campbell of the average distances of the stars of different spectral types negative this explanation in a most decided manner. It appears, for instance, that the M stars are on the average more remote and more luminous than type A. There is an outstanding question of great difficulty. In parallax investigations it is found that the M stars are the faintest of all the types; in statistical discussions of proper motions, &c., they are found to be the brightest except type B. Similar difficulties occur with the other types. Russell has put forward the theory that type M consists of two divisions, one being the very earliest and the other the latest stage in evolution. Against this it may be urged that both divisions of type M are characterised by very high velocities in space; this seems to indicate a close relation between them.—Dr. G. F. C. **Searle**: (1) The comparison of nearly equal electrical resistances. Four resistance coils, A, B, C, D, are arranged to form the four sides of a Wheatstone's quadrilateral. The coils C, D are approximately equal, but, as their ratio is eliminated, it is not necessary to know it. A balance is obtained by shunting A, B with large resistances a_1, b_1. The coils A and B are then interchanged and a fresh balance is obtained by shunting them with a_2 and b_2. (2) An experiment on the harmonic motion of a rigid body.—G. T. **Bennett**: A double-four mechanism.—F. E. **Baxandall**: The presence of certain lines of magnesium in stellar spectra. In a recent paper on new series of lines in the spark spectrum of magnesium, Prof. Fowler gives spark lines of magnesium at wave-lengths 4384·86, 4390·80, 4428·20, 4434·20, which do not fall into series. Weak lines in apparently corresponding positions have been found in the spectra of α Canis Majoris (type A_0) and α Cygni (type A_2, Pec.), and the suggestion is made that the stellar and laboratory lines are identical. It is in such stellar spectra as those mentioned that the well-known Mg spark line at wave-length 4481·3 occurs at its maximum intensity. The new lines have not been traced in any other types of stellar spectra.

MANCHESTER.

Literary and Philosophical Society, November 18.—Mr. Francis Nicholson, president, in the chair.—Prof. G. Elliot **Smith**: The controversies concerning the interpretation and meaning of the remains of the dawn-man found near Piltdown. The author explained the nature of the controversies concerning other bearings of the Piltdown discovery on the history of ancient man: (1) the age of the remains; (2) the question of the association of the jaw and the skull; (3) the significance of the jaw and teeth and the reconstruction of the missing parts; (4) the reconstruction of the brain-cast and the nature of the brain; and (5) the place which Eoanthropus should occupy in the phylogeny of the Hominidæ. (1) It is practically certain that the fragments are of the Pleistocene date. (2) There is definite internal evidence that the jaw is not really an ape's; the teeth it bears are human, and the skull, although human, is much more primitive than any skull assigned to the genus Homo. (3) The reconstruction of the jaw and teeth has now been practically settled once for all by the subsequent discovery of the canine tooth. (4) He considered that there was no longer room for doubt as to the position the fragments originally occupied in the skull; and it is very improbable that the complete brain-cast could be more than 1100 c.c. in capacity. (5) There seems ample justification for

putting the Piltdown remains into a genus separate from all the other Hominidæ. Eoanthropus must represent a persistent and very slightly modified descendant of the common ancestor of *Homo sapiens* and *H. primigenius*. There is no positive evidence that the genus Homo, or even Eoanthropus, had come into existence in Pliocene times. The fact of *E. dawsoni* being found in a deposit that may perhaps be as late as the Mid-Pleistocene does not invalidate the conclusion that the genus to which it belonged was ancestral to the Heidelberg man. When man was first evolved the pace of evolution must have been remarkably rapid, and it is quite possible that amidst the turmoil incidental to the inauguration of the Pleistocene period a new group of anthropoids rose superior to the new difficulties, and became "dawn-men." It is almost certain that man began to speak when his jaw was in the stage represented in that of Eoanthropus. The brain already shows considerable development of the parts associated in modern man with the power of speech.

NEW SOUTH WALES.

Linnean Society, October 29.—Mr. W. S. Dun, president, in the chair.—Dr. J. M. **Petrie**: Hydrocyanic acid in plants. Part ii., Its distribution in the grasses of New South Wales. The existence of hydrocyanic acid in the Gramineæ was discovered by Jorissen, in 1884. Since then, about thirty species have been recorded as containing a cyanogenetic compound. The author's work is a continuation of investigations into the cause of sudden fatalities among sheep in this State. More than 200 species of grasses were tested systematically. Glucosides, capable of yielding hydrocyanic acid, were detected in twenty species, eleven of these being native grasses, the others introduced. The acid existed free in only two species, *Cynodon incompletus* and *Diplachne dubia*; in the rest, it is mainly combined as glucoside, and, therefore, only liberated by contact with the natural ferment of the plant under favourable conditions.—Archdeacon F. E. **Haviland**: Notes on the indigenous plants of the Cobar district, N.S.W. No. 2. In this second contribution the number of natural orders represented in the Cobar district is increased from 64 to 71; of genera, from 197 to 275; and of species, from 337–504.—E. **Turner**: New fossorial Hymenoptera from Australia and Tasmania.

BOOKS RECEIVED.

Exercises from A New Algebra. Parts i.–iv. By S. Barnard and J. M. Child. Pp. 274. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*.

Hunting the Elephant in Africa, and other Recollections of Thirteen Years' Wanderings. By Capt. C. H. Stigand. Pp. xv+379. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

Examples in Physics. By H. Freeman and E. Jobling. Pp. 96. (Cambridge: W. Heffer and Sons, Ltd.) 1*s*. net.

La Technique de la Radiotélégraphie. By Dr. H. Rein. Translated by G. Viard. Pp. x+262+v plates. (Paris: Gauthier-Villars.) 9 francs.

Leçons de Mathématiques Générales. By Prof. L. Zoretti. Pp. xvi+753. (Paris: Gauthier-Villars.) 20 francs.

Paléontologie végétale. By Dr. F. Pelourde. Pp. xxviii+360. (Paris: O. Doin et Fils.) 5 francs.

Die Brownsche Bewegung und einige verwandte Erscheinungen. By Dr G. L. de Haas-Lorentz. Pp. 103. (Braunschweig: F. Vieweg und Sohn.) 3.50 marks.

Der heutige Stand der Synthese von Pflanzenalkaloiden. By Dr. H. Bauer. Pp. viii+144. (Braunschweig: F. Vieweg und Sohn.) 4.50 marks.

Tensoren und Dyaden im dreidimensionalen Raum. By E. Budde. Pp. xii+248. (Braunschweig: F. Vieweg und Sohn.) 6 marks.

Industrial Mathematics. By H. W. Marsh, with the collaboration of A. G. F. Marsh. Pp. viii+477. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

Smithsonian Institution. U.S. National Museum. Bulletin 80. A Descriptive Account of the Building Recently Erected for the Department of Natural History of the U.S. National Museum. By R. Rathbun. Pp. 131+34 plates. (Washington: Government Printing Office.)

History of Geography. By Dr. J. Scott Keltie and O. J. R. Howarth. Pp. ix+154. (London: Watts and Co.) 1*s*. net.

Guide to the Materials for U.S. History in Canadian Archives. By D. W. Parker. Pp. x+339. (Washington: Carnegie Institution.)

The Sabanu. The Studies of a Sub-Visayan Mountain Folk of Mindanao. Part i., by Lieut.-Col. J. P. Finley. Part ii., by W. Churchill. Pp. v+236+2 plates. (Washington: Carnegie Instiution.)

Heredity in Skin Color in Negro-White Crosses. By C. B. Davenport. Pp. 106+4 plates. (Washington: Carnegie Institution.)

Guide to Materials for the History of the U.S. in the Principal Archives of Mexico. By Prof. H. E. Bolton. Pp. xv+553. (Washington: Carnegie Institution.)

Metallographie. Erster Band. Die Konstitution. Zweiter Teil. Heft. 1. Die Konstitution des Systemes Eisen-Kohlenstoff sowie der sonstigen binären Kohlenstofflegierungen. By Dr. W. Guertler. Pp. xl+648+ plates. (Berlin: Gebrüder Borntraeger.) 32 marks.

Handworterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief 64–68. (Jena: G. Fischer.) 2.50 marks each Lief.

The Englishwoman's Year Book and Directory, 1914. Edited by G. E. Mitton. Pp. xxxii+431. (London: A. and C. Black.) 2*s*. 6*d*. net.

Who's Who, 1914. Pp. xxx+2314. (London: A. and C. Black.) 15*s*. net.

Who's Who Year-Book for 1914–15. Pp. vii+178. (London: A. and C. Black.) 1*s*. net.

The Writers' and Artists' Year-Book. Edited by G. E. Mitton. Pp. x+154. (London: A. and C. Black.) 1*s*. net.

The American Annual of Photography, 1914. Edited by P. Y. Howe. Pp. 328. (New York: American Annual of Photography Inc.; London: G. Routledge and Sons, Ltd.) 3*s*. 6*d*. net.

Union of South Africa. Mines Department. Annual Reports for 1912. Part iv., Geological Survey. Pp. 193+xvii plates. (Pretoria: Government Printing and Stationery Office.) 7*s*. 6*d*.

Who's Who in Science. International, 1914. Edited by H. H. Stephenson. Pp. xx+662. (London: J. and A. Churchill.) 10*s*. net.

Transactions of the Royal Society of Edinburgh. Vol. xlix. Part 2. Session 1912–13. Pp. 229–529+ plates. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 32*s*. 6*d*.

Continuity. By Sir Oliver Lodge. Pp. 118. (London: J. M. Dent and Sons, Ltd.) 1*s*. net.

Elementary Practical Electricity and Magnetism. By J. C. Kirkman. Pp 136. (London: G. G. Harrap and Co.) 2*s*. 6*d*. net.

Coconut Cultivation and Plantation Machinery. By H. L. Coghlan and J. W. Hinchley. Pp. xii+128+x plates. (London: Crosby Lockwood and Son.) 3s. 6d.

L'Education de l'Effort Psychologie-Physiologie. By Prof. G. Demenij. Pp. vii+228. (Paris: F. Alcan.) 3.50 francs.

Junior Geometry. By A. G. Cracknell. Pp. viii+276. (London: W. B. Clive.) 2s. 6d.

Garden Farming. By L. C. Corbett Pp. x+473. (Boston, Mass., and London: Ginn and Co.) 8s. 6d.

Our Domestic Birds: Elementary Lessons in Aviculture. By J. H. Robinson. Pp. x+317. (Boston, Mass., and London: Ginn and Co.) 6s.

Physical Chemistry: its Bearing on Biology and Medicine. By Prof. J. C. Philip. Second edition. Pp. vii+326. (London: E. Arnold.) 7s. 6d. net.

Echoes: A Book of Verse. By A. L. H. Anderson. Pp. 80. (London: Elkin Mathews.) 2s. 6d. net.

A New Era in Chemistry. By H. C. Jones. Pp. xii+326. (London: Constable and Co., Ltd.) 8s. 6d. net.

Catalogue of Hardy Trees and Shrubs Growing at Albury Park, Surrey. Compiled by A. B. Jackson. Pp. x+66. (London: West, Newman and Co.)

Durch König Tschulalongkorns Reich. Eine deutsche Siam-Expedition. By Dr. C. C. Hosseus. Pp. xii+219+plates. (Stuttgart: Strecker and Schröder.) 15 marks.

Report on the Crustacea Schizopoda Collected by the Swedish Antarctic Expedition 1901–3, under the Charge of Baron Dr. O. Nordenskjöld. By H. J. Hansen. Pp. 56+vi plates. (Copenhagen: G. E. C. Gad.)

The Golden Bough. Third edition. Part vii. Balder the Beautiful. By Prof. J. G. Frazer. 2 vols. Pp. xx+346; xi+389. (London: Macmillan and Co., Ltd.) 20s. net.

Theodore Roosevelt: an Autobiography. Pp. xii+647. (London: Macmillan and Co., Ltd.) 10s. 6d. net.

My Life with the Eskimo. By V. Stefánsson. Pp. ix+538. (London: Macmillan and Co., Ltd.) 17s. net.

A History of Land Mammals in the Western Hemisphere. By Prof. W. B. Scott. Pp. xiv+693. (London: Macmillan and Co., Ltd.) 21s. net.

A School Statics. By G. W. Brewster and C. J. L. Wagstaff. Pp. viii+248. (Cambridge: W. Heffer and Sons, Ltd.) 3s. net.

A Proper Newe Booke of Cokerye. Edited by C. F. Frere. Pp. clxiv+124. (Cambridge: W. Heffer and Sons, Ltd.) 7s. 6d. net.

Robert Bridges, Poet Laureate. Readings from his Poems. By Prof. T. H. Warren. Pp. 39. (Oxford: Clarendon Press.) 1s. net.

Hazell's Annual for 1914. Edited by Dr. T. A. Ingram. Pp. cxi+592. (London: Hazell, Watson and Viney, Ltd.) 3s. 6d. net.

Geological Survey of New Jersey. Bulletin No. 10. The Mechanical and Chemical Composition of the Soils of the Sussex Area, New Jersey. By A. W. Blair and H. Jenning. Pp. 110+2 plates. Bulletin No. 11. The Mineral Industry of New Jersey for 1912. By Dr. M. W. Twitchell. Pp. 43. (Trenton, New Jersey.)

Catalogue of the Mesozoic Plants in the British Museum (Natural History). The Cretaceous Flora. Part i. Bibliography, Algæ, and Fungi. By Dr. M. C. Stopes. Pp. xxiii+285. (London: British Museum (Natural History); Longmans and Co.) 12s.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 18.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Employment of Power in H.M. Post Office: H. C. Gunton.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Standardising of Colours and Symbols representing Geographical Data, especially on Small Scale Maps: Prof. A. J. Herbertson.

LINNEAN SOCIETY, at 8.—The Evolution of the Inflorescence: J. Parkin.—*Hypericum desetangsii*, Lamotte, a New British Plant: C. E. Salmon.—The Mouth-parts and Mechanism of Sucking in *Schizoneura lanigera*: J. Davidson.

INSTITUTION OF MINING AND METALLURGY, at 8.—Cupellation Experiments. II.: A Simple Method for the Detection of the Platinum Metals in Cupellation Beads: C. O. Bannister and G. Patchin.—Notes on Mines in the Ottoman Empire: G. Maitland Edwards.

FRIDAY, DECEMBER 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Mechanical Engineering Aspects of Road Construction: Col. R. E. B. Crompton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Air-filtration and the Cooling and Ventilation of Electrical Machines: W. E. Gurry.

MONDAY, DECEMBER 22.

ARISTOTELIAN SOCIETY, at 8.—William of Ockham on Universals: C. Delisle Burns.

INSTITUTE OF ACTUARIES, at 5.—Whole Life Non-profit Assurances: F. J. Cameron.

TUESDAY, DECEMBER 23.

INSTITUTION OF CIVIL ENGINEERS at 8.—*Further Discussion:* Cyclical Changes of Temperature in a Gas-engine Cylinder: Prof. E. G. Coker and W. A. Scoble

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