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## The Aeronautical Research Committee.

THE report of the Court of Inquiry into the loss of R38 on August 24 has been issued by the Air Ministry. Its findings are important and disquieting. Having described what actually happened when the accident took place, the Court makes comment on the initiation and development of the design. Briefly summarised, the report states that a great advance on previous British airships was made with insufficient preparation and with an unsuitable organisation. It is stated that further inquiry is being made by the Aeronautical Research Committee. It is of interest, therefore, to turn to the recently issued Report[1] of that body and to read the notes relating to experiments and research on airships. Pages 11 and 21 will be found to be connected intimately with R38 and other airships, and a relevant extract is given later in this article.

In addition to the importance given to it by the accident, the Report of the Aeronautical Research Committee for the year 1920–21 is a document of considerable general scientific interest. Not only does it give an account of work done, but it also furnishes matter for comment on the growth of a new subject, and illustrates a present-day tendency to widen the idea of research to cover anything new. It is self-evident that the pursuit of new things is not necessarily desirable, and if due economy is to be observed, either a return is required to the older usage of "research" to mean progress, or a new word is necessary to express the latter idea.

At present there is a Directorate of Research in the Air Ministry, as well as the Aeronautical Research Committee, and the Report under review indicates a confusion of functions. In many respects the older organisation was better, and consisted of a Technical Department in the Air Ministry, an advisory committee to which it could refer new problems, and research establishments at the National Physical Laboratory and the Royal Aircraft Establishment for the assistance of the Committee. When first formed in 1909 by Mr. Asquith, the Advisory Committee for Aeronautics consisted of a small number of men of science dealing with an undeveloped subject; the state of aeronautics compelled them to look for general knowledge and to leave application to the internal working of the Admiralty Air Department and the Directorate of Military Aeronautics.

During the war, as in many other branches of science, extension of the boundaries of knowledge of aeronautics almost ceased in the endeavour to apply to warfare the results of earlier research, with the consequence that the Advisory Committee became almost wholly occupied with technical matters. The references were so numerous that sub-committees were formed to deal with separate branches of the subject. An organisation essentially of war type has now become a regular part of the peace system of the country, and has been called the Aeronautical Research Committee. On pages 4, 5, and 6 of the Report appear lists of the *personnel* of the various Committees, and, in spite of the repetition of names, the lists indicate a very large body of people acting as advisers. The number appears to be out of all proportion to the staffs available for carrying on research, and can be justified only, if at all, on the ground that the members are there as technical experts, and not as supervisors of research.

The Committee has no executive powers, and work for it is carried out at the National Physical Laboratory through the Department of Scientific and Industrial Research, or at the Royal Aircraft Establishment through the Directorate of Research. In such circumstances it is clear that sympathetic administration is needed if progress is to be possible; at the present moment the con-

[1] Report of the Aeronautical Research Committee for the year 1920–21. Pp. 52. (London: H.M. Stationery Office.) Cmd. 1458. 3*d*.

ditions for success appear to be non-existent. The Report (page 11) says:—

"The Committee have learnt with great regret of the decision to stop or greatly to reduce all work connected with airships, and have addressed a letter to the Ministry pointing out the importance of full-scale research, not only for airship progress, but as an essential part of general aerodynamic theory upon which the design of all types of aircraft depends."

In spite of such letter no change of policy appears to have been considered, and the closing down of all research, laboratory as well as full-scale, would have been complete but for the deplorable accident to R38. It is more than possible that the disaster would have been avoided had the facilities for full-scale research asked for by the Aeronautical Research Committee during the last two years been granted by the Air Council.

As an isolated instance this would be important, but it appears rather as a typical example and a result of bad administrative arrangements in the Air Ministry and related bodies. A further abstract (page 52) says:—

"The evidence given by pilots in the course of this inquiry showed, however, that the handling in the air of large flying boats, particularly those of F type, had given considerable trouble, and it appeared that there was little doubt that the trouble with the F boats was mainly due to weathercock instability. Further it appeared that few data have yet been collected on the lateral stability and control of any type of aircraft. The subject is of such frequent recurrence, in relation to accidents, as to warrant an extended inquiry into the present state of knowledge regarding lateral control and stability: a recommendation to this effect has been put forward, and the matter is being prosecuted."

The reply—in effect—is that the Air Ministry cannot afford to maintain the only staffs capable of such inquiry, and that the information is not considered to be worth one-quarter per cent. of the annual expenditure on the Royal Air Force. The direct saving of the money now lost by the wreck of R38 would have maintained fundamental research in aeronautics for the greater part of a generation. Whilst such a policy is being followed by the Air Council it would be a delusion to suppose that the best of aeronautical research committees could be an effective safeguard against further disasters to military and civil aircraft.

One of the more striking pieces of work detailed in the report for the year is that of the Fire Prevention Sub-Committee. Not until the end of the war was attention adequately directed to the prevalence of fire after a bad landing, and this matter was taken up by the Committee. A glance through the items enumerated on page 40 suggests that matters normally entrusted to the designers of aircraft still require much attention. It should not be necessary at this period of time to include "development of a safe system of engine installation generally" and "the avoidance of rubber and other inflammable material under the cowl" in the programme of a *research* committee.

Of the various sectional programmes, that of the Materials and Chemistry Sub-Committee most nearly approaches scientific research. The assistance of the universities has been invoked and in due course a fruitful return may be anticipated. The Committee has there taken the line of encouraging the individual worker to give of his best. It is a possible line of development, since this branch of aeronautics comes as a natural extension of well-established sections of engineering. The aeronautical engineer is interested in all the mechanical engineering tests of materials, including those on fatigue, but to an unusual degree of refinement. The limits of weight of aircraft for successful flight leave far less room for error in estimating stresses than in application to such a subject as locomotive building for railways.

In relation to aero-engines, which are a normal development from heavier internal-combustion engines, a somewhat similar use of universities and schools of technology is possible. On the other hand, the provision of a high altitude test house is peculiar to aeronautics, and for many years to come training institutions cannot be expected to provide facilities. Both in the case of specialised engine research and aerodynamics generally it appears that facilities are effectively under the control of the Air Ministry, and for progress in the next decade a more enlightened policy appears to be a preliminary requisite.

There is much more of interest in the Report, which as a whole shows the utility of a body of men who can consider a subject in relation to first principles. For its share in such work it will probably be concluded that the Aeronautical Research Committee has justified its existence. It is possible, nevertheless, that a body limited to such functions would be far more effective.

## The Science of Pharmacognosy.

*Handbuch der Pharmakognosie.* By A. Tschirch. Band III. Lieferung 1, 1921. 10 marks. Lieferung 1–4 and Lieferung 9–37. (1908–14.) 2 marks each. (Leipzig: Chr. Herm. Tauchnitz.)

AFTER an interval of four years Prof. Tschirch has continued the publication of his compendious "Handbook of Pharmacognosy" and issued the first part of the last volume. About twenty parts will constitute this section, which will deal with the drugs containing phloroglucin derivatives, tannins, alkaloids, antigens (toxalbumins), bitter principles, vesicants, colouring principles, resins, and a few other groups. Part i. deals with such drugs as male fern, cusso, kamala, cutch, gambier, and kino.

Pharmacists and all who are interested in drugs may look forward to the approaching completion of what is undoubtedly the most ambitious literary attempt that has ever been made in the field of pharmacognosy. By pharmacognosy the author means the science which has for its object the acquirement of a complete knowledge of animal and vegetable drugs, their correct description, and their rational grouping under general headings. Pharmacognosy, according to Prof. Tschirch, should no longer remain a collection of individual drug descriptions, however perfect they may be; these must be welded together into an independent science many of the problems of which are capable of experimental solution. To attain this object, chemistry, botany, zoology, physics, and every science that can give assistance must be laid under contribution. With this end in view the author, as is well known, has laboured with his pupils in the University of Berne for the last twenty-five years, directing during that time innumerable researches chiefly in the fields of the botany and chemistry of drugs.

The work is divided into general and applied pharmacognosy. Under the first heading the author deals with the cultivation of medicinal plants, the collection and preparation of the parts used as drugs, the commerce, sorting, packing, etc., and with the subsidiary sciences of botany, zoology, chemistry, physics, geography, history, ethnology, etymology, etc. Most of these subdivisions have had special terms coined for them; thus cultivation is designated "pharmacoergasia," commerce "pharmacoemporia," chemistry "pharmacochemistry," and so on. Pharmacoergasia (117 pages) consists of a compilation of facts concerning the cultivation of various drugs, and is a somewhat heterogeneous collection the systematic arrangement of which would be attended with considerable difficulty. Commerce (42 pages) lends itself better to separate treatment, and the section is exceedingly interesting. The subject of the history of drugs, to which no fewer than 558 pages are devoted, also makes excellent reading; under this heading the history of drugs from the earliest records to modern times is fully discussed.

Among the subsidiary sciences, Prof. Tschirch regards pharmacochemistry as the most important, since the value of a drug depends, in the majority of cases, on the constituents contained in it. For this reason the classification of drugs should be based on the relationships of the chief constituents. Such a classification has been adopted by the author in the second part of his work (applied pharmacognosy), although he admits that in his opinion only 1 per cent. of the drugs known have been sufficiently investigated. Under this system the larger groups, such as the sugars, starches, celluloses, aliphatic acids, fats, volatile oils, resins, aromatic phenols, tannins, glucosides, and alkaloids, are subdivided into smaller ones; thus the group of alkaloidal drugs is subdivided according to the constitution of the principal alkaloid. It would therefore be impossible to classify correctly any alkaloidal drug until the constitution of its principal alkaloid was known. The rapid strides that are now being made in our knowledge of the chemistry of drugs are reducing this objection to a chemical classification, but a very long time must elapse before a satisfactory position can be attained.

The treatment of each individual drug in the second part is very complete. First the synonyms are given; then the etymology, the botanical source, the pests to which the plant is subject, its cultivation, harvesting, commerce, morphology, anatomy, characters of the powder, chemistry, adulterations, uses, and so on, are discussed in the fullest detail, the bibliography being particularly complete. In the case of rhubarb the space devoted to the description is thirty pages, including numerous illustrations. The weakest point is certainly the microscopical characters of the powdered drugs; these are usually dismissed in a few lines, the author relying almost entirely on his description of the anatomy.

Even with the assistance afforded by his colleagues and pupils, Prof. Tschirch's task has been a stupendous one; he has accomplished it with conspicuous success, and the handbook will doubtless be for many years a mine of information for pharmacognosists. Nevertheless, the advisability of publishing so large a work in a succession of parts appearing at somewhat distant intervals may

well be doubted. By the time the last appears the first will be at least fifteen years old, and scientific works age very rapidly. The division of the handbook into several volumes for each of which one or more experts should be responsible would appear to be a better plan.

## Human Physiology.

*Human Physiology.* By Prof. Luigi Luciani. With a preface by Prof. J. N. Langley. (In five volumes.) Vol. 5. *Metabolism—Temperature—Reproduction, etc.* Edited by Prof. M. S. Pembrey. Pp. viii+422. (London: Macmillan and Co., Ltd., 1921.) 30*s.* net.

THIS, the fifth and final volume of Luciani's notable "Human Physiology," is as full of interest and originality of treatment as any of the previous volumes. Messrs. Macmillan deserve every credit for having borne the cost of translation and production of probably the last great attempt by a single individual to deal with physiology in full detail. It is true that for exhaustiveness of treatment we must resort to works prepared by several authors, or to the still fuller monographs. Undoubtedly we get a more complete account written by a specialist in the particular section, but it is questionable if the light and shade are so good as in the old-fashioned single-author type of book. Too often the little section, no doubt an important part of the whole, is almost dragged from its context and set in the full glare of the limelight. For specialists in the subject this is perhaps of no great moment, as they can perform the necessary correction, but for the average intelligent worker who desires information in a subject perhaps cognate to his own this triumph of specialism may be neither suitable nor very enlightening. Granted that the great chance of failure in the one-man book lies in the fact that the author has a bias, nevertheless this very deficiency lends a colour and virility which are frequently absent from the more scientific and coldly critical monograph—indeed, provided the author is broad enough in his views, this bias may be regarded as a definite asset.

Luciani's work, despite its defects, is a living, stimulating book written by a physiologist with a broad and sane outlook. It is a work which the professional physiologist, the ordinary medical practitioner, and the medical student can read with pleasure and profit. Its great value—and the present volume is no exception—is the amount of space which is devoted to sections of physiology which are, as a rule, but shabbily treated in other text-books. On the other hand, sections which might merit more complete treatment in the light of modern interest and research are, on the whole, less thoroughly done than in many smaller books. Thus, in the volume under review the question of the accessory food factors is confined to a brief note by the editor.

As regards the present volume, the first three chapters deal with different phases of metabolism. These chapters give a most excellent historical survey of the development of the subject. The account of the gradual appreciation of the fact that all proteins are not of equal value, gelatine being taken as the example, is particularly interesting and valuable, and, in view of the modern trend of ideas, very suggestive. A good deal of space is also devoted, with propriety, to the much-neglected subject of mineral metabolism. Luciani's final conclusion as regards metabolism in the exchange both of matter and of energy, whether of each tissue or of the organism as a whole, is of interest, as he believes that the regulation is "the fundamental function of the nervous system considered as a whole and a unit, and not of one or other part or segment."

The next three chapters are devoted to a full discussion of reproduction. These chapters are full of valuable information—perhaps not quite so detailed as in the original—much of which is very difficult to find elsewhere. The fact, too, that parturition is dealt with in considerable detail as a purely physiological phenomenon is excellent. These chapters are followed by a suggestive and stimulating chapter on the stages of life and death. Apart from Dastre's book—and in some respects this single chapter even excels that striking work—it would be impossible to refer to a more complete source for out-of-the-way details in many varied aspects of physiology. It has also the merit of being eminently readable philosophy. Like Luciani's sane pronouncement on the rival claims of vitalism and materialism in an earlier volume, his closing sentence to this chapter, and incidentally to his own part of the work, is personally illuminating:—

"In order to ensure ourselves this ideal *euthanasia,* we have but to convince ourselves that *materialism* is utterly unable to afford any explanation of the most ancient problems of man and the universe; belief in *philosophy,* in the spiritualistic or even the idealistic hypothesis, is all that is needed to enable us to estimate life aright and to look death in the face, if not with a smile on our lips, at all events with calm resignation and confidence based upon hope."

The final chapter, as Luciani states in a footnote, was prepared by his assistant, Prof.

Baglioni. It gives a rapid summary of ethnology and anthropology—good in its way, but, owing to shortage of space, too compressed to be of real value. The point is emphasised that modern sociology shows a marked tendency to state and solve its various problems in terms of physiology.

To Prof. Pembrey is due hearty congratulations for the judicious and careful way in which he has edited the volume. It must have required endless patience and time. The translation is good, and the number of actual errors detected but few. The publishers have produced a book of pre-war standard in paper, printing, illustrations, and binding. It is a pity, however, that a complete index for the five volumes was not incorporated in this concluding volume.

E. P. C.

## Principles of Electrical Engineering.

*Electrical Engineering.* By Dr. T. F. Wall. Pp. xi+491. (London: Methuen and Co., Ltd., 1921.) 21*s*.

A SURVEY of the principles of electrical engineering intended for students in universities and the advanced classes in technical schools is given in this book. The author's treatment of the subject can be commended, although in places the condensation will make it difficult for the uninitiated to follow his reasoning. He begins by a careful discussion of electrostatic theory, proving, in some cases by novel methods, the capacity formulæ which are used by engineers. He describes how the dielectric is sometimes graded in high-tension cables, and shows how the requisite calculations to find the electric force in the dielectric can be made. No mention is made, however, of the severe limitations imposed on the use of intersheath methods of grading by the large capacity current which flows in the sheath. The corona effect is mentioned, but the formula given is not so accurate as that due to F. W. Peek. The formulæ for the sparking voltages between spheres are not given.

On p. 194 it is stated that the standard values for the resistance of copper at present in use are those found by Matthiessen. This is not the case. Electricians use the international standard of resistance for copper given in Publication No. 28 of the International Electrotechnical Commission. They also find it advisable to use three temperature coefficients: the "constant-mass" temperature coefficient, the volume resistivity and the mass resistivity temperature coefficients.

On p. 202 Newton's law of cooling is given as if it applied to radiation instead of to convection. It is deduced that the melting current of a fuse wire varies as the 1·5th power of the diameter instead of the 1·25th power, which follows from more accurate theory. On p. 381, l. 11, we take it that "two-thirds" is a misprint for "three-halves," as the capacity between two wires is obviously increased by bringing a third wire into the neighbourhood.

The author attacks the problem of practical harmonic analysis in the proper way. He takes the Fourier solutions for $a_n$ and $b_n$, the coefficients of the cosine and sine components of the Fourier series, and computes their values by mathematical quadrature. Taking $m$ ordinates for the half-wave, he writes:—

$$a_n=\frac{2}{m}\left[y_1\cos n\frac{\pi}{m}+y_2\cos n\frac{2\pi}{m}+\ \ldots\ +y_m\cos n\frac{m\pi}{m}\right],$$

and a similar formula for $b_n$. Taking $m=10$, he finds the first, third, and fifth harmonics for a given curve, and suggests that a similar analysis will give the higher harmonics. It should have been stated that more ordinates would have to be measured if the higher harmonics are to be determined accurately.

In our opinion the first and third harmonics are best determined by dividing the base of the positive half of the wave into twelve equal parts and then applying Weddle's rule. To make reasonably certain of finding the fifth harmonic accurately it would be necessary to divide the base into eighteen, or better twenty-four, equal parts, and draw the ordinates at the points of division. If we apply the author's method to a rectangular wave of height unity, we get $b_1=1{\cdot}263$ and $b_3=0{\cdot}393$. The true values, 1·273 and 0·424, are given by Weddle's rule.

A. R.

## Semi-popular British Botany.

*A New British Flora: British Wild Flowers in their Natural Haunts.* Described by A. R. Horwood. Vol. 3, pp. xi+251+plates 18–31; Vol. 4, pp. xi+257+plates 32–49; Vol. 5, pp. xi+234+plates 50–64; Vol. 6, pp. xix+232. (London: The Gresham Publishing Co., Ltd., 1919.) 12*s*. 6*d*. net each vol.

THE first two volumes of this work were reviewed in NATURE of April 21 last, p. 232. Vol. 3 deals with flowers of the woods and copses, roadsides and hedges, while the fourth volume presents the flowers of "mountains, hills, and dry places," "lakes, rivers, ditches, and wet places," "waste places, gardens, refuse-heaps, village greens, farmyards, etc." While thoroughly unbotanical in that it scatters

the various species of the same genus, yet in a semi-popular work of this kind the method has much to be said for it. The coloured plates are beautifully done, and the photographs, of which there is at least one for nearly every species, are almost uniformly excellent, and many of them are triumphs of art. Perhaps the best feature of the work is that the photographs in almost every case show the habit of the plant in its native haunts. Where the plant is shown as part of a landscape the effect is often beautiful, as in the photographs of a reed swamp on a Norfolk broad and of the great yellow watercress. In a photograph such as that which is meant to illustrate the duckweed, the latter occupying only a small patch on the water surface, the conspicuous elements of the vegetation which fill the rest of the figure might have been indicated by marginal names. The "close-up" photographs are almost uniformly successful, and we know of no other series to equal them. Occasionally, however, as in the photograph of the bugle (*Ajuga reptans*), the plants are too closely surrounded by other vegetation to show their distinctive features. The figure of the lily-of-the-valley is evidently taken from a garden. Anyone who has seen it flowering wild in an English copse would wish that the more dainty wild plant might have been captured by the camera in its natural surroundings. The distribution of each species in Britain is given in considerable detail, together with the various local names and a mass of folk-lore the utility of which is somewhat doubtful.

Vol. 5 deals with the flowers of bogs and marshes, heaths and moors, rocks and gravelly places. The same high quality of the illustrations is maintained, and many of the photographs show not only the plant concerned, but also the ecological association in which it flourishes. The last part of this volume includes "Hints and Notes," chiefly on matters ecological, with reference to the plants described. An appendix contains a summary of the natural orders, and short diagnoses of the genera (520) of British flowering plants. This is followed by a bibliography of general works on such matters as the origin and distribution of the British flora, the ecology, pollination, soil, fungal and insect pests, and folk-lore of British plants. A glossary completes the volume.

The sixth and final volume gives unillustrated descriptions of species not included in the earlier volumes. The London Catalogue of British Plants (1908) enumerated nearly 2000 species, and Mr. Druce's British Plant List includes some 3000, of which more than 1000, however, are aliens. About 147 species are considered endemic, consisting mainly of Rubi and Hieracia.

Differing somewhat in character from any previous treatment of the British flora, this work is particularly to be commended as a semi-popular account emphasising the ecological and natural history aspects, embellished with numerous photographs which for the most part are very carefully selected. It must be said, however, that the ecology is not of a very serious kind.

R. R. G.

## Our Bookshelf.

*Gynecology.* By Dr. Brooke M. Anspach. Pp. xxvi+752. (London: J. B. Lippincott Co., 1921.) 42*s.* net.

WE have here an excellent treatise—exhaustive, clear, well illustrated. The like may be said of many medical books, but the present work is especially good in that it links up, better than most of its predecessors, the student's early scientific work with his later practical instruction. An unavoidable fault of medical training is that it is conducted by relays of specialists, each of whom concentrates on a single subject and trenches as little as possible on the work of his colleagues. First one group of subjects is laid aside, then another, and so on. Theoretically the endeavour is to base practical efficiency on antecedent scientific knowledge; but the human mind forgets as well as learns, and the curriculum is long. Commonly at the end of it something of anatomy, physiology, and biology has faded from the mind of the budding surgeon, physician, and student of man. However well equipped to deal with cut-and-dried matters in established ways, he may fail, through lack of understanding, to meet strange emergencies with new expedients. Becoming a practitioner, he may not remain a thoughtful man of science. In the present work all that is necessary to a full understanding is dealt with lucidly, if briefly. The immediate subject-matter is handled as clearly, but in greater detail. The book may be cordially recommended, for it is very good.

*New Alt-Azimuth Tables,* 65° *N. to* 65° *S.* Pp. xvii+154. (Tokyo: Hydrographic Department, 1920.)

SINCE the very general adoption of the method of navigation known as the Marcq system of position lines, in which, whatever the azimuth, the position line is determined by one and the same problem, the calculation of altitude, many attempts have been made so to simplify the working that the results can to a great extent be effected through the medium of suitably arranged tables by simple inspection. A fresh attempt of this nature forms a leading feature of the excellent little work recently issued by the Hydrographic Department at Tokyo. Like other tables of the kind, such as

those of the Rev. F. Ball, R.N., and of Capt. Aquino, of the Brazilian Navy, Mr. S. Ogura, the inventor of the method, commences by assuming such a point upon the chart that latitude and hour-angle are each represented by an exact number of degrees. In the subsequent procedure, however, he differs wholly from the methods of his predecessors, and by means of but one special table, occupying only eighteen pages, carries out his purpose in a manner which, in point of simplicity, is certainly not inferior to anything that has gone before. A second table of about nine pages is added, but this is nothing more than a specially arranged table of logarithmic secants, convenient, but not in any way indispensable to the principle upon which the method is based.

Other new and original tables given in the volume are those for finding azimuth, identifying an unknown star, and so forth, and the contents afford a fresh proof that no effort is spared by the Japanese naval authorities to keep in close touch with the many developments in the science of navigation that have taken place in recent years.

*Le Destin des Etoiles: Etudes d'Astronomie Physique.* By Svante Arrhenius. Traduction française par T. Seyrig. (Nouvelle Collection scientifique.) Pp. v+224. (Paris: Félix Alcan, 1921.) 8 francs net.

THE course of development of suns and planets from the primitive nebula to planetary death is discussed in this book. It deals first with the Galaxy, describing the conclusions of Wolf, Easton, Seeliger, Charlier, and Shapley on its extent and structure. The author ascribes the two great star streams to the interpenetration of two cosmic clouds, the rapid rotational motion of certain nebulæ that is revealed by the spectroscope being supposed to arise from the collision of nebulous masses in the course of this interpenetration. He holds that the dark regions in the Galaxy have been swept clear by the passage of cosmic clouds.

Several chapters are occupied with planetary atmospheres and with the changes that they probably undergo in the course of the planet's development. It is suggested that free oxygen is not present until the surface is sufficiently cool to be fit for the support of life. The habitability of the planets is also discussed, the moon and Mercury being classed as dead worlds, Mars as possibly supporting low forms of vegetation, while Venus is supposed to be in the carboniferous stage.

The book can be recommended for its bold speculations, which include in their scope much recent observational work.

A. C. D. CROMMELIN.

*Kentucky Superstitions.* By Dr. D. L. Thomas and Lucy B. Thomas. Pp. viii+334. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1920.) 12*s.* 6*d.* net.

UNTIL recently Kentucky was the most remote and primitive of the States of America. Among the Mountain whites, as is well known to students of American social conditions, the law did not run; they lived in conditions which were practically tribal, and the most prominent features in their social habits were the blood-feud and the illicit still. The Lowland whites and negroes, the remaining elements in the population, were also very little touched by outside influence. It is therefore not surprising to find that the compilers of this collection have been able to get together more than four thousand instances of superstitions, among which a firm belief in witchcraft and in the efficacy of charms and magical cures in illness figures prominently. A large proportion of these beliefs will be familiar to students of British folklore. As the Kentucky population was derived mainly from the Carolinas, Maryland, and Virginia, these superstitions have a pedigree going directly back to England in the seventeenth century. The authors consider that the negro has assimilated white folklore, his only contribution being the Voodoo or Hoodoo beliefs. Certain elements, however, suggest that a closer examination might modify this view.

*Notes on Dynamics, with Examples and Experimental Work.* By Terry Thomas. Pp. 123. (London: Crosby Lockwood and Son, 1920.) 6*s.* net.

THE "notes" issued by Mr. Thomas deal with a fairly wide range of dynamical problems, and there are hundreds of excellent exercises, but this is all one can say in their favour. The diagrams are very roughly drawn, and the whole style of the book is reminiscent of the student's lecture notes. Thus one must object to a statement like "The engineer unit of mass is $M/g$, where M is the mass in pounds, and $g=32{\cdot}2$"; or "The various forms of energy are: potential, kinetic, heat, electrical, and chemical"; or "Neglecting the effect of the axle, the moment of inertia of a flywheel is $MR^2/2$," without saying anything about the construction of the flywheel; or "$I_z=I_x+I_y$" in dealing with moments of inertia, without mentioning that this refers to a plane lamina.

The author is of the opinion that it is much safer for beginners to reduce all forces to poundals and dynes, and carries this doctrine so far as to introduce the term "tondal." This is an interesting opinion, but it is very doubtful whether many teachers will agree with it.

S. BRODETSKY.

*Countryside Rambles.* By W. S. Furneaux. (New Era Library.) Pp. lvi+186. (London: George Philip and Son, Ltd., n.d.) 3*s.* 6*d.* net.

As a populariser of natural history Mr. Furneaux is already well known. In the present volume the contents of which are arranged in accordance with the four seasons, attention is directed to many of the more striking objects and phenomena, chiefly botanical and zoological, that are likely to come within notice during walks in the country. It is lightly and pleasantly written, and the forty-six plates of photographic illustrations are very successful.

## 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.]*

### Occurrence of the Aurora Line in the Spectrum of the Night Sky.

I HAVE pursued the line of work outlined in my letter to NATURE of March 31, 1921 (vol. 107, p. 137). The result has been to show that at Terling, Essex, the aurora line can be photographed on two nights out of three. Exposures were made on 150 nights, irrespective of weather.

The intensity on ordinary occasions appears to have little or no connection with magnetic disturbance or the distribution of spots on the sun. The most interesting point that has come out, however, is that the aurora line is much stronger at Terling than at Beaufront Castle, near Hexham, Northumberland. I have made exposures on twenty-six different single nights at the latter place, and have never found a trace of the aurora line on any of them, though the same instrument and the same kind of plates were used as at Terling.

Positive results at Terling were sandwiched in between the negative results at Beaufront; thus the latter cannot be attributed to seasonal variation.

Five nights' cumulative exposure have been tried on two occasions at Beaufront, and on each plate the aurora line was obtained.

I have been very much astonished at this diminished intensity of the aurora line as one goes north. The difference of latitude is about 3°. It would seem that the aurora line as photographed in the south of England will not fit into the scheme of distribution of the polar aurora. I hope to pursue this line of work to the north and to the south as opportunity may offer. RAYLEIGH.

October 9.

### Atomic Structure.

IN connection with the problem of the constitution of the atom discussed in my letter to NATURE of March 24 last (vol. 107, p. 104), I should like to add a few complementary remarks about the manner in which the orbits of the electrons in the atom are characterised.

According to this view of atomic constitution, the electrons in the atom are arranged in groups in such a way that the orbit of every electron within one and the same group is characterised by the same total number of quanta. Since, however, for orbits characterised by more than one quantum there exist several types of orbits possessing the same total number of quanta, the electrons within each group do not in general play equivalent parts, but are divided into a number of sub-groups corresponding to different types of possible orbits. Now it is a salient feature of this picture that the atom cannot be said to be composed of a number of well-defined spherical shells of electrons moving in sharply separated regions of the atom. In fact, although the electrons of a given group mainly move within one and the same shell-shaped region of the atom, the electrons, at any rate of certain sub-groups, will in their revolution penetrate into the region of the orbits of the electrons of inner groups. This gives rise to a coupling between the various groups, which is an essential feature of the interpretation of the stability of the atom. As a consequence of this, the orbit of an electron may be considered from different points of view, according as attention is mainly paid (1) to the larger part of the orbit which lies outside the region of inner groups, and which nearly coincides with an almost closed Keplerian ellipse, or (2) to the mechanical properties of the whole orbit, regarded as a type of central orbit composed of loops which only in their outer part possess an approximately Keplerian character.

Now in the classification described in my former letter the orbits were regarded from the first, and more superficial, point of view. The numbers of quanta characterising the orbits of the electrons in the different groups correspond to Keplerian ellipses, which coincide approximately with the outer parts of the orbits of the electrons in question. It has since been possible, by a detailed examination of the parts of the orbital loops situated within the region of inner groups, to classify the orbits from the second, and more fundamental, point of view, leading to a simple and unambiguous result. In fact, we are led to a classification in which, when we proceed outwards from the nucleus, the number of quanta characterising a certain group of orbits is always larger by one unit than that of the preceding group. For the groups in the inner region of the atom, where the attraction of the nucleus preponderates, this new rigorous classification coincides with the old one of my former letter. But it departs from the old for groups in which the orbits of the electrons mainly fall in the outer region of the atom, where the attraction of the nucleus is largely compensated for by the repulsion of the electrons in the inner groups. For these groups the quantum numbers of the orbits given in my former letter were equal to, or even smaller than, those of inner groups.

Notwithstanding the essential progress made by this modification in the classification of the orbits, the main features of this model of the atom remain the same. For instance, my former statements of the numbers of electrons in the various groups and sub-groups in the atom hold unaltered for all groups. In fact, in fixing these numbers by the correspondence principle we find them to depend on the harmony of the motion of the electrons within each single group. They depend, therefore, primarily on the relative dimensions of the approximately Keplerian loops, and only secondarily on the way in which these loops are joined together to form complete central orbits. Thus the previous model of the atoms of the inert gases holds unaltered also as regards the outer groups, provided that the numbers stated as defining the number of quanta of the orbits in the various groups are considered instead as defining the number of sub-groups within the corresponding groups. Moreover, the numbers in question offer an approximate estimate of the spatial extension of the regions of the orbits of the electrons in the different groups in the atom. For instance, the orbits in the outermost "shell" in the Niton atom must be characterised as six-quanta orbits instead of as two-quanta orbits; but the dimensions of the orbital loops will by no means be of the same order of magnitude as those of the orbit of an electron revolving in a Keplerian orbit characterised by six quanta in the region outside that of the orbits of the electrons in the five inner groups; they will rather be of the same order as those of a similar Keplerian orbit characterised by only two quanta.

From these remarks it will be seen that my former applications of the theory to the interpretation of the physical and chemical properties of the elements

remain in substance unaltered. At the same time the elaboration of the theoretical considerations sketched in this letter throws a good deal more light on the interpretation of many details. For instance, it is possible to account for the appearance in the atom, with increasing atomic number, of groups of new constitution in such a way that we obtain a natural interpretation not only, as before, of the existence of such families of elements in the periodic table as those of the iron metals and the rare earths, but also of the almost complete absence of any effect on the Röntgen-ray spectra of the appearance of such groups. This absence is explained by the fact that in these families we do not witness any sudden change with increasing atomic number in the total number of quanta of the orbits of the electrons of certain groups. On the contrary, we may be assumed to witness in the appearance of each of these families the completion of a group by the inclusion of further electrons moving in orbits characterised by the same number of quanta. This addition to the group is brought about by a change in the interaction between the various possible types of orbits with this number of quanta caused by the alteration in the dimensions of the orbital loops and in the "apparent" number of quanta which may be said to characterise these loops.

I have confined myself here to these points of general character. For details of the theory and its applications I must refer the reader to a paper in preparation for publication by the Royal Danish Academy of Science. N. BOHR.

Copenhagen, September 16.

### The Separation of Chlorine into Isotopes.

IN NATURE of April 22, 1920 (vol. 105, p. 230) Harkins and Broeker reported that they had obtained a partial separation of the element chlorine into isotopes. Five determinations made early in February of that year showed atomic weight increases of 0·052, 0·059, 0·057, 0·055, and 0·053 unit of atomic weight. Assuming that ordinary chlorine has an atomic weight equal to 35·460, the new chlorine as separated had an atomic weight equal to 35·515.

Shortly after the publication of this report in NATURE the progress of the separation was stopped by the death of Mr. Broeker. Soon after this an entirely independent diffusion was begun by Dr. Anson Hayes and the present writer, using new apparatus and a different source for the hydrogen chloride. In this way about twenty grams of chlorine which has an atomic weight higher by 0·0375 unit than that of ordinary chlorine, and eighty grams with an atomic weight higher by 0·034 unit, have been obtained, together with several kilograms the atomic weight of which has not been determined, but must be more than 0·2 unit high in order to give the results cited above. Thus far the effort has been to collect considerable material for future work rather than to get the maximum increase of atomic weight. The details of this work were reported to one of the American chemical journals in April of this year, but publication may be delayed many months by a strike of the printers.

The atomic-weight method used gave results accurate to 0·003 unit of atomic weight, and consisted in determining the amounts of acid in samples of ordinary and isotopic hydrochloric acid of the same density. The pyknometer was made in such a way as to give high precision, and the thermostat was regulated to 0·001°. Eighteen atomic-weight determinations were made.

Absence of impurities, and especially of bromine and iodine, was ensured by using only the purest materials in the diffusion in an apparatus consisting of glass and porous porcelain only, and by recrystallising the chlorine from water in the form of sodium chloride three times and by precipitating it once in the same form by passing in isotopic hydrogen chloride gas. In addition to this, two fractional distillations with potassium permanganate and one fractional distillation without this substance were used.

Mr. T. H. Liggett, who worked with the present writer on this problem in the year 1917–18, has reported that he also has secured an increase of 0·05 in the atomic weight of chlorine by using the same method—the diffusion of hydrogen chloride gas.

Thus we have definitely confirmed the separation reported by Harkins and Broeker.

WILLIAM D. HARKINS.

University of Chicago, August 28.

### The Pickering Series in O Type Stars.

IF the Pickering series, consisting of the lines 5411, 4542, 4200, etc., in stellar spectra, is due to ionised helium, it is known from the investigations of Fowler and from Bohr's theory that there must be additional lines which appear as violet components of the Balmer series of hydrogen. As these components have an average separation of 2 Å. they should be readily seen in the spectra of O type stars. Unfortunately, there are two unfavourable circumstances: first, the O type stars are all faint, and, secondly, the lines of both the Balmer and the Pickering series are in general so diffuse as to be hopelessly blended.

A preliminary survey was made here last year of O type stars for the purpose of selecting one or more stars of reasonable brightness and with fairly sharp lines. As a result 10 Lacertæ, type Oe 5, magnitude 4·9 was selected as the most suitable star for tests with higher dispersion. On resuming work this year the director, Dr. J. S. Plaskett, directed attention to 9 Sagittæ, type Oc, magnitude 6·2, as also a very suitable star. After some preliminary experiments, two plates of 9 Sagittæ and 10 Lacertæ with three-prism dispersion (10 Å. to 1 mm. at Hγ) were secured on August 12 which showed components at Hβ and Hγ at the theoretical separation. With this as a start, check plates were secured, and in addition high dispersion plates, requiring 9–10 hours' exposure were secured of the region around Hα in 10 Lacertæ. The preliminary wave-lengths on the international scale of the complete Pickering series, and also of the Balmer series, are summarised in the following table:—

| Pickering series. | | Balmer series. | |
|---|---|---|---|
| Star. | Computed. | Star. | [1] Star – Lab.[a] |
| 6559·71 [1] | 6560·15 | 6562·79 [1] | ± ·00 |
| 5411·54 | 5411·53 | | |
| 4859·07 [2] | 4859·35 | 4861·34 | + ·01 |
| 4541·65 | 4541·62 | | |
| 4338·77 | 4338·70 | 4340·45 | − ·02 |
| 4200·00 [3] | 4199·86 | | |
| 4099·96 | 4100·00 | 4101·70 | − ·04 |

[1] The wave-length of Hα was assumed in order to determine the position of the other component. Measures of the Hα component were difficult to make, partly on account of the small linear dispersion and partly because of the existence of a line 6558·6, origin unknown.

[2] Blend with Fowler's enhanced nitrogen line 4858·82 in 10 Lacertæ. In 9 Sagittæ there is no component, as it is probably obliterated by the enhanced nitrogen line appearing as emission.

[3] Blend with Fowler's enhanced nitrogen line 4200·06.

The first column contains measured wave-lengths of the Pickering series in the star, the second the computed values, the third contains the measured wave-lengths of the Balmer series in the star, and the fourth the residuals, star−laboratory, using Curtis's wave-lengths. In view of the closeness of the agreement between the observed and computed values, there can be no doubt as to the existence of the helium components of the Balmer series, and hence no doubt that the Pickering series is due to enhanced helium.

Using these preliminary wave-lengths, corrected to vacuum, the value of the constant $N_{He}$ in Bohr's formula, $n = N_{He}\left(\frac{1}{4^2} - \frac{1}{m^2}\right)$, for the Pickering series has been computed for all lines except those with footnotes. The weighted mean, using in addition the measured wave-length 4685·76, comes out $N_{He}$=438 890·3, with a total range of 16·8. From the well-known formula:

$$\frac{m_0}{M} = \frac{N_{He} - N_H}{N_H - \frac{1}{4}N_{He}},$$

arising from the correction to Böhr's simple theory on account of the motion of the nucleus, the mass of the electron $m_0$ in terms of the mass M of the hydrogen atom comes out $\frac{1}{1851·6}$. The revised values of the wave-lengths which will result from additional plates and re-measures should give a value of the electron mass of a high degree of accuracy.

In a recent paper (Proc. Roy. Soc., A, vol. 99, p. 135, 1921) Saha has predicted that at about the stage Ob in stellar spectra the Balmer series disappears and is replaced by the Pickering lines 6560, 4859, 4339, 4100. Reference to his tables shows that the enhanced Mg line 4481 should disappear at a still higher temperature than the Balmer series. In the star 9 Sagittæ the line 4481 has almost disappeared. In fact it has only been glimpsed on one of several plates. However, at Hγ there are lines at 4340·4 (Hγ) and 4338·8. Further, Hγ is about six times as intense as the Pickering component. This non-verification of Saha's prediction is scarcely surprising when it is recalled that the nebulæ, which are probably more advanced than O type stars, show the Balmer series (Lick Observatory Publications, vol. 13).

H. H. PLASKETT.

Dominion Astrophysical Observatory,
Victoria, B.C., September 17.

## Radiation and Chemical Action.

IN the *Philosophical Magazine* for November, 1920, Prof. Lindemann has shown that if Prof. W. C. McC. Lewis's hypothesis is true, *i.e.* that the velocity of a chemical reaction is proportional to the intensity in the system of the radiation of a wave-length which is characteristic of the reaction, then in the case of the inversion of cane-sugar by dilute acid, exposure to the radiation of the sun should increase the reaction velocity $5 \times 10^{13}$ times.

Recently Prof. Lewis has suggested that any such effect would not be true for the conditions under which such a reaction is usually carried out, because the activating rays lie in the region of 1μ, and at this wave-length water, the solvent, would absorb the radiation almost totally in the first thin layer, so that the bulk of the liquid would remain unaffected.

In order to test the radiation hypothesis, paying heed to Prof. Lewis's suggestion, the following simple experiment has been carried out. A solution containing 100 gr. of cane-sugar and 3·65 gr. of hydrogen chloride per litre was made up and divided into two portions. One was left to stand indoors at room-temperature (14·7° C.), while the other was forced upwards through four fine jets made from 3 mm. diameter glass tubing drawn out to the narrowest of capillaries; this treatment took place on the roof in full sunshine. The liquid from the jets formed fine columns about 8 cm. high, which then broke up into clouds of small drops, the drops rising a further 40 cm. They were allowed to fall, and collected in a large dish; the temperature of the resulting liquid had risen to 19·1° C.

Now for the cane-sugar at the concentrations used the period required for half to be inverted is at 20° C. from Lewis's measurement of the velocity constant, $1·6 \times 10^5$ seconds, or approximately 47 hours. On Lewis's hypothesis, illumination by the sun should reduce this to $3 \times 10^{-9}$ seconds; hence it was reasonable to expect some indication of a more rapid change in the exposed portion if the hypothesis were true. Two polarimeter tubes were filled, one with the exposed portion, the other with the unexposed. The rotations measured were:—Unexposed solution, 13·06°; exposed solution (measured 2 min. later), 12·82°. In other words, illumination by the sun had had no appreciable effect on the reaction velocity.

The size of the drops in which the one portion had been exposed was measured later by catching drops of the same solution formed under the same conditions on black velvet and measuring them under a microscope. They were of pretty constant size, the average diameter being 0·015 cm. It is thus difficult to imagine that the absence of any effect was due to absorption by the solvent. Further, from Stokes's formula the size gives an average time of fall 0·68 second, so that the time of exposure is ridiculously ample. For even if the radiation density at 1μ had been reduced inside each drop, by absorption, to $10^{-8}$ of its value, which is unlikely, then a rough calculation, assuming the truth of the hypothesis, shows, that an exposure for this time should result in a difference in polarimeter reading for the two solutions of about 13°, instead of the observed 0·24°.

It is, of course, realised that this simple experiment has no bearing upon M. Perrin's version of the radiation hypothesis, in which the reactants are supposed to absorb several quanta of considerably longer wave-length than 1–2μ. But this also can be tested directly by experiments, which it is proposed to carry out here as soon as possible.

T. W. J. TAYLOR.

Brasenose College, Oxford, October 2.

## Qualities of Valency.

IN his article in *Science* of July 22 (see NATURE, September 15, p. 101), and in his address to Sections A and B of the British Association at Edinburgh, Dr. Irving Langmuir asks us to believe that the sodium and chlorine atoms in sodium chloride are never united by a chemical *bond*, *i.e.* that the salt is ionised in its synthesis and remains ionised under all conditions. This appears to be a denial of the existence of NaCl molecules, yet such molecules exist in the state of vapour at *cir.* 2000° C. Are we, then, to suppose that sodium and chlorine ions are held together at this temperature by electrostatic attraction only? Difficult to reconcile with this idea, if it is applied to salts in general, are the phenomena of aqueous solutions of some salts—mercuric salts, for example—which are attributed to imperfect ionisation and the increase of specific conductivity of imperfect

electrolytes on dilution. These difficulties, if they are real, might be removed by reverting to the idea of electrons acting as binding material in compounds capable of ionisation instead of supposing that they have passed completely and irreversibly over from the positive to the negative atom and have been incorporated into the sheath of the latter. This is not to confuse electrovalency with covalency, for the essential difference between the two kinds of valency is still that electrons are transferable in the one case and not in the other.

It is apparent, however, that Dr. Langmuir regards ionisation in a wider sense than is usual from his statement that "compounds without covalency must consist of positively and negatively charged ions"; and that among such compounds he places $SF_6$, because the sulphur atom is sufficiently positive to yield to the powerful attraction of the fluorine atoms for electrons.

In this connection I would like to direct attention to the unique characteristics of the elements of the first short period as compared with those of the second short period and following periods, and to inquire whether Dr. Langmuir's theory can afford an explanation of them.

The hydrides of the first short period are inert compared with corresponding hydrides in subsequent periods. Compare, for example, $CH_4$ with $SiH_4$. Why is $CH_4$ stable and inert, while $SiH_4$ is rather unstable and undergoes metathesis with some salts? Presumably H is joined to C in methane by covalency, while the hydrogen of silane is "ionised." Why is this so? Comparison of HF with HCl shows an analogous difference. Why is HF so weak an acid? Certainly not for lack of electronegativeness on the part of fluorine. If we are to regard HCl as always "ionised," does covalency in the case of HF gradually give place to electrovalency as its aqueous solution is diluted and specific conductivity increases, and, if so, why? Comparison of $CCl_4$ with $SiCl_4$ is equally interesting, because $CCl_4$ is analogous to $CH_4$ in inertness and $SiCl_4$ to $SiH_4$ in reactivity. Why, then, does covalency obtain with one chloride and electrovalency with the other?

These few questions point to the fundamental problem of the gradation of properties of the elements in the periodic classification; and further developments of his theory, which Dr. Langmuir promises, will be looked for with great interest.

R. M. CAVEN.

Royal Technical College, Glasgow,
September 26.

## The Dushman Equation for the Velocity of a Monomolecular Reaction.

IN view of the discussion at the Faraday Society on September 28, it is perhaps of interest to direct attention to the Dushman equation for the monomolecular velocity constant (Journal A.C.S., 1921, vol. 43, p. 397). This equation, $\kappa = \nu\epsilon^{-\frac{N\hbar\nu}{RT}}$, where $\hbar$, R, T, and $\nu$ have the usual significance and $\epsilon^{-\frac{N\hbar\nu}{RT}}$ represents the number of active molecules, is found to hold fairly accurately for certain monomolecular reactions that have been investigated. Of these the chief are the decomposition of phosphine and nitrogen pentoxide. Much dispute has arisen as to the meaning of $\nu$. Is this related to the frequencies of the *activating* radiation, or is it a frequency characteristic of some degree of freedom in the decomposing molecule? Judging from the constancy of $h\nu$ over a range of temperatures, the latter would appear to be the more reasonable assumption. The relationship between $\nu$ and the absorbed and emitted frequencies would thus be left open.

On this hypothesis it is possible to ascribe a simple meaning to the Dushman equation, for the "period of existence" of the molecule in the active condition will be $1/\nu$, *i.e.* the period of time corresponding to one molecular vibration. This equation could not hold if the rate of chemical decomposition of the active molecule was in any way different from its rate of decay, due to the emission of quanta to its environment. For if there is any difference between the two rates, the position of equilibrium will be disturbed, and the number of active molecules will not be given by the Maxwell relation. In general, the time of association of an activating quantum (of a lower frequency than $\nu$) with a gaseous molecule will be greater than $1/\nu$, so that the effect of chemical decomposition will lower the concentration of the active molecules at the steady state and decrease the velocity constant. $\kappa$ would in these circumstances be less than the value obtained from the Dushman equation. Tolman (Journ. A.C.S., 1921, vol. 43, p. 269) finds for nitrogen pentoxide that $\kappa$ (calc.) $= 19 \times 10^{-5}$, while $\kappa$ (obs.) $= 4{\cdot}87 \times 10^{-5}$. The change in $\kappa$ is thus in the required direction. The *exact* agreement obtained by Dushman in the case of phosphine would thus appear to be accidental.

W. E. GARNER.

University College, London.

## The Duration of Sunrise and Sunset.

MY attention having been accidentally directed to this matter, I have made observations for the purpose of comparing the observed duration of sunrise and sunset with the duration computed from geographical position and *Nautical Almanac* data, and have now seventy-nine complete observations, made mostly with marine horizons on Manila Bay, the China Sea, the open Pacific, Vineyard Sound, and Buzzard's Bay, with a few made with land horizons. The viewpoints have been from sea-beach to 1512 metres elevation.

There seem to be two types of marine sunrise and sunset; one, type A, about twice as frequent as the other and accompanied by horizon mirage. The diagrams (Fig. 1) accompanying this letter, sketched from photographs obtained at Woods Hole, show the characteristics of the two types, which are described with historical details in *Popular Astronomy* (vol. 29,

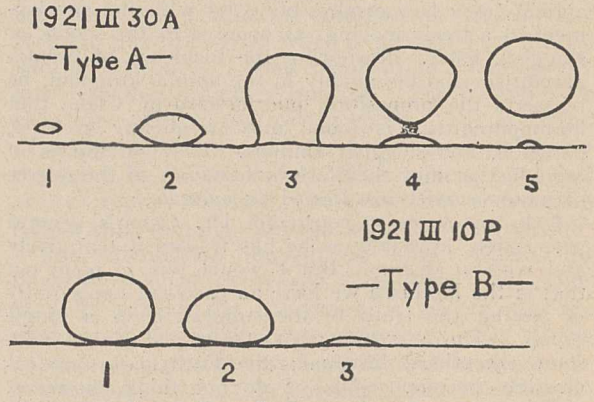


FIG. 1.—Types of marine sunrise and sunset.

pp. 251 ff., May, 1921) and, with theory and methods used, in the *Philippine Journal of Science* (vol. 17, pp. 607–14, 1920).

The time observations, made with field-glass or telescope, stop-watch, and ordinary watch, show that with type A there is, on the whole, a slight excess of observed duration over computed, amounting for forty-four cases to 0·55 per cent.; a few cases give small deficiencies. This may be, perhaps, explained by atmospheric dispersion. Type B, however, always gives excess, sometimes remarkably large, even 2 min., or 68 per cent., with an average excess for twenty-two cases of 12·3 per cent., which is difficult to explain.

Records of duration of sunrise and sunset are almost non-existent; a careful search, with inquiries of several prominent astronomers, has failed to produce more than about half a dozen, mostly made by Le Gentil at Pondichéry in 1769 while on his transit of Venus expedition. While he made no such use of them, on computing they give results in agreement with the above. It would seem, perhaps, worth while for others to take the matter up and record and publish *at least* date and hour, geographical position, nature of horizon, duration, and type or form of disc. The horizon should be quite level or distant if at all irregular. Naturally, the best horizon is that of the sea or a large lake; but I have reason to believe that the results of observing with a distant level land horizon might be sometimes quite extraordinary.

While the sun is the source of light in such observations, and the *Nautical Almanac* and four-place logarithms have to be used in the computing, the subject is not astronomical, but meteorological, and, I believe, has to do with temperature distribution in the atmosphere. We have here one of those residual phenomena the study of which may lead to the discovery of interesting facts and which can be forwarded by amateur observers, the more and the more widely scattered the better.

WILLARD J. FISHER.

Cambridge, Mass., September 14.

## Is Bisexuality in Animals a Function of Motion?

IN NATURE of September 29, p. 145, Dr. Orton makes the interesting suggestion that bisexuality in animals may be causally connected with the development of a freely moving, as opposed to the sessile or sluggish, habit. Reviewing the incidence of hermaphroditism and bisexuality in the animal kingdom, he reasserts the proposition put forward by Claus that hermaphroditism is found most frequently in fixed, parasitic, and sluggish animals. The two modes of reproduction may therefore be functions of the degree of motor activity manifested by animals.

I do not wish to contradict Dr. Orton's general proposition, especially as he has framed it tentatively and without dogma. But I would like to point out that in the Mollusca we have an excellent opportunity of testing the truth of the suggestion in a single group. The streptoneurous Gastropoda are, with some exceptions, bisexual; the Euthyneura are exclusively hermaphrodite. I do not think, however, that we can select the Euthyneura as exclusively "sluggish" animals and the Streptoneura as exclusively "active." The Pulmonata (Euthyneura), with their lengthy æstivation or hibernation period, might be regarded as more sluggish than the average Prosobranch. But other Euthyneura which apparently do not æstivate or hibernate for a long period cannot be regarded as more sluggish than the Streptoneura, viz. the Tectibranchs and Nudibranchs. Having kept many of these animals in captivity myself, I can testify that they are no less active than Streptoneura observed under similar conditions. An Aplysia is not more sluggish than a Buccinum or a Paludestrina. I admit that an intimate study of the habits of all Gastropoda is not available, but the known facts go to show that many of the hermaphrodite forms are as active as the bisexual ones. Dr. Orton may reply that many of the apparently bisexual forms may be liable to intermittent hermaphroditism. I have no doubt that permanent and intermittent hermaphroditism may be commoner in the Streptoneura than we imagine, but all the evidence accumulated over many years goes to show that bisexuality is regular and very widely developed among this group. During the last two years, for example, I have examined more than a hundred examples of various species of Paludestrina and kindred genera, and not found a single hermaphrodite form. In Pelseneers's "Variations et leur Hérédité chez les Mollusques" (1920) there are only five genera cited in which occasional hermaphroditism is recorded, though doubtless Dr. Orton could add a few more to the list.

The suggestion that hermaphroditism is either the direct result of the sedentary habit or that it is in some way facultative for animals leading such a mode of life is indeed interesting. But in that case it is difficult to see why it is not found as the *exclusive* mode of reproduction among the Scaphopoda, the Lamellibranchia, and the Polyplacophora (Chitons), which are all, on the whole, more sluggish than the Streptoneura. Dr. Orton's proposition may well be true of sessile or parasitic forms, but it scarcely seems to be true of animals which are merely sluggish. It should be pointed out that great diversity of habit occurs in the various groups of Gastropoda which might on a superficial view, perhaps, be categorised as "active" or "sluggish." Along with really sluggish forms are associated species which are active swimmers, burrowers, and climbers. Finally, it might be asked whether the locomotor test is an entirely safe criterion of physiological "sluggishness" or "activity."

G. C. ROBSON.

Zoological Department, British Museum (Natural History), October 3.

## An Algebraical Identity.

IN NATURE of July 21 (vol. 107, p. 652) appears a letter from Mr. W. E. H. Berwick, inquiring whether the values of $y$, $z$ satisfying the equation $z^2-py^2=-4$, which are derivable from Gauss's cyclotomic formulæ, constitute generally the primitive solution of this equation. In reply I have to point out that a comparison of Gauss's formulæ (Mathews, "Theory of Numbers," p. 215) with Kronecker's formula

$$\{\tfrac{1}{2}(T+U\sqrt{D})\}^h=\Pi(1-\omega^{\rho^{2n+1}})/\Pi(1-\omega^{\rho^{2n}})$$

(Mathews, p. 253), where $T^2-DU^2=4$ is the primitive solution of this equation, T and U being positive, shows that $z$, $y$ are connected with the primitive solution $a$, $b$ by the relation

$$\frac{|z|+\sqrt{p}\,|y|}{2}=\left(\frac{a+\sqrt{p}\,b}{2}\right)^h,$$

where $h$ is the number of properly primitive classes of determinant $p$. Incidentally, it appears that $z$ is always positive and $y$ negative.

R. F. WHITEHEAD.

September 20.

## Consciousness and the Unconscious.[1]

By PROF. C. LLOYD MORGAN, LL.D., D.Sc., F.R.S.

*Emergent Evolution.*

BY general consent we live in a world in which there seems to be an orderly passage of events. That orderly passage of events, in so far as something new comes on to the scene of Nature, is what I here mean by evolution. If nothing really new emerges—if there be only permutations of what was pre-existent (permutations predictable in advance by some Laplacean calculator)—then, so far, there is no evolution, though there may be progress through survival and spread, on one hand, and elimination on the other. Under Nature is to be included the plan, expressive of natural law, on which all events (including mental events) run their course.

From the point of view of a philosophy based on science our aim is to interpret the natural plan of evolution, and this is to be loyally accepted just as we find it. The most resolute modern attempt to interpret evolution from this point of view is that of Prof. S. Alexander in his "Space, Time, and Deity." He starts from the world of common sense and science as it seems to be given for thought to interpret. In order to get at the very foundation of Nature he bids us think out of it all that can possibly be excluded short of the utter annihilation of events. That gives us a world of ultimate or basal events in purely spatial and temporal relations. This he calls "space-time," inseparably hyphened throughout Nature. From this is evolved matter, with its primary and, at a later stage of development, its secondary qualities. Here new relations, other than those which are only spatio-temporal, supervene. Later in logical and historical sequence comes life, a new quality of certain systems of matter in motion, involving or expressing new relations thus far not in being. Then within this organic matrix, already "qualitied" (as he says) by life, there arises the quality of consciousness, the highest that we know. What may lie beyond this in Prof. Alexander's scheme may be learnt from his book.

This thumb-nail sketch can do slight justice to a theme worked out in elaborate detail on a large canvas. The treatment purports to formulate the whole natural plan of progressive evolution. From the bosom of space-time emerge the inorganic, the organic, the conscious, and, perchance, something beyond. And with this successive emergence of new qualities goes the progressive emergence of new orders and modes of relatedness. The plan of evolution shows successively higher and richer developments.

Such a doctrine, philosophical in range but scientific in spirit, to which, I may perhaps be allowed to say, I, too, have been led by a rather different route—I call emergent evolution.

[1] Abridged from the presidential address delivered to Section J (Psychology) of the British Association at Edinburgh on September 9.

The concept of emergence is dealt with by J. S. Mill, in his "Logic," under the consideration of "heteropathic laws." The word "emergent," as contrasted with "resultant," was suggested by G. H. Lewes in his "Problems of Life and Mind." When oxygen, having certain properties, combines with hydrogen having other properties, there is formed water, some of the properties of which are quite different. The weight of the compound is an additive *resultant*, and can be calculated before the event. Sundry other properties are constitutive *emergents*, which could not be predicted in advance of any existent example of combination. Of course, when we have learnt what happens in "this" particular instance in "these" circumstances, we can predict what will happen in "that" like instance in similar circumstances. We have learnt something of the natural plan of evolution. We may also predict on the basis of analogy as we learn to grasp more adequately the natural order or plan of events. But could we predict what will happen prior to *any* given instance—*i.e.* prior to the development of this stage of the evolutionary plan? Could we predict life from the plane of the inorganic, or consciousness from the plane of life? In accordance with the principles of emergent evolution we could not do so. The Laplacean calculator is here out of court.

*In Mind.*

To come to closer quarters with our sectional topic, what do we mean when we say that this or that is "in mind"? In a well-known passage Berkeley distinguished that which is in mind "by way of attribute" from that which is in mind "by way of idea." Fully realising that this should be read in the light of Berkeley's adherence to the creative concept, one may none the less claim for it validity on the empirical plane where mind is regarded as a product of emergent evolution. The former, therefore (*i.e.* what is present in mind by way of attribute), I shall speak of as *minding*, the latter as that which is minded. The former is a character constitutive of the mind—that in virtue of which it is a mind; the latter is objective *to* the mind or *for* the mind. That which is minded always implies minding; but it does not necessarily follow that minding implies something minded.

The distinction based on that drawn by Berkeley may be expressed in another way. One may be said to be conscious *in* perceiving, remembering, and, at large, minding; that which is perceived, remembered, or minded is what one is conscious *of*. I am conscious *in* attending to the rhythm or the thought of a poem; I am conscious *of* that to which I so attend. I need not *then* be conscious *of* attending to the poem, though perhaps I may, in psychological mood, subsequently make the preceding process of attention an object of thought.

*Dependence and Correlation.*

On these terms what is minded is no less mental than the process of minding. But I suggest that the word "consciousness" should be reserved for that which Berkeley spoke of as "in mind by way of attribute," or, in Prof. Alexander's way of putting it, as "a quality" of that organism which is conscious in minding. Anyhow, consciousness is here in the world. Creative evolution says: Yes, here in the world, but not of the world. It acts (as *élan vital*) into or through the organism regarded as a physical system; but its source is a disparate order of being to which, in and for itself, and *an sich*, it properly belongs. It depends on the physical organism in act but not in being. Now this, I urge, is a metempirical explanation of given facts, but not an empirical interpretation of them as (in my view) science tries to interpret. And its cause should be tried before a different court of appeal from that of science. Hence under emergent evolution one uses the word "dependence" in another sense, and urges that the very being of consciousness, as a quality of the organism, depends upon (or implies the presence of) the quality of life as prior in the natural order of emergence. If we enumerate successive stages, then consciousness is a quality (4) of certain things (very complex and highly organised things) in this world. In these same things there is also present the quality of life (3), and a specially differentiated chemical constitution (2). Empirically we never find (4) without (3), nor (3) without (2); and we express this by saying that consciousness depends on (or implies the presence of) life; and that life depends on a specialised kind of chemical constitution. It is an irreversible order of dependence. But there are things, such as plants, in which we find (as is commonly held) life without consciousness; and other things, such as minerals, in which there is chemical constitution (not, of course, "the same" chemical constitution) without life. Furthermore, there seems to have been a time when consciousness had not yet been evolved; and an earlier time at which life had no existence. But this or that chemical constitution is itself an emergent quality (2) of certain things; and there was probably a yet earlier stage of evolution at which even this quality had not yet emerged—a purely physical stage (1) at which (let us say) electrons afforded the ultimate terms in relation within physical events, continuously changing under electromagnetic (and, of course, also under spatio-temporal) relations.

There is clearly nothing in the foregoing thesis which necessarily precludes the further consideration of the same events from the point of view of creative evolution. The questions: What makes emergents emerge? What directs the whole course of emergent evolution?—these questions and their like are *there* quite in place. Furthermore, as between emergent thesis and creative antithesis, Kant's "Solution of the Third Antinomy" may afford a guiding clue.

*The Quality of Consciousness.*

Before proceeding further certain preliminary questions must be briefly considered. First, is there progressively emergent evolution in consciousness? It is a question of cardinal importance. My contention is that such evolution obtains in both aspects, inner and outer, the one in correlation with the other. This means that interpretation under emergent evolution is applicable to mental no less than to non-mental events. In other words, there is just as much progressive emergence in the inner or psychical aspect of organic nature as there is in the outer or physiological aspect. This is the keynote of mental evolution throughout its whole range.

I regret here to depart from the conclusion to which Prof. Alexander has been led. Take such episodes in our mental life as seeing a rainbow, hearing a musical chord, partaking of woodcock, dipping one's hands into cool water. In Prof. Alexander's interpretation (as I understand it) percipient consciousness, in each case, differs only in what he speaks of as "direction." That alone is enjoyed. All further difference in one's cognitive experience on these several occasions is due to the difference in that non-mental set of events with which one is then and there compresent. Even feeling, as affective, is not itself enjoyed. Feelings are objective experiences of the order of organic "sensa." They are not in mind by way of attribute. We are conscious of pleasure and pain but are not differentially conscious *in* receiving them. Consciousness is here just compresent with certain phases of life-process. Thus, for Prof. Alexander, consciousness, alike in sensory acquaintance, in perceptive cognition, and even in feeling pleasure or the reverse, is itself undifferentiated (save in "direction"); all the differentiation is in the non-mental world (beyond us or within our bodies) which is experienced and which transmits its characters to a recipient in which the rather featureless quality of consciousness has emerged.

*Consciousness and Enjoyment.*

Thus far the word "conscious" is used in the broad and comprehensive sense that was almost universally accepted a generation ago. But in accordance with current usage we must now distinguish consciousness from the unconscious. I happen to regard the word "unconscious" as peculiarly unfortunate—chosen as it is on the *lucus a non lucendo* principle. But let that pass. There it is and we must make the best of it—seeking to penetrate its dark wood. Under the older and more comprehensive use, consciousness may be indefinable. As in the case of spatial or of temporal relatedness we have got down to something that we find, rather than to something that can be strictly defined. Hence one has to proceed by indicating instances that fall within the inclusive class which we so name. The position is that, in the comprehensive class which we used to comprise under the heading of conscious-

ness, it is now thought desirable to make two sub-classes—(*a*) the unconscious and (*b*) the conscious. There is call, therefore, for the indication of some criteria which shall serve to distinguish the one from the other. Here definition is required. And since the unconscious is "served with the negative prefix," it is clear that the criteria we seek must distinguish by their presence the conscious from the unconscious in which these criteria are absent. Under what heading, then, are we now to place the comprehensive class including both (*a*) and (*b*)? I suppose we may call it the class of psychical events—as distinguished from physical and physiological events. But we still want some convenient noun which we may qualify by the adjectives "conscious" and "unconscious." I borrow from Prof. Alexander, and adapt for my present purpose, the name "enjoyment." Perhaps the chief objection to the choice of this word is that it must be understood as including what is unpleasant no less than that which is pleasurable. But as I cannot find a better, and am loth to coin a worse, I ask leave to use this word "enjoyment" to include all that has the psychical character or aspect. I regard the emphasis on affective tone which it suggests as a point in its favour.

On these terms there fall within the comprehensive class of enjoyment two sub-classes: (*a*) unconscious enjoyment and (*b*) conscious enjoyment—the latter marked by certain differentiating criteria. The question now arises: Is the distinction between the conscious and the unconscious just the same as that which is often drawn between "above the threshold" and "below the threshold" (supraliminal and subliminal)? Or, if they are not just the same, is there such close and intimate alliance that we may still say that all that is supraliminal is conscious and all that is subliminal is unconscious? What I wish to suggest is that the line between supraliminal and subliminal need not be coincident with that between conscious and unconscious. There are, I believe, modes of enjoyment both conscious and unconscious in the supraliminal field. But this reopens the main question: What are the differentiating criteria of the conscious?

*Criteria of Consciousness.*

Ask the plain man what he means when he speaks of acting consciously and he will probably reply: "I mean doing this or that with some measure of intention and with some measure of attention to what is done or to its outcome. The emphasis may vary; but one, or other, or both, of these characterise action that I call conscious. If I offend a man unconsciously there is no intention to give offence. When a cyclist guides his machine unconsciously he no longer pays attention to the business of steering, avoiding stones in the road, and so forth." Now if this correctly represents the plain man's view, it is clear that a full consideration of his attitude would involve careful discussion of intention and of attention. This is beyond my present scope. I want to dig farther down so as to get at what, as I think, underlies his meaning, and thus to put what I have to submit in a much more general form.

I want, if possible, to get down to what there is in the most primitive instances of consciousness—*i.e.* right down to that which characterises them as such. I believe that there is always in addition to that which is immediately given (say under direct stimulation in sense-awareness) some measure of revival with expectancy, begotten of previous behaviour in a substantially similar situation. Consciousness is always a matter of the subsequent occasion, and always presupposes a precedent occasion. In other words it is the outcome of repetition; and yet, paradoxically, when it comes it is something genuinely new. But this is the very hall-mark of emergence. That is why Prof. Alexander and I speak of consciousness as an emergent quality.

Let us analyse some simple first occasion—that on which a chick behaves to a ladybird will serve. The eye is stimulated from a distance with accompanying enjoyment (*a*). The chick responds by approaching and pecking with enjoyment in behaving (*b*). There follows contact stimulation with its enjoyment (*c*); and, thereon, behaviour of rejection with its enjoyment (*d*). We have thus, as I interpret, a biologically determined but orderly sequence affording successive modes of enjoyment *a, b, c, d*. So far the precedent occasion. On a subsequent occasion there is (*a*) as before in presentative form; this is immediately given in sensory acquaintance. But (*b, c, d*) are also "in mind"—mediately or in re-presentative guise, under revival, as what Prof. Stout calls "meaning." We have therefore (under an analogy) on the precedent occasion the notes *a, b, c, d*, struck in sequence. We have on the subsequent occasion (*b, c, d*) rung up by (*a*) through a "mechanism" provided psychically and neurally in the instrument. And when the notes (*a, b, c, d*) thus vibrate together they have the emergent quality of what one may speak of as the *chord* of consciousness.

What is there, however, about this emergent chord which differentiates it from the precedent sequence of notes *a, b, c, d*? It must be something psychical in its nature. I suggest that the revival carries with it a specific mode of new enjoyment which may be called "againness"; that which affords the basis of felt recognition. There is also something equally new in expectancy. That this is (so far as our own experience testifies) a factor in the chord of consciousness is, I should suppose, scarcely open to question.

Now whereas on the precedent occasion it is behaviour unconsciously directed towards that from which stimulation arrives that determines the order *b, c, d* as sequent on *a*, on the subsequent occasion it is the "meaning" (*b, c, d*) which then consciously determines the direction of behaviour. This centering of "meaning" on that

to which behaviour was on the precedent occasion unconsciously directed is the basis of conscious reference to an object.

The characteristics, then, of a chord of consciousness are revival with expectancy and with conscious reference which anticipates, and, through anticipation (thus forestalling the event), may endorse or inhibit, the further course of behaviour. And its emergent character, as chord, makes consciousness, not merely an additive blend of constituent tones of enjoyment, but (in Browning's forcible emphasis on a wholly new quality) "a star." (Cf. *Abt Vogler.*)

I have thus far dealt with the criteria of consciousness on the lines of what I conceive to be its evolutionary genesis. I must now ask whether these criteria—revival with expectancy and reference—do not characterise what we commonly regard as conscious enjoyment in our own adult life. My own experience is consonant with the outcome of genetic treatment. And I would ask others if there is not in our current consciousness always some measure of felt "againness" carried over from the past in revival, and always some measure of "comingness" in expectancy. I would ask whether there is not, as essential to consciousness, some leaning back on previous experience, some leaning forward to that which the future has in store. Is not this what M. Bergson means (I do not say all that he means) when he speaks of consciousness as "a hyphen" linking past and future?

*Levels of Psychical Integration.*

In our normal life much integration proceeds on the reflective level—that of rational thought and volitional conduct. The older philosophers, with some variation of terminology, urged that the difference between this reflective level and the perceptive level below it (*e.g.* in Descartes's animal automatism) is one not only of degree but of kind. The difference, they said in effect, is radical and absolute, demanding metempirical explanation. Thus the word "kind" carried a definitely metaphysical implication the influence of which is still with us to-day. But apart from this, as a matter of frankly empirical description of what is found, it was their way of expressing what I seek to express by saying that reflective consciousness has a new emergent quality—that which characterises reason as distinguished from perceptual intelligence. We have, however, the one word "consciousness" for both these levels. But within the more comprehensive sub-class, comprising all instances of consciousness, we may distinguish two sub-classes subordinate therein, (i) that of instances of reflective consciousness, and (ii) that of instances of non-reflective consciousness. Both sets of instances have the criteria of consciousness. But in (i) there is a further *differentia* in that "value" (in the technical sense) is referred to the object of such reflective thought. There is then, on this view, reflective integration, and there is also non-reflective or perceptive integration, each on its appropriate level, and each in its distinctive way conscious.

In dealing with the supraliminal field it seems to me imperative to distinguish according to the mode of origin of the integration that obtains therein. We must ask: How far is the "form" which it assumes (iii) the outcome of reflective integration; (ii) the outcome of unreflective or perceptive integration; and (i) the outcome of the integration in the subliminal unconscious to which as living beings we are heirs? If I am right in regarding (ii) and (iii) as successively emergent qualities of consciousness there is somewhat of a leap (though no breach of continuity) from (i) to (ii), and from (ii) to (iii). There is always something more (involving new terms in new relations) in the higher-level conclusion than is contained in the lower-level premises. This is the cardinal principle of all emergent evolution. Without this there would be nothing really new—merely a reshuffling of the old.

*Are there Unconscious Images and Ideas?*

In the interpretation to which I have been led unconscious enjoyment (not necessarily involving unconscious images and ideas) is no less integrated than is the system of physiological events which gives to life its emergent quality. If the analogy be permitted, just as in the physiological symphony of life there are chords and phrases and motifs, each with an emergent character of its own (*e.g.* the part played by the instruments of the reproductive sub-system), so too, in the psychical symphony of unconscious enjoyment there are correlated chords, phrases, and motifs. And all goes well so long as due balance and harmony are maintained in the orchestral performance, no matter what instruments play a dominant part at the time being. But unconscious enjoyment is primarily inherited psychical music correlated with the outcome of life-inheritance. I entertain little doubt that the life of animals, could we only feel its inner aspect as they themselves do, is brim-full of a rich music of unconscious enjoyment. As I write the swifts are wheeling and shrilling in the summer air. Am I wholly wrong in imputing to them an integrated form of enjoyment which is theirs on a basis of inheritance? Perhaps even sympathetic naturalists fail adequately to realise to what extent in animals the business of life as such, with further life as its wage, has also its psychical reward in enjoying so fully the performance of life's job. And this reward in the enjoyment of doing is inherited with the ability to do. A behaviourist interpretation of how it all comes about is, I believe, perfectly sound in its way. Not in what it emphasises, but in what (among extremists) it ignores—a psychical factor—does it seem to me to be deficient. In us at any rate the presence of enjoyment is undeniable. And though it is so readily caught up into consciousness it still carries, I think, the marks of its unconscious origin.

What does the poet or the artist tell us? Does he not claim that what springs up within him—if it be in truth (he may add) in any valid sense *his*—is quite inexplicable on what he regards as psychological principles? And if psychological principles deal only with conscious integration he is right. His poetry, or his art, is not in its essential nature the outcome of perceptive or reflective integration. Its well-springs lie deeper than that in the unconscious. He rightly affirms that the real thing in all true art is beyond his conscious control, though the means by which it is expressed must be learnt and may be bettered by taking thought. This is enshrined in the proverb: *Poeta nascitur non fit.* And even of those who can only appreciate his work, may it not be said, with a touch of paradox, that enjoyment in art becomes reflectively conscious in criticism? This need not mean that the critic enjoys poetry any the less for the combination in higher integration of unconscious and conscious enjoyment. What it does mean is that the glad newness and glory of surprise lies in the poetry and not in the criticism. Once again it must be said that it is the fresh unexpectedness that is still the hall-mark of the unconscious.

## The Age of the Earth.

ALTHOUGH it cannot be claimed that the joint discussion on the "Age of the Earth," at the meeting of the British Association at Edinburgh on September 13, led to the complete reconciliation of the views of the various sections of the Association represented, there could be no doubt concerning the extraordinary interest taken in it. Members desiring admission overtaxed the capacity of one of the largest lecture theatres in Edinburgh, and shortly after the all too short discussion one might overhear in the streets of the city the remark, "They haven't settled it yet." It was quite evident that it was a good thing, if merely for the dissemination of modern views on the subject, that authoritative representatives of each science should address the same composite audience of physicists, geologists, biologists, and many who would claim none of these descriptions.

It was not surprising that the starting point of all the speakers was the inadequacy of Lord Kelvin's estimate of twenty million years for the age of the sun. Lord Rayleigh, whose lucid opening of the discussion will long be remembered, evidently believed that Kelvin had covered his estimate sufficiently with the proviso concerning sources of solar energy other than gravitation. Such sources, *i.e.* radio-active materials, Kelvin was unaware of, but we now know them to exist in the earth, and must presume them also to exist in the sun. Lord Rayleigh proceeded to develop his argument for arriving at the age of uranium-bearing rocks from considerations of the uranium-lead and helium which they now contain. The order and rate of radio-active disintegration through the series from uranium to lead are known with considerable precision; helium also is evolved at a definite ascertained rate. An examination of the amount of lead now present in uranium minerals enables the time when disintegration commenced to be specified, for the lead in the rocks in question proves to be not ordinary lead but wholly that isotope of atomic weight 206 which is necessarily associated with the decay of uranium. Thus broggerite found in the pre-Cambrian rocks at Moss, Norway, contains lead of atomic weight 206·06; the lead-uranium ratio is 0·113, and this points to an age of 925 million years, upon the assumption that uranium and its products have always decayed as they do now. Estimates of age can also be made by measuring the content in rocks of that other product of disintegration—helium—although leakage of this gas makes the calculation less reliable. Allowing for this, however, the indications by helium content are generally confirmatory of those given by the lead-uranium ratio. These methods can be applied to younger formations of rocks, thus obtaining the approximate age of each.

Lord Rayleigh pointed out that Prof. H. N. Russell, by applying the argument statistically to the earth's crust as a whole, arrived at the period $8 \times 10^9$ years as an upper limit—this being six times longer than that of any individual rock yet examined. He concluded by giving a period amounting to a moderate multiple of 1000 million years as the probable duration of the earth's crust in a condition suitable for the habitation of living beings. The radio-active investigations leading to this conclusion are supported by other physical and astronomical evidence.

Prof. Sollas, who followed, made merry on behalf of the geologist, "newly enriched" from a "bankrupt" with a "mere score of millions of years" to a "bloated capitalist—with more millions in the bank than he knew how to dispose of." Within broad limits, he said, geologists were ready to leave to the physicists the precise calculation of geological time. Some geologists, notably the brilliant and lamented Barrell, had already begun to rebuild their science on the magnified scale. For himself, he preferred first "to make sure that the new radio-active clock was not as much too fast as Lord Kelvin's was too slow." In this connection Prof. Sollas directed attention to Prof. Joly's examination of the "pleochroic haloes" occurring in uranium-bearing black mica. These haloes, which are formed by the $\alpha$-rays expelled by uranium in the various stages of its disintegration, are found generally to have ranges consistent with those obtaining in modern times. The two inner rings, however, form a notable exception, indicating ranges greater than normal

by one-sixth, and Prof. Joly's conclusion is that in Caledonian times there existed a metope of the uranium which we now know, with possibly very different properties. If this is true, the uranium clock has not been keeping uniform time, and the true age of the earth cannot be found by presuming that it has done so.

Prof. Sollas proceeded to explain and criticise the arguments whereby geologists are seeking to modify estimates of age based upon sedimentation, sea salinity, and denudation, so as to bring them more in accordance with radio-active and other physical calculations. He evidently considered these modifications not only premature (for reasons given earlier), but to some extent unsound. Geologists, he said, are not an undivided family, and proceeded to dissent, in anticipation, from the views of Prof. J. W. Gregory, read afterwards in abstract, owing to his regrettable absence, by Prof. Jehu. The necessity for modification of the hundred million years or so, based on the original salinity argument, was stated by Prof. Gregory to be due to certain omissions and untenable assumptions. It was assumed that the sea was originally fresh, although the oldest fauna, the Cambrian, has marine characteristics, and no allowance was made for large supplies of sodium chloride raised by magmatic waters from beneath the earth's surface. Denudation also was supposed to be uniform, although it was very improbable that this had been the case. The earth is now under the influence of a time of quick movement, whereas formerly it had alternated between times of repose and activity, owing to deformations which it had undergone. (One cannot refrain from quoting Prof. Sollas's comment that "we must no longer picture a time when the earth was 'young and wantoned in her prime,' but must suppose that she has exchanged the passive indolence of youth for the fiery activity of old age."). Altogether Prof. Gregory considered that the best-known geological estimates might safely be multiplied ten- or twenty-fold, thus bringing them into line with the physical evidence.

Prof. Eddington brought forward interesting evidence based on astronomical observations. He described the observed behaviour of certain variable stars, of which δ Cephei is a typical example, in which there is strong reason for supposing that the fluctuations of intensity are due to some intrinsic property of the star, and not to external influence. The observed change of period (itself a few days) of δ Cephei has been proved by a long series of measurements to amount to 0·08 sec. per annum, or 1 per cent. in 58,000 years. If the periodicity is associated with "pulsation" of the star it will be related also to the density in such a manner that the density of the star is changing at the rate of 1 per cent. in 29,000 years. From considerations of the luminosity of the star—a red "giant"—it would require an increase of density at the rate of 1 per cent. in *forty years* to provide the necessary energy according to Lord Kelvin's gravitational contraction hypothesis. We may conclude (1) that the star certainly has sources of energy other than gravitation, and (2) that Lord Kelvin's time scale should be lengthened in the proportion 29,000 : 40, or about 700 : 1, at least during this stage of its evolution. A considerable factor of the same kind would be required for the sun also, even though its evolution has progressed much further, so that it is now a "dwarf" star.

Owing to lack of time it was not possible for Dr. H. Jeffreys to take a verbal part in the discussion, and his remarks were communicated afterwards. Dr. Jeffreys's calculations are based upon two distinct considerations: (1) the temperature distribution downwards in the earth's crust, taking into account the radio-active content; and (2) the tidal theory of the origin of the solar system. It is not possible to do them justice here, but we propose to publish them in a later issue. Both theories lead to the estimate of approximately $2 \times 10^9$ years since the solidification of the earth's crust, which is in remarkable agreement with the results of other physical methods.

Sir Oliver Lodge, in a few words at the end of the discussion, pleaded for justice to Kelvin, whose calculation specifically assumed that "no source of energy other than gravitation existed." But Dr. Dear, with a rare eloquence which delighted the audience, would not let the matter rest there, but asserted that Kelvin arrived at his twenty-million-year estimate by three distinct methods, and regarded it as unalterable.

In closing the discussion the president, Prof. O. W. Richardson, laid stress upon the necessity for further careful experiments for the final elucidation of the problem.

## The Constitution of Molecules.

THE joint discussion on the "Constitution of Molecules" by Sections A and B of the British Association aroused great interest, and the audience, which filled the large meeting room to its utmost capacity, included many visitors from other sections. Dr. Irving Langmuir introduced the subject with a clear and attractive presentation of the theory which is associated with his name and with that of Prof. G. N. Lewis. As originally published, this theory depended on a rather large number of arbitrary assumptions, but it has since been greatly simplified, and now involves only the three postulates described in NATURE of September 15, p. 101. The first of these postulates, according to which the electrons arrange themselves in the atom in definite layers of 2, 8, 8, 18, 18 and 32, is sometimes in conflict with the third, which requires that the residual charge on each atom and group of atoms should tend to become a minimum, and by giving greater weight to

one or to the other it is possible to bring the majority of compounds within the scheme. This possibility, whilst making it easy to find an explanation for a variety of facts, is an obstacle to the establishment of the theory on a firm physical basis. However, Dr. Langmuir is engaged on the quantitative examination of the consequences of the suggested distribution of electrons, and the progress made since the original publication in 1919 is so great that a still closer approximation to chemical facts may be expected with some confidence. One theoretical prediction, that of the salt-like character of lithium hydride, was mentioned as having been confirmed by experiment, and this confirmation is of some importance.

Unlike the Bohr atom, which is based mainly on the physical study of radiation, the Langmuir atom finds its chief justification in its power of accounting for chemical facts, and its presentation is almost entirely non-mathematical, so that it should make a special appeal to chemists. However, the discussion which followed the opening address approached the subject mainly from the point of view of physics and electro-chemistry, few chemists having yet considered in detail the bearing of the theory on organic or structural chemistry. The awakening of a greater interest in the subject of valency among chemists is likely to be one of the most useful results of the discussion, since the unsatisfactory position of the existing theories is well known, especially in regard to inorganic compounds, and the difficulties have usually to be evaded rather than met in the presentation of the subject. On Dr. Langmuir's view, it is incorrect to write structural formulæ for inorganic compounds such as salts, acids, or silicates, by using the same system of bonds as for organic compounds, electro-valency, which is represented by an electron passing from the sheath of one atom to that of another, being essentially different from co-valency, represented by the sharing of a "duplet" of electrons by two atoms. This distinction is an important feature of the theory, and is very ingeniously applied in the explanation of the structure of molecules of diverse kinds.

Prof. Smithells, whose interest in the matter is that of a chemist, exhibited a series of models of atoms and molecules which went far to make the suggested arrangements of electrons clear to the audience, models or photographs of models being almost essential to an elementary explanation. Prof. W. L. Bragg showed how the X-ray analysis of crystal structure leads to the result that each atom may be regarded as occupying a sphere of measurable and constant radius, a conclusion which is entirely in harmony with the structure of the Langmuir atom. On the other hand, he mentioned new evidence of an important character, derived from the diffraction of homogeneous X-rays by atoms. As X-ray analysis may be used to determine the position of atoms in a space lattice, so a further refinement of the method leads to conclusions as to the arrangement of the electrons within the atom. The results appear to show that most of the electrons are clustered together in the inner portion of the sphere occupied by the atom, that is, close to the nucleus, whereas the Langmuir structure, as at present assumed, requires that the number of electrons should be greatest in the outer shells.

Another difficulty arises from the static character of the Langmuir atom. Prof. Partington brought forward evidence from the molecular heats, which may be derived theoretically from a dynamic atom of the Bohr type, but are inconsistent with the arrangement which has been adopted to account for chemical valency. Sir Oliver Lodge, however, welcomed the remark of Dr. Langmuir that a static arrangement was not a fundamental condition of the theory, and suggested that chemists and physicists would find a dynamic atom the most suitable for the explanation of both classes of phenomena. A way out of the difficulty was suggested by Dr. E. K. Rideal, his view being that the atoms might be regarded as static except during the actual emission or absorption of energy, oscillation of the electrons under those conditions being more probable than rotation. Members of an assemblage of apparently like molecules differ in reactivity, this difference being attributed to an alteration of the position of one of the valency electrons relatively to the nucleus. This view awaits experimental confirmation.

Direct evidence in favour of the theory was produced by Prof. Rankine from experiments on the viscosity of gases. These lead to values for the dimensions of the chlorine molecule, for instance, corresponding with two argon atoms with their outer electron shells contiguous, and to similar relations between bromine and krypton, and between iodine and xenon. Further, on the assumption of the Langmuir structures, methane bears to ammonium the same relation as krypton bears to rubidium. Rubidium and ammonium are known from crystallographic evidence to have nearly equal molecular volumes, and an atom of krypton should therefore have the same volume as a molecule of methane. Determinations of viscosity prove this to be the case. Dr. S. H. C. Briggs gave reasons for writing elements as compounds of a nucleus with electrons, and for applying the ordinary type of equation for dissociation and similar reactions to elements as well as to compounds.

In the informal discussions which took place among members of Section B after the meeting it was possible to learn something of the attitude of chemists towards the theory. The distinction between electro-valency and co-valency is valuable, and the harmony between the new conceptions of the grouping of atoms and that of the space-lattice in crystals is very attractive. The least satisfactory aspect of the theory is seen in its application to carbon compounds. The tetrahedral arrangement of the carbon atoms, confirmed by the X-ray analysis of the diamond, has not only accounted with wonderful success for the known facts of organic chemistry, but also has

proved itself invaluable in predicting new facts, so that it has now established itself in an almost impregnable position. Dr. Langmuir's atom, although presenting a tetrahedral aspect, is less able to adapt itself to organic compounds. A single bond, in the ordinary notation, is represented by an edge common to two cubes, a double bond by a face in common, so that an entirely different structure has to be adopted for a triple linking, and acetylene becomes one of the puzzles of the theory. It was also remarked that the model of sodium carbonate was essentially similar to that proposed by Werner, suggesting that the co-ordination theory might be elaborated to explain many chemical facts in place of a new hypothesis. It is probable that the study of valency will receive much attention in the near future, and that chemists will test each hypothesis thoroughly in its application to structural chemistry, which rests on an enormous mass of definitely established facts, with which a theory must be able to deal. In the meantime, the scheme of Dr. Langmuir, so clearly presented on this occasion, forms an excellent basis for discussion, and the Edinburgh meeting has served a most useful purpose in focussing attention on the difficulties, as well as on the advantages, of the proposed solution of the problem.

## The Study of Bird-migration by the Marking Method.

THOUGH many valuable contributions have been made in recent years to our knowledge of the various phenomena associated with bird-migration, yet much remains to be accomplished.

One of the most important desiderata is to obtain definite information of a detailed nature as to the provenance of the migrants which arrive in spring, let us say, in the British Isles, and are widely or more or less locally distributed during the summer, and equally, or more widely, dispersed in their winter retreats. The same remarks apply to the numerous winter visitors: In what particular areas have they passed the summer? Do, for instance, redwings from Iceland winter with us as well as redwings from their wide-ranging summer haunts in Europe? Whence come the hosts of birds-of-passage which traverse our isles in spring *en route* for summer haunts in more northern lands, and return in the autumn on their way to their accustomed winter quarters? Each species comprised in these three groups of migrants is in all likelihood widely dispersed at both seasons, but as yet our knowledge is infinitesimal as to where the summer visitors to our country pass the winter, or where our winter visitors pass the summer, and we know nothing regarding either the summer or the winter haunts of the passage migrants.

In addition, more definite information is desirable as to (1) the routes followed by birds to reach their seasonal haunts; (2) whether the young seek the same summer and winter quarters as their parents; and (3) the winter retreats of the migratory section of certain British birds—the so-called partial migrants.

The difficulty in solving these important problems may fairly be described as insurmountable *in the main*; but it has been proved feasible to obtain glimpses of enlightenment, and it is most desirable to add to these glimpses, which, when correlated, become important. This may be accomplished in detail by the process called "ringing," and in its broader aspects through a knowledge of the distribution of racial forms, *if* such forms are based on well-marked characters. The ringing method is, however, the more promising, since the data so obtained are of a definite nature; and all who have the opportunity should cordially co-operate in forwarding the researches on these lines which are now being carried out.

With this end in view the University of Aberdeen instituted, in 1910, an inquiry for "The Study of Bird-migration by the Marking Method." This work was carried on for several years as a piece of research under the general direction of Prof. J. Arthur Thomson, to whose son, Dr. Landsborough Thomson, on whom the carrying out of the investigation devolved, we are indebted for the "Results," which were recently published in *The Ibis*. The total number of species ringed was about 100, and the number of individual birds 27,802. The total number of "reappearance records" (recoveries) was 879, or 3·2 per cent. But, as in other inquiries of a similar nature, many of the recoveries, as was to be expected, were made in the vicinity of the scene of marking, and after an insignificant period of time. Information of an important nature was obtained, some of which forms a valuable contribution to our knowledge of the seasonal distribution abroad and at home of the following species—namely, the lapwing, woodcock, starling, song thrush, swallow, hedge-accentor, mallard, herring gull, and blackheaded gull. The data regarding these have been carefully analysed and studied in all their bearings, and the deductions derived therefrom are given in detail. Regarding the rest of the species discussed, thirty-five in number, the data are not considered sufficient for such elaborate treatment, and for these brief summaries are given which afford in some cases records of considerable interest. There are also useful sections in which are discussed the purposes of bird-marking, its history, the interpretation of results, conclusions regarding bird-migration, and the value of the method of ringing, all of which are well worthy of perusal.

The University of Aberdeen is to be congratulated on its enlightened action in fostering this special piece of research, which, thanks to the labours and skilful treatment of one of its *alumni*, backed by the assistance of a number of enthusiasts, also *alumni*, has, greatly to his credit, been brought to a successful issue. W. E. C.

## Obituary.

WE regret to see the announcement of the death, at the ripe age of eighty-three, of MR. JOHN THOMSON, a well-known pioneer in the application of photography to the furtherance of geographical knowledge at a time when the photographer depended for success on his own skill rather than on the improved appliances which have since put the art within the reach of every amateur traveller. Mr. Thomson started for the Far East in 1862, and, after residing for a time at Singapore, in 1865 undertook the first of his more ambitious journeys, which took him to the interior of Cambodia, where he secured excellent pictures of the wonderful antiquarian remains lying buried in the tropical jungles, particularly at Nakhon Wat. Under the title "The Antiquities of Cambodia" he published in 1867 a selection of these photographs in book form, with descriptive letterpress, thus making those imposing ruins first generally known to the British public. Later he extended his wanderings to China, both visiting many of the ports and making trips into the interior, one of which took him up the Yangtse beyond the gorges of its middle course. In 1873 he issued an extensive series of photographs, illustrative of China and its people, in four folio volumes. Two years later he published a general narrative of his "ten years' travels, adventures, and residence" in the Far East. Once more, in 1878, he made use of his camera for the illustration of a country more or less off the beaten track —this time the island of Cyprus—on which he issued an illustrated work in two quarto volumes in 1879. When, about this time, a scheme of instruction for intending travellers was set on foot by the Royal Geographical Society, Mr. Thomson, who had become a fellow of the society in 1866, was put in charge of the instruction in photography, for their proficiency in which many travellers have been largely indebted to his valuable hints. At his studio in Bond Street he had the privilege of taking the portraits of many distinguished modern travellers, and he extended his collection to those of earlier times by photographic reproductions of existing portraits.

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WE announce with regret the death of DR. JOHN WARD COUSINS on September 22 at the age of eighty-seven years. Dr. Cousins received his medical training at St. Thomas's Hospital, and proceeded to the degree of M.D. (Lond.) in 1859. In the following year he became a fellow by examination of the Royal College of Surgeons, and after a short time at hospital practice devoted himself entirely to surgery. In connection with this work he quickly made himself prominent by the numerous inventions and improvements in surgical instruments which he devised. His ingenuity received its reward in 1884, when he was awarded a prize by the British Medical Association and a gold medal by the International Inventions Exhibition. His administrative powers found scope from 1893–95, when he was president of the Central Council of the British Medical Association, and in 1899, on the occasion of the Portsmouth meeting of the association, Dr. Cousins was elected president.

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SIR JAMES DIGGES LA TOUCHE, whose death at Dublin is announced, belonged to an old Anglo-French family, and was a member of the Indian Civil Service for forty years before his retirement in 1907. At the close of a successful official career he was appointed to the post of Lieutenant-Governor of the United Provinces of Agra and Oudh, and to a seat on the Council of India. He was a typical civilian of the older school, hard-working and devoted to the interests of the Indian people, but lacking that breadth of view which would have qualified him to meet the new political conditions which arose after his retirement from the Service. Though he knew the people intimately, he possessed little imagination or literary skill, and he published nothing except a gazetteer of the Province of Ajmir. His memory will be preserved by his educational policy—the improvement of the teachers' position, the provision of improved school buildings and boarding-houses, and, finally, by his foundation of the Medical College at Lucknow, which was the crown of his official labours.

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THE death is announced of PROF. GUSTAV MANN at Tampico, U.S.A., on July 18, at the age of fifty-seven years. Prof. Mann's vivid personality will be best remembered by Oxford physiology students of twenty years ago, and his translation to the chair of physiology at the Tulane University, New Orleans, was a grievous loss to the progress of histology in this country. As a master of the technique of his subject he was probably unsurpassed, and his breadth of view and lively imagination gave his instruction an unusual interest and significance, carried on by his pupil and successor at Oxford, S. G. Scott, until the latter's premature death. Too volatile to be largely productive in the ordinary way, his "Physiological Histology" is often the most thumbed book in laboratories where section cutting is taken seriously, and many grateful pupils will lament a real master whose determination to get himself disliked led him into so many troublous adventures.

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WE much regret to announce the death, in his eighty-third year, of PROF. JULIUS VON HANN, for many years director of the Zentralanstalt für Meteorologie und Geodynamik, Vienna.

## Notes.

WITH regard to the article on "University and Civil Service Salaries" published in our issue of August 25, the editor of the *Civil Service Gazette* has written to say that "the proportion of Civil Servants receiving above 500*l.* per annum is relatively very small, whereas the number of teachers receiving this amount all over the country is decidedly large." The latter part of this statement, we may say, even if it were true, is quite beside the point. That a large number of teachers all over the country should receive more than 500*l.* per annum does not make the lot of a large number of university teachers who receive less than 500*l.* per annum any better or more endurable. It may be recalled that the article arose out of a letter (and subsequent correspondence) from the Provost of Worcester College to the *Times* of August 15. This letter stated, *inter alia*, that many Civil Servants receive double, and even treble, the salary that the greatest learning and distinction can obtain at Oxford, and this notwithstanding that, with few exceptions, Civil Servants of the highest class are men whose intellectual attainments, as tested in examinations, fall considerably short of the standard of a tutorial fellowship at Oxford. If, therefore, any comparison of emoluments is to be made, it should not be as between university teachers and the whole body of the Civil Service, but as between university teachers and Civil Servants *of the highest class*. When this is done we find, as stated in our article, that the emoluments of university teachers fall considerably below those of this class, and we mentioned the modest 800*l.* a year of a tutorial fellow of Oxford, and referred to the fact that the permanent heads of Government Departments after September 1 will receive "only" 3000*l.* a year—as one of the *Times* correspondents quaintly puts it. Whether Civil Servants of the highest class are overpaid or not is a question which we did not discuss. But we had no hesitation whatever in asserting that, in view of such salaries, University teachers—who are public servants no less than the Civil Service—are grossly and unfairly underpaid.

OCTOBER weather this year has created a record which has outstripped the many weather records of 1921. Each day of the first week was extremely warm. The *Times* of October 6 contained a communication on the "Warmest October day on record." Descriptive of October 5 it gave shade temperatures of 84° at Kensington Palace and Camden Square, 83° at Kew Observatory and Hampstead, 82° at Croydon, Bath, Weston-super-Mare, and South Farnborough. At Camden Square so high a reading had not previously been reached in October during a period of sixty-four years. At Kew the reading was the highest October reading in fifty years, and 6° above the previous maximum in October, 1886. On October 6 the temperature was 84° at Kensington and Hampstead, 83° at Croydon, and 82° at Kew. Temperatures of 80° and above occurred this year at Greenwich on four days between October 1 and 6, the reading was 83·3° on October 5, and 84·4° on October 6. The average maximum for the early days of October is 60°. There was only one day in September warmer than October 6, 87·9° on September 9, and there was no day so warm in August this year. In the previous eighty years, since 1841, there had been only one day in October with a shade temperature so high as 80°, the thermometer registering 81° on October 4, 1859. In 1908 there were four days, October 1–4, with the thermometer at Greenwich above 75°, the first three days each having a temperature of 78°. This is the nearest approach in October to the hot spell just experienced. In the eighty years there have been fifty-seven Octobers with the maximum for the month less than 70°, and two Octobers with the maximum less than 60°. During the night of October 3–4 the lowest temperature in parts of London was 64°. In the previous eighty years at Greenwich the thermometer has only once remained above 60° throughout the night, the highest night minimum being 60·3° on October 6, 1916. In Paris the temperature of 82·8° last week is stated to have been the highest recorded in October since 1757.

ANNOUNCEMENT is made in the *Times* of October 6 that a flashless and smokeless powder has been produced by the Ordnance Corps of the United States army, and that the flameless effect is obtained by mixing certain substances with the propellant so that a dull red glow, instead of a flame, is produced at the muzzle of the gun. The subject of flamelessness in artillery is one which presents difficulties, both as to its tactical advantage in all circumstances—for when the round is flameless there is usually a certain amount of smoke—and also as to achieving the condition in guns of all calibres. An advantage of a flameless explosive is the reduced liability to backflash on opening the breech of the gun. The subject has been studied photographically for a number of years in connection with the liability of blasting explosives to ignite fire-damp in mines, and Will showed by this method that the addition of salts, mostly of the alkaline metals, to blasting explosives suppressed the after-flame of the explosion, not only from explosives such as the carbonites (mixtures of nitroglycerine, nitrates, and oxidisable substances), but even from trinitrotoluene and picric acid. According as the mixture of gases evolved from the explosion, containing inflammable gases such as carbon monoxide and hydrogen, does or does not ignite on mixing with the air at the mouth of the bore-hole, so the explosive gives flame or is flameless. The same principle has been applied to the burning in a gun of propellants of suitable calorimetric value, and for calibres up to five inches mentioned in the *Times* report flamelessness can be attained without much difficulty. To solve the problem for larger guns is, however, by no means so easy.

IN his address on October 3 to the newly constituted Glasgow Society for Psychical Research Sir Oliver

Lodge gave an interesting exposition of his view of the æther of space as a region of possibilities in contrast with matter as a region of facts. Following Bergson's theory that memory is a purely spiritual fact which does not depend on the brain for its existence, but requires the intervention of the brain for its expression, and that mind generally, though itself psychical and not physical, needs and uses matter as its instrument, he argued that if mind when dissociated from matter continues to exist, it can only be that there is something else which can perform the function of matter and serve as its instrument. For himself he has told us he is convinced that disembodied spirit personalities do exist in fact, and therefore for him it would seem the æther is a necessary postulate. His acceptance of the principle of relativity does not apparently in the least affect his belief in the real physical existence of the æther; it seems only to have added a few more negative qualities to that exceedingly elusive stuff and made its residual positive reality more than ever difficult to imagine. Still, perhaps the new society may succeed where Michelson and Morley failed, for psychical research, as Sir Oliver conceives it, is purely and essentially physical research, however suspect to some of us its methods may appear.

LORD GREY OF FALLODON has always been a keen supporter of all legislation for the protection of wild birds. A great believer in "sanctuaries" for birds, he has done much on his own estate to shield all species which have chosen to settle there. His success with various species of wild birds he related in the course of a most delightful address given on October 6 to the Berwickshire Naturalists Association. From the strictly scientific point of view, there were many items of more than passing interest in this address. Particular attention, for example, was directed to the fact that among the Anatidæ, where the males lose their resplendent livery and go into "eclipse," they take no interest in their offspring, which have to be reared by the female alone. But where no "eclipse" dress is worn they prove devoted parents, taking their full share in the task of tending the young. That the various species of wild ducks, when in a state of Nature, are monogamous seems conclusively proved by their behaviour at Fallodon, wherein they contrast with birds of the same species in captivity.

SIR FRANK DYSON, Astronomer Royal, has been elected master of the Clockmakers' Company.

THE G. de Pontécoulant prize of the Paris Academy of Sciences has been awarded to Dr. A. C. D. Crommelin, Royal Observatory, Greenwich, in recognition of his general astronomical work.

MR. A. CHASTON CHAPMAN has been appointed a member of the Royal Commission on Awards to Inventors in succession to Sir James Dobbie, who has resigned.

A DINNER will be held at the Hotel Cecil on Tuesday, October 25, to celebrate the purchase of the Brent Valley Bird Sanctuary, and to make known the need of funds for its upkeep and endowment. The Right Hon. Viscount Grey of Fallodon, K.G., will preside. Tickets may be obtained from the honorary secretary at the Hermitage, Hanwell, W.7.

THE Royal Society of South Africa proposes to entertain the members of the Shackleton Expedition when they arrive in Cape Town. The society has entertained previous expeditions, and at a recent meeting the president expressed the hope that the forthcoming visit would arouse public interest in South Africa in scientific exploration and would lead to additional support for such enterprises.

IN the article on the explosion at the nitrogen fixation works at Oppau, in NATURE of September 29, it was pointed out that ammonium nitrate is explosive on the application of an intense initial impulse such as the detonation in its midst of a high explosive. It is, therefore, of interest to read in the *Chemical Trade Journal* (October 1, p. 409) that the directors of the Badische Anilin und Soda Fabrik have issued a report in which they state that a store of ammonium sulphonitrate exploded, and that it had been the custom to break up the stock of this mixture by means of explosive bodies. Until now the directorate had apparently considered the ammonium nitrate sufficiently deadened by the presence of the ammonium sulphate.

A MESSAGE from Col. Howard Bury to the *Times* states that a practicable route to the summit of Mount Everest has been discovered. A camp was formed at the col at the head of the Kharta Valley at a height of 22,500 ft., and Messrs. Mallory, Bullock, and Wheeler pushed on to the glacier below the north col on the following day. The north col, which connects Mount Everest with the north peak, was ascended to a height of 23,000 ft. At this point the party was stopped by bad weather, but it is believed that an ascent by the north-east *arête* will be possible. The reconnaissance of the approaches to Mount Everest from the Tibetan side is now complete, and, a route having been found, there appears to be no reason why a properly organised expedition should not reach the summit next year.

THE ninth meeting of the Indian Science Congress will be held in Madras on January 30–February 3, 1922. His Excellency Lord Willingdon, Governor of Madras, has consented to be patron of the meeting, and Mr. C. S. Middlemiss will be president. The following sectional presidents have been appointed:—Agriculture, Rai Bahadur Ganga Ram; Physics and Mathematics, Mr. T. P. Bhaskara Shastri; Chemistry, Dr. N. R. Dhar; Zoology, Mr. S. W. Kemp; Botany, Dr. W. Dudgeon; Geology, Mr. G. H. Tipper; Medical Research, Major Cunningham; Anthropology, Rai Bahadur Hira Lal. Public lectures will be delivered by Prof. Hemchandra Das Gupta, Dr. de Graaf Hunter, and Prof. J. Matthai. Capt. C. Newcomb, Khan Sahib Mohammad Azizullah, and Sahib Bahadur have been appointed honorary local secretaries. Further information can be obtained on application to Dr. J. L. Simonsen, the honorary general secretary.

THE members of the British Association had, during their recent visit to Edinburgh, an opportunity of examining the remarkable hoard found in 1819 at Taprain Law, a conical hill nearly midway between Haddington and Dunbar. The excavations were carried on by the Society of Antiquaries of Scotland, to whom Mr. Balfour, the owner of the land, generously presented all that was found, which is now exhibited in the Scottish National Museum. It is almost certain that this great collection of silver plate was a robbers' hoard. Some of the objects are plainly Christian, others pagan, with traces of Oriental decoration. The Saxons were notorious sea-raiders, while the native Celts were not, and the hoard possibly consists of plunder from churches or private houses somewhere on the Continent. It may be assumed that the *cache* was made about 1500 years ago, and the raiders who buried it were probably interrupted by the approach of another and stronger force, leaving the treasure to be unearthed by excavators in our time.

IN the Journal of the Bihar and Orissa Research Society for March, 1921, Dr. W. H. R. Rivers discusses the origin of that remarkable custom of marriage, peculiar to the Rajputs, known to anthropologists as hypergamy. Under this system a man must take his wife from a group of equal or lower rank than his own, while a woman must marry a man from a group of equal or higher rank than her own. He suggests that it arose as the result of the influence of certain conditions operating in the case of the occupation of a country by a race of warriors—a sentiment among the invaders against the union of their women with the indigenous inhabitants of their new home; the fact that many women, but in numbers smaller than those of the men, accompanied the invaders; the warlike character of the invaders, and their superiority in equipment over the indigenous people, which allowed them to satisfy their own desire for union with the indigenous women without giving their own women in return. The first of these conditions was probably the most important. The institution became specialised among the Rajputs because among the other immigrant race, that of the Brahmans, who had the same sentiment about their women, their sanctity enforced endogamy. "It is probably to this positive character of the sanctity of the Brahman rather than to the negative character of their unwarlike nature that we must look for the clue to the development of endogamy in place of the hypergamy of the Rajputs."

IN the *Irish Naturalist* for September the Rev. W. F. Johnson continues his valuable observations on the Irish Ichneumonidæ and Braconidæ, and records more than one hundred species belonging to these obscure and little known groups of Hymenoptera, mainly from Poyntzpass. Three species are added to the British and Irish list, *Microcryptus femoralis*, *Glypta schneideri*, and *Mesoleius fraternus*.

ANNALS of the South African Museum (vol. 18, part 3) consists of an important illustrated monograph by Dr. F. Ris on "The Dragon-flies of South Africa." It occupies upwards of 200 pages, and is prefaced by a general account of those structural features which are useful in classification. Both sub-orders of these insects are well represented, and one genus and rather more than a dozen species are described as new. The work should prove valuable to resident entomologists in South Africa as an aid to the identification of the various species, and at the same time enable them to extend our very meagre knowledge of the biology of the dragon-flies of the countries concerned.

OWING to the damage wrought by vast numbers of ducks on the rice-fields of California an aeroplane patrol was established, charged with the task of flying over the fields to frighten away the birds. This method was inaugurated in 1919, and was so successful that now five aeroplanes "are kept busy, making both night and day flights to frighten off the wild ducks." But while the farmers are highly pleased, the American Game Protection Association is greatly perturbed, and this because of the number of birds killed by striking the propellers and guy-ropes. Thus, according to the July issue of *California Fish and Game*, the association has demanded that permits for the use of aeroplanes for this purpose should be revoked.

IN the August issue of the *Entomologist's Monthly Magazine* Mr. E. E. Green describes two new species of Coccidæ from Britain, viz. *Pseudococcus paludinus*, nov., and *Ripersia scirpi*, nov. The former occurred on the foliage of various plants in Wicken Fen, and the latter was met with at Camberley on the stems of *Scirpus caespitosus*. Mr. L. A. Box records *Gronotoma nigricornis*, Keef., a Cynipoid insect new to the fauna of Britain. The insect was bred from the pupæ of an Agromyzid fly found at Blakeney Point, Norfolk. In the September issue of the same journal Mr. B. P. Uvarov describes a new genus and species of wingless, long-horned grasshoppers from the collection in the British Museum. The species, which is named *Chapardina importata*, was obtained from a greenhouse at Richmond, and there is no doubt that it was imported from some exotic country. The land of its origin is a matter for speculation, and it may possibly have come originally from some part of the Oriental region.

IN *La Nature* (No. 2475) M. Léon Bertin reviews recent work on the so-called habit of feigning death which has been attributed to many animals belonging to varied groups, especially to mammals and arthropods. The phenomenon has been variously ascribed to conscious action or intelligence, instinct, or an extreme state of fear, and M. Bertin protests against these vague anthropomorphic explanations unsupported by systematic study and experimental proof. He cites the work of M. Rabaud, who showed that by the stimulation of certain areas of the body of arthropods, particularly the sternum and the lateral parts of the thorax, a state of catalepsy or insensibility could be induced, lasting for varied times according to the strength of the stimulus, the particular animal operated on, and even the temperature. Similarly,

he demonstrated the existence of other areas, the tarsi of the legs and the tip of the abdomen, the excitation of which restored the animal to the normal. M. Rabaud believes that most of the instances of feigning death cited among the arthropods can be explained on the above grounds as pure reflex phenomena in which the organs of perception (visual, olfactory, and auditory) play at most an insignificant part. He even suggests that similar reflex areas can be demonstrated in the vertebrates, and that the feigning of death in that group is also largely a reflex phenomenon. He combats strongly the view that it is a conscious action, or instinctive, or the result of fear, and proceeds to demonstrate that the view that it is a protective attitude is untenable. The precise physiological explanation is still obscure, but M. Bertin rightly insists on the importance of M. Rabaud's observations.

A REPORT prepared for the National Research Council by Messrs. E. B. Mathews and H. P. Little on the position of geology and geography in the United States is published in the Bulletin of the Geological Society of America for April, 1921. It appears from this report that out of 571 colleges and universities, 466, or 81 per cent., offer no instruction in geography. Of the remaining 105 colleges only 31 offer courses of more than two years' duration, and no more than six of these train students in advanced work. Poor as this equipment in geographical teaching is, it is fairly evenly distributed throughout the States with the exception of those in the south. The demand for trained geographers far exceeds the supply. In geology opportunities for training are more satisfactory, although out of the 571 institutions 144 offer no instruction in geology and 268 none worthy of the name. As many as 97 colleges, however, provide courses of four or more years' duration. As in geography, the southern States provide few advanced courses.

THE Geological Survey of Scotland has issued a new edition (1921, 2*s.* 6*d.*) of the memoir describing the Arthur's Seat volcano. Few alterations have been made in Dr. B. N. Peach's text, but Dr. Flett has now described the igneous rocks in accordance with the current classification of the Carboniferous lavas of Scotland. Prof. Judd's view is maintained, namely, that the eruptions form a continuous series, and that the apparent break under the Lion's Haunch is due to the accumulation of the later lavas and agglomerates in a vent from which the earlier bedded lavas had been erupted. A coloured geological map on the scale of six inches to one mile is now inserted in the memoir. The "Summary of Progress of the Geological Survey of Great Britain for 1920" (3*s.* 6*d.*) covers a wide range, from Brockenhurst to Banff. Numerous observations of interest are recorded from western Mull and the adjacent islets. A deposit of Cainozoic desert-sand has been found overlying the chalk at Gribun. The common origin of the two layers of basalt that form respectively the walls and the roof of Fingal's Cave must have been recognised long ago, since Scrope dealt with the matter in the Vivarais in 1825 ("Volcanos," p. 141). We now, however, have an authoritative statement on this point, while a triple zoning is described in other flows, where a slaggy top remains above the irregularly columnar portion.

AN important paper by Prof. H. E. Armstrong and Mr. C. A. Klein on "Paints, Painting, and Painters" is published in the Journal of the Royal Society of Arts of August 26 (vol. 69, No. 3588). As is well known, painters are liable to contract lead poisoning, and at the International Labour Congress to be held in Geneva this month the question of the prohibition of the use of white lead in paint is to be discussed. Prof. Armstrong and Mr. Klein consider that the risk to the painter of lead poisoning has been much exaggerated, and support this conclusion with much experimental work. Some of the ills from which painters suffer are to be attributed, not to the lead, but to the turpentine or other volatile "thinner" with which the paint is made. They point out that white-lead paints have special properties not possessed by substitutes, and they maintain that by the use of a few simple expedients the risks incurred by the painter from the use of lead paints may be practically eliminated. The paper is one that should be studied by all interested in industrial hygiene.

ACCORDING to the report of the work of the Physical Department of the Ministry of Public Works, Egypt, for the year ending March, 1920, the department has returned to normal working conditions from the disturbed state which existed during the war. The hydrographical section is responsible for the Nile gauges and for the rainfall records, and, in addition, tests measuring tapes, thermometers, and barometers. The meteorological section issues the weather reports and forecasts, and runs the Helwan Observatory. A weights and measures section, in maintaining just standards, takes action against three or four thousand persons per annum, and secures convictions in 98 per cent. of the cases. About four thousand scientific instruments were repaired in the workshops during the year, while the research section carried out work on the sulphuric acid hygrometer, and devised and tested a "turbulance gauge" for use in measuring river discharge.

THE "Prizma" process of colour cinematography, invented by Mr. W. V. D. Kelley, which is now being introduced as a practical method, is described in the current number of *Conquest* by Mr. E. R. Mason-Thompson, M.A. It is analogous to "Kinemacolor," but each pair of red-orange and blue-green records is taken simultaneously, the light passing through the lens to the film being divided by optical means so as to give two pictures at each exposure. In printing the positive, the negative moves twice as far as the positive film, and thus all the records of the same colour are printed as consecutive pictures. The positive film is then similarly exposed on its other side (both sides are coated with sensitive emulsion) to the records of the other colour in such manner that each pair of pictures registers. Each side of the film is then separately mordanted and treated with a dye of appropriate colour. The two coloured images being superposed, the positive film is half the length

required by the "Kinemacolor" process, it does not need to be passed through the exhibiting lantern at double the usual speed, and it is claimed that the difficulty of colour fringes in the case of quickly moving objects is eliminated.

AN account of the Temple submarine stud driver appears in *Engineering* for September 30. The function of this appliance is to fix studs into ships' plates or other steelwork under water, so that patching plates or attachments for lifting may be bolted on. The studs used at a demonstration at Caxton Hall were of tool steel, tempered to a dark blue colour. One end of the stud is bluntly pointed and the other end has a screw thread cut on it. The studs are shot from the muzzle of a gun held in contact with the plate, and pierce the plate so that about an equal length of the stud is left projecting on both sides. The operation of driving the stud is instantaneous, and the noise is scarcely more than that of an airgun. The explosive charge may consist of any ordinary propellent explosive, and in quantity is about the same as in a standard 0·303 rifle cartridge. It is stated that studs can be driven into solid steel by the Temple gun, and that two $\frac{5}{8}$ in. plates can be pinned together by studs shot through them; also a pin of only $\frac{1}{8}$ in. diameter can be driven through a $1\frac{1}{4}$ in. plate. This appliance, which has been invented by Mr. Robert Temple, is certainly a very remarkable one. The process is in the hands of the Temple Cox Research Company, Dacre House, Dean Farrar Street, Westminster.

SIR THOMAS HEATH considers that of all the manifestations of the Greek genius none is more impressive, and even awe-inspiring, than that which is revealed by the history of Greek mathematics. The Oxford University Press is publishing immediately in two volumes "A History of Greek Mathematics," by Sir Thomas Heath.

## Our Astronomical Column.

THE LUNAR ECLIPSE OF SUNDAY, OCTOBER 16.—This eclipse, which will be nearly total, begins at 9h. 14m. (position angle 45°), reaches its greatest phase (0·938 of the diameter, the south limb being uneclipsed) at 10h. 54m., and ends at 12h. 34m. (position angle 283°). As there is not another large lunar eclipse visible at a convenient altitude in the British Isles until September, 1932, this occasion should be utilised. The chief work during lunar eclipses is the observation of occultations, both phases being visible under similar conditions. Such observations facilitate the determination of the moon's diameter, and serve to test the suggestion that the lunar atmosphere may have more refractive power by day than by night. Six stars in the Bonn Durchmusterung will be occulted during eclipse. The details are given in the following list (computed for Greenwich):—

| B.D. number | Mag. | Disappearance | Angle | Reappearance | Angle |
|---|---|---|---|---|---|
| ° | | h. m. | ° | h. m. | |
| 7·218 | 9·2 | 10 3 | 24 | 10 59 | 292 |
| 7·222 | 9·3 | 10 19 | 56 | 11 35 | 258 |
| 7·224 | 9·0 | 10 20 | 100 | 11 25 | 214 |
| 7·225 | 9·5 | 10 28 | 70 | 11 46 | 243 |
| 7·228 | 9·3 | 10 57 | 90 | 12 10 | 225 |
| 7·227 | 9·1 | 11 6 | 41 | 12 17 | 273 |

The angles are measured from the north point towards the east.

The occultation of 263 B Piscium, mag. 6·4, may also be mentioned, though it does not occur at the eclipsed limb; the times and angles are 8h. 55m., 90°, and 10h. 3m., 224°.

It is also of interest to study the colour and amount of illumination of the region in shadow; probably the variations from one eclipse to another arise from differences in the transparency of the earth's atmosphere. It would be well to examine some of the regions, such as Aristillus, in which Prof. W. H. Pickering has observed changes during the lunation, as it is possible that their appearance might be affected by the passage of the shadow.

MORNING STARS.—Before sunrise on clear mornings, during the last half of October, there will be an unusual and striking display of four brilliant planets. Venus, Mars, Jupiter, and Saturn will all be visible, and will continue to be so during the remaining months of the present year.

Their variations of position will induce a number of interesting conjunctions and configurations, both amongst themselves and with the waning crescent of the moon as she passes them in her monthly round.

On October 16 Venus will rise at 3.43 a.m., Mars at 3.0 a.m., Jupiter at 4.41 a.m., and Saturn at 4.19 a.m. On this date, an hour before sunrise, the four planets named will form an almost perpendicular line over the east by south horizon.

The following conjunctions will occur:—

| | h. m. | | ° ′ | |
|---|---|---|---|---|
| Oct. 22 | 7 55 a.m. | Venus and Saturn | Venus 0 35 | South |
| ,, 25 | 4 12 p.m. | Venus and Jupiter | Venus 0 31 | North |
| ,, 28 | 1 18 a.m. | Mars and Moon | Mars 3 38 | ,, |
| ,, 28 | 3 24 p.m. | Saturn and Moon | Saturn 3 41 | ,, |
| ,, 28 | 10 0 p.m. | Jupiter and Moon | Jupiter 2 14 | ,, |
| ,, 29 | 3 56 a.m. | Venus and Moon | Venus 2 25 | ,, |
| ,, 30 | 11 58 p.m. | Mercury and Moon | Mercury 2 36 | South |

These occurrences will not be all visible, as they take place at unsuitable times, but the objects mentioned may be observed in proximity on the mornings before and after the events named.

In November, during the last fortnight of the month, the planet Mercury will also be favourably visible and add another interesting object to the unusual assemblage of brilliant planets in the morning sky.

LARGE FIREBALL.—Mr. W. F. Denning writes:—"On October 6, 9h. 25m. G.M.T., a fireball of unusual brilliancy was observed by Mr. J. P. M. Prentice at Stowmarket. It was of a beautiful orange colour, with a thick streak, and burst in the middle of its flight, leaving a blue-green cloud of gaseous material which was visible for eight seconds. The fireball was also seen by the writer at Bristol, and he rated it as much more brilliant than Venus, but it was unfavourably seen right through a cloud, which it rather brightly illuminated. The nucleus could be distinctly traced as it pursued its path, and the position could be accurately recorded from a few bright stars which were not obscured at the moment. The radiant point of the object was near $\beta$-Aurigæ at 87°+40°, and the height of the object from 86 to 48 miles from over the mouth of the Thames to Littlehampton in Sussex."

## The Australian National Research Council.

A CERTAIN measure of co-ordination and co-operation in science was achieved during the war by Great Britain, France, America, and Japan, with results which were far-reaching in importance. Men of science in Australia felt that something of the sort would also be productive of good results in that continent, which until recently was represented in the world of science solely by independent State Royal Societies. The climax was reached in 1919, when the International Research Association meeting in Paris invited the co-operation of Australian men of science. No representative scientific body, with the exception of the Australian Association for the Advancement of Science, which had not met since 1913, was in existence at that time, so the matter was referred to the Melbourne meeting of the association, held on January 5–11 last (NATURE, May 26, p. 408). There it was decided that an Australian National Research Council should be formed and organised on lines similar to those adopted by countries already working under the International Research Council. A scheme of organisation was drawn up and approved by the Australasian Association, which provided for a council of a hundred members representative of pure and applied science.

Australia has now, therefore, three organisations of a general scientific nature apart from Government Departments, State societies, and museums. First there is the Australasian Association for the Advancement of Science, which meets normally every second year. Even if more frequent meetings were possible, lack of funds would probably hinder the effective direction of investigations by this body. Then there is the newly constituted National Research Council, in regard to which Sir Baldwin Spencer suggested in his presidential address to the Australasian Association at Melbourne that it might, with the view of economising time, energy, and money, be constituted as the standing committee of the Australasian Association, with independent powers of initiating research and dealing with such funds as were placed at its disposal. The third scientific organisation in existence is the Commonwealth Institute of Science and Industry, founded by Act of Parliament in 1920. The constitution of this body is not considered satisfactory by men of science, but it demonstrates official recognition of the importance of scientific investigation, and at present it is the only one of the three organisations which can command the funds necessary for carrying out investigations. Sir Baldwin Spencer is of opinion that the constitution of the National Research Council of the United States might have been copied with advantage when this body came into being.

However, now that the Australian National Research Council is an accomplished fact, it is hoped that it will serve as a representative Australian unit in international scientific organisation, and, in addition, have an important influence in encouraging scientific research in Australia.

The following is a list of members of the council as it is at present constituted :—

*Agriculture:* Mr. F. B. Guthrie, Prof. A. J. Perkins, Mr. A. E. V. Richardson, and Prof. R. D. Watt.

*Anthropology:* Prof. R. J. A. Berry, Mr. C. Hedley, Rev. John Matthew, Mr. S. A. Smith, Sir Baldwin Spencer, and Prof. F. Wood-Jones.

*Astronomy:* Dr. J. M. Baldwin, Prof. W. E. Cooke, Mr. E. F. Dodwell, and the Rev. E. F. Pigot.

*Botany:* Mr. R. T. Baker, Mr. R. H. Cambage, Prof. A. J. Ewart, Prof. A. A. Lawson, Mr. A. H. S. Lucas, Mr. J. H. Maiden, and Prof. T. G. B. Osborn.

*Chemistry:* Prof. C. E. Fawsitt, Mr. J. B. Henderson, Mr. A. E. Leighton, Prof. Orme Masson, Prof. J. Read, Prof. E. H. Rennie, Assoc.-Prof. A. C. D. Rivett, Mr. H. G. Smith, Prof. B. D. Steele, and Prof. N. T. M. Wilsmore.

*Economics and Statistics:* Mr. G. H. Knibbs and Mr. G. Lightfoot.

*Engineering:* Mr. J. J. C. Bradfield, Prof. R. W. Chapman, Mr. A. J. Gibson, and Mr. A. G. Michell.

*Geography:* Capt. John King Davis, Mr. Loftus Hills, Prof. W. Howchin, and Sir Douglas Mawson.

*Geology:* Mr. E. C. Andrews, Sir Edgeworth David, Mr. B. Dunstan, Mr. A. Gibb Maitland, Prof. H. C. Richards, Prof. E. W. Skeats, Dr. F. L. Stillwell, and Mr. L. Keith Ward.

*Mathematics:* Prof. H. S. Carslaw, Mr. A. McAulay, Mr. J. H. Michell, Prof. H. J. Priestley, and Mr. E. M. Wellish.

*Mental Science and Education:* Prof. Francis Anderson and Prof. William Mitchell.

*Meteorology:* Mr. H. A. Hunt and Prof. T. Griffith Taylor.

*Mining and Metallurgy:* Mr. G. D. Delprat, Mr. G. C. Klug, Mr. R. Sticht, and Mr. W. E. Wainwright.

*Pathology:* Sir Harry B. Allen, Dr. A. W. Campbell, Prof. J. B. Cleland, Dr. S. W. Patterson, Dr. W. J. Penfold, and Prof. D. A. Welsh.

*Physics:* Prof. K. Grant, Prof. T. H. Laby, Dr. E. F. J. Love, Prof. T. R. Lyle, Prof. T. Parnell, Prof. J. A. Pollock, and Assoc.-Prof. Vonwiller.

*Physiology:* Prof. H. G. Chapman, Dr. E. E. Embley, Prof. W. A. Osborne, and Prof. Brailsford Robertson.

*Veterinary Science:* Dr. Sydney Dodd, Dr. J. A. Gilruth, Prof. J. D. Stewart, and Prof. R. A. Woodruff.

*Zoology:* Dr. W. E. Agar, Mr. J. J. Fletcher, Mr. W. W. Froggatt, Prof. W. A. Haswell, Prof. T. Harvey Johnston, Assoc.-Prof. Georgina Sweet, and Mr. G. A. Waterhouse.

The first meeting of the Australian National Research Council was held in Melbourne on August 23–25 last, at which the nature of the work it would undertake was discussed.

Sir Edgeworth David, at a reception before the business sessions, said that he hoped the first full meeting of the National Research Council would be an epoch-making day in the annals of Australian science. Never in the whole history of Australia was there such a need for co-ordination in scientific effort. It would help to defend the country against foreign aggression. The public had no idea what we owed to science for our final victory in the great war.

Later, an executive committee, constituted as follows, was elected: *President:* Sir Edgeworth David. *Vice-Presidents:* Sir Baldwin Spencer, Prof. Orme Masson, Mr. G. H. Knibbs, and Mr. J. H. Maiden. *Members:* Sir Douglas Mawson, Profs. H. J. Priestley, E. W. Skeats, B. D. Steele, N. T. M. Wilsmore, R. W. Chapman, J. A. Pollock, K. Grant, and T. R. Lyle, Messrs. L. Hills, and W. E. Wainwright. *Secretary:* Mr. Cambage. There was some discussion as to the qualifications of associate members, and it was decided to admit as associate members only those who have carried out meritorious original scientific work.

One of the subjects of discussion of the second day's meeting was a motion on the order paper in

the name of Prof. T. H. Laby, that the Australian National Research Council should adopt such a constitution as would enable it to perform the following functions: (*a*) The discussion and publication of the results of scientific investigation by the publication of scientific papers and by co-operating with the State scientific societies in such work. (*b*) The promotion of scientific research generally, and the investigation of specific problems, bringing the latter under the notice of the Commonwealth and State Governments when that course is desirable. (*c*) The promotion of the application of scientific methods in questions of government and administration when such methods are peculiarly and specially applicable. (*d*) The promotion of the interest and status of scientific workers in Australia. The first of these clauses was negatived by a large majority, but the publication by the Council of abstracts of scientific papers by Australians was agreed to. Clauses (*b*) and (*c*) were carried, but clause (*d*) was rejected. In the discussion on the last clause Prof. Agar said that the Council should confine its attention to furthering the interests of science rather than the interests of men of science. The Council also rejected a proposal made in connection with the foregoing motions that it should form from those of its members who represent mathematics, physics, astronomy, and engineering, a section for the encouragement, discussion, and publication of research in the mathematical and physical sciences.

A letter from Sir Arthur Schuster, inviting the Council to submit business for consideration at the Brussels meeting of the International Research Council was considered. In this connection it was agreed to represent to the Commonwealth Government the need for funds to enable Australia to join certain of the International Unions. Mr. E. C. Andrews was appointed a delegate to the Pan-Pacific Scientific Congress to be held in 1923.

Among other business transacted, Sir Edgeworth David directed attention to the desirability of forming a Commonwealth Geological Survey, in addition to the State surveys, and further action is to be taken. A committee was also appointed to report on the possibility of making a gravity survey of Australia.

A special committee then reported on the proposed establishment of a solar radiation station at Sydney; the necessary funds had been raised successfully by public subscription, and it was considered that the project was a matter of considerable scientific importance.

The National Council formally took over from the Australasian Association for the Advancement of Science work of an international character relating to geophysics and physical and chemical constants.

The Australian National Research Council, so far as its constitution and objects are determined, is to be exclusive in character, and it will be concerned with the organisation of scientific work in Australia, and with co-operation in international research, but it will not discuss or publish scientific papers.

## Scottish Fisheries.

By PROF. W. C. MCINTOSH, F.R.S.

THE Thirty-ninth Annual Report of the Fishery Board for Scotland, 1920 (H.M. Stationery Office, 3*s*.), as usual, contains much important information connected with the Scottish fisheries. In the introduction the Board refers to the present depressed condition of the industry, which is due, not to dearth of fishes of all kinds, but to industrial and transport troubles and the general unrest, as well as the partial dislocation of foreign trade in cured fishes. It bewails the increasing incursions of foreign trawlers in the Moray Firth, unmindful that the closure of the area beyond the three-mile limit was, as Lord Bryce and others long ago pointed out, the *fons et origo* of the trouble. The figures of the captures for 1920 show that with 1366 fewer boats than in the record year 1912 the quantity landed was 2,261,167 cwt. less. The supposition concerning the "accumulation" of fishes during war-time is conjectural.

The present remarks, however, mainly deal with the Board's scientific fisheries work, which, so far as its experienced staff is concerned, maintains its high standard. The Board apparently believes in the International Council for the Exploration of the Sea, yet it does not explain how this international *camaraderie* has failed to put an end to the raids of foreign trawlers in the Moray Firth. Indeed, it may well be doubted if, after twenty-one years' experience of the International Council, any practical result of importance to the British fisheries has resulted from the large expenditure, or evolved any solid basis for the revival of the scheme. The details of the Board's expenditure on this head should at once be published. Further, it is remarkable that the chairmanship of this Council has hitherto been only in British or German hands (often unscientific). The most experienced fisheries research workers firmly believe that, with all deference to the international exchange of views, real progress lies in the work of each country's scientific staff in its own ships and marine laboratories. That the Board is open to criticism is apparent from the fact that whilst other nations, notably the Danes, have worked up the life-histories of the food and other fishes collected in their ships in a praiseworthy manner, the large collection of eggs, larval, post-larval, and young fishes procured by the Board's steamer, with perhaps a few trifling exceptions, is unknown. Instead of leading the way in such work, the Board appears to pin its faith in this department to endless, but expensive, statistics of captures here and there. It clings to the notion that by a size-limit or by the closure of areas of the North Sea (which it formerly abjured) plaice will be benefited—forgetful of the persistence of this fish, notwithstanding the pessimism of nigh a thousand years. The recent work of Dr. Petersen, of Copenhagen, on intensive plaice-fishing will afford the Board some information on this head. The Board's intention to ascertain the present condition of the fishing-grounds (an advice given many years ago) is to be commended, as also is the development of oyster fisheries, though the decline of the oyster fisheries of the Forth is as yet unremedied. A profitable field for the energies of the Board would also be the encouragement of the canning of the sprats from the Forth, Tay, and other places.

The Board finally alludes to the reorganisation of its scientific staff, and it is to be hoped that, warned by the experiences in the Fishery Departments of England and Canada, untried, or even non-scientific, men will not be placed over the heads of trained scientific workers of perhaps a quarter of a century's experience. Whilst these public Departments have in many respects a free hand, science and the public also have rights, interference with which will soon lower the status of those who enter on such work.

## University and Educational Intelligence.

CAMBRIDGE.—The vote on the admission of women to the University will be taken on Thursday, October 20. The point at issue this time is as follows:—Grace I., which is accepted by the women's colleges as a solution and is supported by them, admits women to membership of the University with full privileges except for a vote on the Senate, the governing body of the University. On the other hand, it grants to the women the right to elect two assessors to sit on the Council of the Senate without votes—a measure that may be of more immediate assistance to them than the vote which the University refused to them last December. Women become eligible for University offices, studentships, and prizes. On the other hand, their numbers are limited. An opportunity for independent development of men's and women's education is offered which may prove very valuable in the future, and their discipline is also differentiated from the men's. One very important condition attached to Grace I. is that men's and women's colleges shall be, and shall remain, distinct.

The alternative, Grace II., offers only titular degrees—a solution which might have been satisfactory in 1897, but is not acceptable at the present day. The carrying of Grace I., which embodies the conclusions of a body formed from all parties except the extremists on either side, offers the only hope of an agreed solution of this long-standing controversy from within the University proper.

Col. Sir Gerald Lennox-Conyngham, Mr. D. C. Henry, and Mr. C. D. Ellis have been elected fellows of Trinity College. The first-named has also been elected prælector of geodesy at Trinity College, and to him will be entrusted the task of building up a school of geodesy in Cambridge. Once again in starting a new scientific school Trinity College has wisely and generously made the University its debtor. Previous instances of a similar kind are the late Sir Michael Foster and Prof. F. G. Hopkins.

LEEDS.—Sir Edward Allen Brotherton, Bart., has given 20,000*l.* to the University for the development of bacteriological study and research, more particularly in the interests of public health. This is the largest individual gift yet received by the University of Leeds.

LONDON.—Some interesting public lectures are announced to be delivered at King's College, London, during the coming term. The department of history and geography has arranged for a course of lectures on the British Empire, which includes the following:—"Geological and Geographical Physical Basis," by Prof. W. T. Gordon, on October 26; "Fauna," by Prof. A. Dendy, on November 2; "Flora," by Prof. R. R. Gates, on November 9; and "Anthropology," by Prof. G. Elliot Smith, on November 16. In each case the lecture-hour is at 5.15 p.m.

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DR. FRANCES M. G. MICKLETHWAIT has resigned the post of principal of the Horticultural College, Swanley, to which she was appointed in January last year.

AN election to Beit memorial fellowships for medical research will take place on or before January 1 next. Applications must be received before October 31. Forms of application and all information may be obtained by letter only addressed to the Honorary Secretary, Beit Memorial Fellowships for Medical Research, 35 Clarges Street, Piccadilly, W.1.

A TEACHERS Conference under the auspices of the League of Nations Union will be held on Saturday, October 22, in the Hall of Reading University College. The opening address on education and international co-operation will be given by Prof. Gilbert Murray at 11 a.m. Communications should be sent to Mr. J. Eppstein, secretary of the conference, 40, Redlands Road, Reading.

AT the next dinner of the Groupe Inter-Universitaire Franco-Britannique, to be held on Tuesday, November 1, at the Connaught Rooms, Great Queen Street, Kingsway, W.C.2, the chair will be taken by M. Raymond Poincaré, past-President of the French Republic and former Rector of the University of Glasgow, who will speak on "The Utility of Inter-Allied Intellectual Relationship." Applications for tickets should be made as early as possible, and in any case not later than Thursday, October 20, to Mr. H. Sloog (hon. secretary), 51 Anson Road, N.W.2. The association was formed in June, 1918, for the purpose of promoting friendly intercourse between British and French university men and persons prominent in the worlds of art, literature, science, commerce, and industry in either country. The membership has since been extended to university men of all Allied and associated nations.

THE *Meteorological Magazine* for September gives a provisional programme of lectures and classes for the 1921–22 session in the School of Meteorology, Imperial College of Science and Technology. Sir Napier Shaw gives a course of four lectures on "Fog" on Mondays of the first term at 3.30 p.m., which commenced on October 10, followed by a course of three lectures on "The Winds above Clouds" on Mondays of the first term at 3.30 p.m., beginning November 7. He will also deliver a course of ten lectures on "The Structure of the Atmosphere and the Meteorology of the Globe" on Fridays of the second term at 3 p.m., beginning January 20, 1922. Dr. C. Chree gives a course of four lectures on "Terrestrial Magnetism" on Mondays of the first term at 3.30 p.m., beginning November 28; while Capt. D. Brunt gives a general course on "Physical and Dynamical Meteorology" on Thursdays of the first and second terms at 2.30 p.m., beginning October 13, 1921. Particulars of these courses may be obtained from the Meteorological Office, South Kensington.

THE Royal Technical College, Glasgow, has recently issued a calendar for the session 1921–22 giving details of the various courses of instruction available at the college. Full-time courses have been arranged which lead to the diploma and associateship of the college in civil, mechanical, electrical, and mining engineering, chemistry, and metallurgy. For the diploma a three-year course must be taken, while for the associateship a fourth year's study is necessary, and in the case of chemistry or metallurgy a thesis on some subject of experimental research must be submitted. The diploma courses are in most cases suitable for students taking the B.Sc. examinations of Glasgow University. Evening courses in the various subjects will also be available for students who have completed a two years' continuation course and to others who can show evidence of equivalent status. Courses in engineering for apprentices have been arranged as part of a scheme of co-operation with some seventy engineering firms in and round Glasgow, whereby selected apprentices attend winter courses at the college and the intervening summers in works. Many of these firms recognise the time spent at the college as part of the period of apprenticeship.

## Calendar of Scientific Pioneers.

**October 13, 1866. William Hopkins died.**—The Cambridge tutor of Tait, Maxwell, Kelvin, and Stokes, Hopkins, in 1850, received the Wollaston medal for his researches on the application of mathematics to physics and geology, and the following year was elected president of the Geological Society.

**October 14, 1831. Jean Louis Pons died.**—While connected with the observatories at Marseilles, Lucca, and Florence, Pons discovered thirty-seven comets.

**October 15, 1907. Maurice Loewy died.**—Born in Vienna, of Jewish parentage, and trained under Littrow, Loewy was invited to Paris by Leverrier in 1860. In 1896 he succeeded Tisserand as director of the Paris Observatory. He completed the great Paris catalogue of stars, and energetically supported the International Photographic Chart. The first equatorial coudé was erected by him in 1882.

**October 16, 1793. John Hunter died.**—A great comparative anatomist and the founder of the famous Hunterian collection, Hunter for many years was one of the surgeons of St. George's Hospital, London. Interred in St. Martin's-in-the-Fields, his remains, through the efforts of Frank Buckland, were transferred in 1859 to Westminster Abbey.

**October 16, 1876. Wolfgang Sartorius, Baron von Waltershausen, died.**—After carrying out magnetic work in various parts of Europe, von Waltershausen made a study of Mount Etna, and in 1858–61 published his "Atlas des Ätna." For about thirty years he held the chair of mineralogy at Göttingen.

**October 17, 1757. René Antoine Ferchault de Réaumur died.**—For nearly fifty years a prominent member of the Paris Academy of Sciences, Réaumur has been called the Pliny of the eighteenth century. His investigations on the cementation of steel were of great practical importance. As a naturalist he is best known for his "Mémoires pour servir à l'Histoire des Insectes," 1737–48.

**October 17, 1887. Gustav Robert Kirchhoff died.**—While professor of physics at Heidelberg, Kirchhoff, in 1859, by a comparison of the solar spectrum with the spectra of various elements, created spectrum analysis. Assisted by Bunsen in 1861, he discovered cæsium and rubidium; his map of the solar spectrum was published by the Berlin Academy shortly afterwards.

**October 18, 1871. Charles Babbage died.**—Sometime Lucasian professor of mathematics at Cambridge, Babbage was a founder of the British Association, and of the Astronomical and Statistical Societies. With Herschel, Peacock, and Woodhouse he was one of the reformers of mathematical studies at Cambridge. For more than thirty years he spent much time and money on elaborate calculating machines, which, never completed, are now in the Science Museum at South Kensington.

**October 19, 1875. Sir Charles Wheatstone died.**—A pioneer worker on the transmission of electricity, Wheatstone, in 1834, became professor of experimental physics at King's College, London, and afterwards with Fothergill Cooke played an important part in the development of the electric telegraph. He also did valuable work in acoustics.

**October 19, 1906. Friedrich Konrad Beilstein died.**—German by birth but Russian by nationality, Beilstein was widely known for his researches on the aromatic series and on petroleum, and for his "Handbuch der Organischen Chemie," a work of reference held in high esteem. E. C. S.

## Societies and Academies.

### PARIS.

**Academy of Sciences,** September 26.—M. Léon Guignard in the chair.—A. **de Gramont** and G. A. **Hemsalech**: The *rôle* of electrical actions in the emission and appearance of certain types of lines of the magnesium spectrum. A detailed account of the variations in the lines produced by changing the conditions under which the arc or spark is maintained. The arc was struck between magnesium electrodes under water, glycerol, and petroleum, and the sparks were passed in atmospheres of hydrogen, oxygen, coal gas, and nitrogen. During the first phase of the arc struck in a liquid drop, modifications of the lines are caused by the intense electric fields.—L. **Casteels**: A type of doubly continuous quadratic generation of a plane cubic given by nine simple points.—T. **Varapoulos**: Some properties of increasing functions.—J. **Chazy**: The Poisson stability in the problem of three bodies.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the first quarter of 1921. Observations were taken on seventy-seven days in the quarter, and the principal facts are resumed in three tables, showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—K. **Ogura**: The static field of gravitation.—E. **Hulthen**: The combinations in band spectra.—M. and L. **de Broglie**: The corpuscular spectra of the elements. A statement of experimental results on the corpuscular excitation of the heavy metals (uranium, thorium, lead), by the X-rays, and bearing on the L, M, and N levels of electrons.—E. **Passemard**: The alluvial terraces of Sebou above Fez. There is clear evidence of the existence in the Sebou valley of three terraces, 30 metres, 16 metres, and 7 metres. The higher terraces have certainly existed, but are now represented by *débris*.—A. **Lumière** and H. **Couturier**: Sodium oleate in the phenomena of shock. When a 1 per cent. solution of sodium oleate is injected into the jugular vein of sensitised guinea-pigs, it is known that these animals can stand, without inconvenience, an injection of the antigen which is mortal to a sensitised animal not treated with the oleate solution, and this protective action has been attributed to the property possessed by sodium oleate of diminishing the surface tension of liquids to which it is added. The authors do not accept this explanation, and show that solutions of sodium oleate alone can produce the symptoms of anaphylactic shock. These symptoms can be suppressed by solutions of sodium hyposulphite.

### BRUSSELS.

**Royal Academy of Belgium,** June 4.—M. G. Cesaro in the chair.—A. **Demoulin**: The minimum surface of Enneper.—Cl. **Servais**: A group of three biological Caylean tetrahedra.—M. **Stuyvaert**: The theorems of Fermat and Euler.—H. **Kufferath**: The stereogrammatic interpretation of the sporulation curve of yeasts, described by Hansen. Its application to physiological and biological phenomena. The author has repeated and extended the observations of Hansen on the sporulation of yeasts. The medium used differed from that of Hansen, and the rate of growth was much slower, but the results fully confirm those of Hansen, as regards the average time of the first proof of the existence of spores at varying temperatures.—P. T. **de Chardin** and C. **Fraipont**: The presence in the lower tertiary of Belgium of a member of the Hyopsodus group.—J. **Errera**: Contribution to the knowledge of the cuprous compounds. Experimental evidence is given of the existence of cuprous

nitrate. The products obtained by the electrolysis of alkaline bicarbonates with a copper anode, and by the electrolysis of solutions of carbon dioxide with copper anode under pressure have been examined.—M. **Philippson**: The laws of the electrical resistance of living tissues. Cellular membranes behave as capacities towards alternating currents. Formulæ are given for the electric conductivity of living tissues, and one of the constants in these formulæ characterises the physico-chemical state of the protoplasm.

SYDNEY.

**Linnean Society of New South Wales,** August 31.—Mr. G. A. Waterhouse, president, in the chair.—H. J. **Carter**: Australian Coleoptera: notes and new species. The paper includes descriptions of Queensland material lately acquired by the Queensland Museum, of specimens from Northern Territory, and of two new species from the Barrington or Mount Royal Range, N.S.W. Thirty-six species belonging to twenty-six genera in the families Lucanidæ, Buprestidæ, Tenebrionidæ, and Cistelidæ are described as new.—G. H. **Hardy**: A preliminary revision of some genera belonging to the Diptera Brachycera of Australia. In this revision certain characters considered to be of primary importance are used in defining some of the genera. In the Asilidæ the antennal characters are used for distinguishing the genera belonging to the sub-family Dasypogoninæ. Two robber-flies belonging to the genus Blepharotes are described as new. The genus Clesthentia, White, is transferred from the Leptidæ to the Therevidæ, and taxonomic improvements for the latter family are suggested. Attention is directed to the need for revision of the type specimens of the Australian species of Apiocera, the only genus of the Apioceridæ represented in Australia.—J. M. **Petrie**: The active principle of *Erythrophloeum Laboucherii*. Examination of a small amount of air-dried leaves and a few beans of *Erythrophloeum Laboucherii* proved that cyanogenetic glucosides and saponins were absent, but that a small percentage of a poisonous alkaloid was present. 2·8 kg. of leaves yielded 56 mg. of an amorphous alkaloid, while 290 g. of the beans yielded 87 mg. of the same alkaloid. Both the chemical and physiological properties of this alkaloid prove it to be identical with the erythrophleine of the African plant, *E. guineense*. The general action of the digitalis group was observed in experiments carried out with the alkaloid of *E. Laboucherii* on frogs and dogs.

## Books Received.

An Experiment in the Eradication of Plague Infection, carried out in the Poona and Adjacent Districts. By Major J. C. G. Kunhardt and Asst.-Surg. G. D. Chitre. First Report: for the Period 1914–1916. Pp. 409–445+charts. Second Report: for the Period 1916–1918. Pp. 446–489+tables. (From *The Indian Journal of Medical Research*, vol. 8, No. 3.) (Calcutta: Thacker, Spink and Co.)

Memoirs of the Geological Survey: Special Reports on the Mineral Resources of Great Britain. Vol. 22: The Lead and Zinc Ores of the Lake District. By T. Eastwood. Pp. iv+56. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd.) 2*s*. net.

Department of Scientific and Industrial Research: Fuel Research Board. Technical Paper No. 4: The Carbonisation of Peat in Vertical Gas Retorts. Pp. 16. (London: H.M. Stationery Office.) 6*d*. net.

Junk's Natur-Führer. Süd-Bayern. Von R. H. France. Pp. v+423. (Berlin: W. Junk.) 32 marks.

Fuel and Refractory Materials. By A. H. Sexton. New edition, completely revised and enlarged by Dr. W. B. Davidson. Pp. vii+382. (London: Blackie and Son, Ltd.) 12*s*. 6*d*. net.

Hydro-Electric Engineering. Edited by Dr. A. H. Gibson. Vol. 1: Civil and Mechanical. By H. W. Cook and the Editor. Pp. x+232. (London: Blackie and Son, Ltd.) 25*s*. net.

Strasburger's Text-book of Botany. Re-written by Dr. H. Fitting and others. Fifth English edition, revised with the fourteenth German edition by Prof. W. H. Lang. Pp. xi+799. (London: Macmillan and Co., Ltd.) 31*s*. 6*d*. net.

Industrial Fatigue and Efficiency. By Dr. H. M. Vernon. (Efficiency Books.) Pp. viii+264. (London: G. Routledge and Sons, Ltd.) 12*s*. 6*d*. net.

Library of the Rothamsted Experimental Station, Harpenden. Catalogue of Journals and Periodicals. Pp. 70. (Rothamsted.) 2*s*. 6*d*.

Anales del Museo Nacional de Historia Natural de Buenos Aires. Tomo 29. Pp. v+688+4 plates. (Buenos Aires.)

Thought and Expression in the Sixteenth Century. By Dr. H. O. Taylor. Vol. 1. Pp. xiv+427. Vol. 2. Pp. viii+432. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 2 vols. 50*s*. net.

An Introduction to the Theory of Relativity. By L. Bolton. Pp. xi+177. (London: Methuen and Co., Ltd.) 5*s*. net.

Sculpture sur Bois. Par Hippolyte Gaschet. (Bibliothèque professionnelle.) Pp. 206. (Paris: J. B. Baillière et Fils.) 6 francs net.

Applied Entomology: An Introductory Text-Book of Insects in their Relations to Man. By Prof. H. T. Fernald. Pp. xiv+386. (New York and London: McGraw Hill Book Co., Inc.) 21*s*. net.

The Intestinal Protozoa of Man. By C. Dobell and F. W. O'Connor. Pp. xii+211+8 plates. (London: J. Bale, Sons and Danielsson, Ltd.) 15*s*. net.

Organic Analysis, Qualitative and Quantitative. By E. de Barry Barnett and P. C. L. Thorne. Pp. xi+168. (London: University of London Press, Ltd.) 7*s*. 6*d*.

The Rudiments of Relativity: Lectures delivered under the Auspices of the University College, Johannesburg, Scientific Society. By Prof. J. P. Dalton. Pp. vi+105. (Witwatersrand: Council of Education; London: Wheldon and Wesley, Ltd.) 5*s*. net.

Imperial Institute: Monographs on Mineral Resources, with Special Reference to the British Empire. Silver Ores. By Dr. H. B. Cronshaw. Pp. ix+152. (London: J. Murray.) 6*s*. net.

Imperial Institute: Monographs on Mineral Resources, with Special Reference to the British Empire. Petroleum. Prepared jointly with H.M. Petroleum Dept. with the co-operation of Dr. H. B. Cronshaw. Pp. x+110. (London: J. Murray.) 5*s*. net.

Studies in Christian Philosophy: Being the Boyle Lectures, 1920. By the Rev. Prof. W. R. Matthews. Pp. xiv+231. (London: Macmillan and Co., Ltd.) 12*s*. net.

The Cambridge Pocket Diary, 1921–22. Pp. xv+277. (Cambridge: At the University Press.) 3*s*. net.

Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1920–21. (Cmd. 1401.) Pp. 121. (London: H.M. Stationery Office.) 1*s*. net.

Department of Applied Statistics (Computing Section), University of London, University College.

Tracts for Computers, No. 6. Smoothing. By E. C. Rhodes. Pp. 60+3 diagrams. (London: Cambridge University Press.) 3*s*. 9*d*. net.

Map Projections. By A. R. Hinks. Second edition, revised and enlarged. Pp. xii+158. (Cambridge: At the University Press.) 12*s*. 6*d*. net.

A Memoir of the Rt. Hon. Sir Edward Fry, G.C.B., 1827–1918. By Agnes Fry. Pp. 328. (London: Oxford University Press.) 12*s*. 6*d*. net.

A Study of Mathematical Education, including the Teaching of Arithmetic. By B. Branford. New edition, enlarged and revised. Pp. xii+432. (Oxford: Clarendon Press.) 7*s*. 6*d*. net.

Monographs on the Theory of Photography, from the Research Laboratory of the Eastman Kodak Co. No. 1: The Silver Bromide Grain of Photographic Emulsions. By A. P. H. Trivelli and S. E. Sheppard. Pp. 143. (New York: D. van Nostrand Co.; Rochester, N.Y.: Eastman Kodak Co.; London: Kodak, Ltd.) 15*s*.

## Diary of Societies.

*THURSDAY*, OCTOBER 13.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. C. W. Kimmins: Springs of Laughter.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—Dr. C. Sheard: Thomas Young Oration.

INSTITUTE OF METALS, LONDON SECTION (at Sir John Cass Technical Institute), at 8.—Dr. O. F. Hudson: Chairman's Address.

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (In Lecture Room, Hotel Cecil), at 8.—Dr. Marie Stopes: Anecdotes of the Past, Present, and Future of Birth Control (Presidential Address).

ABERNETHIAN SOCIETY (at St. Bartholomew's Hospital), at 8.30.—Dr. C. Addison: Medical Men and Public Life.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—P. Sargent: Presidential Address.

*FRIDAY*, OCTOBER 14.

ASSOCIATION OF ECONOMIC BIOLOGISTS (In Botanical Lecture Theatre, Imperial College of Science), at 2.30.—Dr. W. Brown and Others: Discussion on the Physiology of the Infection Process.

JUNIOR INSTITUTION OF ENGINEERS (Inc.), at 8.—C. H. Woodfield: Electric Cranes.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—J. H. Parsons: The Fourth Cranial Nerve.—E. Clarke: Milestones in Refraction Work.

*SATURDAY*, OCTOBER 15.

PHYSIOLOGICAL SOCIETY (at Guy's Hospital), at 4 p.m.—N. W. MacKeith, M. S. Pembrey, W. R. Spurrell, E. C. Warner, and H. J. W. J. Westlake: Changes in Urine and Respiration in Relation to Exercise.—G. P. Crowden, Gwenda Hill, and M. S. Pembrey: Physiological and Anatomical Comparisons of a Pair of Identical Twins.—E. D. Adrian and A. Forbes: The All-or-Nothing Response of Sensory Nerve Fibres.—G. S. Adair, J. Barcroft, and A. V. Bock: The Identity of Hæmoglobin in Human Beings.—M. Nagahashi: Magnetic Gas Analysis.—J. C. Drummond, G. P. Crowden, and Gwenda Hill: Nutrition on High Protein Dietaries.—B. J. Collingwood: The Constitution of Blood after the Intravenous Injection of (*a*) a Solution of Thrombin, prepared by the Gamgee Method; and (*b*) Tissue Extract.—A. V. Hill and W. E. L. Brown: The Effect of $CO_2$ on the Heat of Combination of Hæmoglobin and Oxygen.—J. Mellanby: Asphyxia by Nitrogen.

*TUESDAY*, OCTOBER 18

ROYAL HORTICULTURAL SOCIETY, at 3.—N. H. Grubb: Some Aspects of Apple Pruning.

ROYAL COLLEGE OF PHYSICIANS, at 4.—Dr. H. R. Spencer: (Harveian Oration).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions made to the Society's Menagerie during the months of June, July, August, and September, 1921.—M. A. C. Hinton: Exhibition of an Embryo African Elephant.—A. Stanley Hirst: On Some New Parasitic Mites.—Prof. J. Playfair McMurrich: Note on the Systematic Position and Distribution of *Sagartia luciae*.

*WEDNESDAY*, OCTOBER 19.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Dr. L. T. Hogben: Preliminary Account of the Spermatogenesis of Sphenodon.—D. M. Stump: An Application of Polarised Light to Resolution with the Compound Microscope.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Commercial Vehicle and Motor Car and Marine Exhibitions, Olympia).—H. S. Hall and H. G. Burford; E. H. Arnott: Agricultural Tractors.

*THURSDAY*, OCTOBER 20.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—G. Brewer: The Langley Machine and the Hammondsport Trials.

CHEMICAL SOCIETY, at 8.—R. L. Grant and F. L. Pyman: Nitro- and Amino-derivatives of 4-Phenylglyoxaline.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Commercial Vehicle and Motor Car and Marine Exhibitions, Olympia).—T. Clarkson: Coke as a Fuel for Commercial Vehicles.—W. D. Williamson: Loading Devices for Commercial Vehicles.

*FRIDAY*, OCTOBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. W. Rosenhain, S. L. Archbutt, and Dr. D. Hanson: Eleventh Report to the Alloys Research Committee on Some Alloys of Aluminium.

### PUBLIC LECTURES.

(*A number in brackets indicates the number of a lecture in a course.*)

*THURSDAY*, OCTOBER 13.

KING'S COLLEGE, at 5.30.—H. W. Fitz-Simons: Bridge Construction (1).

UNIVERSITY COLLEGE, at 4.—Dr. T. G. Pinches: Babylonian Magic (2).

*FRIDAY*, OCTOBER 14.

UNIVERSITY COLLEGE, at 4.30.—Dr. J. C. Drummond: Nutrition (1).

*SATURDAY*, OCTOBER 15.

REGENT STREET POLYTECHNIC, at 10.30.—Prof. H. H. Turner: Modern Astronomical Theories.

*MONDAY*, OCTOBER 17

KING'S COLLEGE, at 5.30.—H. Moore: Liquid Fuels (1)

UNIVERSITY COLLEGE, at 5.—Prof. G. Dawes Hicks: The Philosophical Aspects of the Theory of Relativity.

*TUESDAY*, OCTOBER 18.

KING'S COLLEGE, at 5.30.—Prof. H. Wildon Carr: The Modern Scientific Revolution and its Meaning for Philosophy (2).—The Perceptual Basis of Physics.—Dr. W. Brown: Psychology and Psychotherapy (1).—L. J. Hunt: Cascade Synchronous Motors and Generators (1).

*WEDNESDAY*, OCTOBER 19.

KING'S COLLEGE, at 4.30.—Dr. C. Da Fano: Histology of the Nervous System (2).

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