THURSDAY, MARCH 20, 1919.

THE VEGETABLE OIL INDUSTRIES.

The Production and Treatment of Vegetable Oils. By T. W. Chalmers. (The *Engineer* Series.) Pp. xi + 152. (London: Constable and Co., Ltd., 1918.) Price 21*s.* net.

THE series of industries which is based on the vegetable oils as raw materials manufactures products which are of the utmost importance to mankind. These industries utilise profitably a very large capital, and in the aggregate give employment to a considerable number of workpeople. They are amongst the most highly organised industries in this country in the application of science to their manufacture, in the enlightened treatment of their workpeople, and in their commercial and financial administration. Consequently the literature, both scientific and technical, dealing with them is a large one, but none the less there is ample room for a book on the somewhat novel lines developed by Mr. Chalmers. He has put together in book form a series of particularly well illustrated articles which appeared from time to time in the *Engineer* during 1917. The subject is treated in a practical manner from the engineer's point of view, and though a certain amount of chemistry is introduced, this is essentially of an elementary character; it is likewise unnecessary, as the chemistry of the subject is fully provided for in existing works.

The vegetable oil industry in this country has received a great stimulus from the conditions brought about by the war. Previously it had developed on international lines; though the raw products came in the main from British Colonies, they were dealt with largely at Hamburg or Marseilles and further elaborated in Holland, only soap-making being an essentially British industry. Now all branches are firmly established in this country, and unless their growth is hampered by unwise legislation and taxation, a contingency which is not altogether impossible, they are likely to prove a great national asset.

The method adopted by Mr. Chalmers is to give a detailed description in simple terms of the processes in use throughout the industries from the raw materials to the finished products. He has succeeded in making this sufficiently detailed to be of considerable value to those engaged either in the particular section or in one of the allied sections of the industry and thus already possessing a general knowledge of the subject, as well as to others outside the industry who may wish to understand it. With such a work, criticism of details is largely a matter of opinion and therefore unnecessary; but on the general question it is perhaps a matter for regret that the author has drawn his experience of the machinery he describes and illustrates from a very limited number of firms, thereby to some extent misleading the reader as to the alternative plant available.

The earlier chapters deal with the preparatory machinery for the nuts and seed before they enter the oil mill proper and that required afterwards to prepare them for the presses or extraction vessels. Oil presses of both the Anglo-American and Cage types are described, these sections being particularly well illustrated. A useful chapter discusses the general arrangement of oil mills of both types.

A very good account is given of the solvent extraction process, which, of course, has a wide field of application outside the vegetable oil industry. The cake from the oil presses contains somewhere about 8 per cent. of oil and is recognised as a very valuable food for cattle; the residual meal from the solvent process contains only about 1 to 2 per cent. of oil, and has to be carefully steamed to get rid of the last traces of solvent. The early imperfect working of this process has caused a prejudice against the meal in the minds of farmers which is to-day entirely unjustified. Furthermore, it is generally stated that extracted oil cannot be refined for edible purposes, though this is entirely contrary to experience. The author lays stress on the fact that recent progress has overcome the objections to the solvent process, and that pressing and extraction can be very profitably worked side by side in the same mill.

The refining of oils so as to make them edible is a subject concerning which much secrecy is usually exercised; the industry has been very much developed in Britain during the last few years, and we should now be entirely independent of the Continent for edible oils.

The manufacture of margarine is omitted, and the author passes to another section of the industry, that of oil-hardening, or hydrogenation. Most of the vegetable oils are too liquid to be used for soap-making or even for edible purposes; this is due to their being unsaturated—that is, they contain an insufficient proportion of hydrogen. This element may be introduced into the molecule by means of a nickel catalyst, whereby a liquid oil can be converted into a solid oil of any desired degree of hardness. The process is full of technical difficulties, and their practical solution, so as to give a thoroughly efficient commercial process, is one of the best achievements of the English chemical manufacturer during the last twenty years. It is worth recalling that but for this process there would have been no soap and very much less margarine during the last two critical years.

The problem of the technical manufacture of hydrogen on a large scale had also to be solved before hardening could be carried on commercially. The author deals with these two subjects in considerable detail and imparts much information which has not hitherto been published.

The final chapters describe the manufacture of soap, perhaps the best known part of the industry, and with the recovery of the glycerine from the soap lyes. As the soap industry has been worked mainly for the sake of this by-product during the

war, considerable interest attaches to its efficient recovery.

The author is to be commended on a solid piece of work, which cannot fail in the long run to be of much use to the vegetable oil industries.

E. F. A.

TEMPERATURE IN CHINA.

La Température en Chine et à quelques Stations voisines d'après des observations quotidiennes. Compilées par H. Gauthier, S.J. 3 vols. Pp. xlviii+784. (Shanghai: Imprimerie de la Mission Catholique, 1918.)

SINCE the publication of Buchan's comprehensive "Report on Atmospheric Circulation," the accepted unit of time in the compilation of climatological data has been the month, and daily averages of meteorological elements have rarely been calculated. The inadequacy of monthly, and the need for daily, normals have often been urged, but the preparation of the latter requires considerable leisure, a rare commodity in most meteorological services.

The present set of three volumes provides daily averages of temperature for China and its vicinity in the most complete and satisfying manner, dealing with one hundred stations, for periods varying from one to forty-four years. The data have been prepared by Father H. Gauthier, S.J., director of the meteorological observatory of Zikawei, which is also the headquarters of the meteorological service of China. The work was obviously a labour of love, from the completeness of the tables and the full discussion. The volumes contain a long and interesting introduction, a set of charts of monthly and annual isotherms of China, with other diagrams, and 784 pages of tables. The introduction alone is a valuable treatise on the climate of China, containing a full discussion and analysis of all elements at Zikawei, including some, like ozone, not generally dealt with, and also a summary of the changes in the meteorology of China month by month.

The harmonic analysis of the annual variation of the meteorological elements at Zikawei suggests a study of the influence of various factors —insolation, pressure, wind, evaporation, etc.—on the temperature. The annual curve is built up, step by step, from these data in a very instructive way by the gradual modification of the symmetrical curve due to heat supplied by the sun as each additional factor is brought in. The final result is to obtain a very close approximation to the mean temperature of each month, and the procedure is repeated with almost equal success for other stations—Irkutsk, Peking, and Hong Kong—for which, however, the author has to bewail the absence of important data like the figures of evaporation.

Other notes on the geographical factors influencing temperature follow, but the *raison d'être* of the book is the set of tables. Of these, 730 pages are devoted to the daily averages of temperature at one hundred stations arranged in order of latitude, each day occupying two pages. The details given include the raw daily means, the same corrected for altitude and also smoothed, the mean and extreme maxima and minima, and the daily range. Corresponding figures are given for 1916 alone.

The author refrains from drawing elaborate conclusions from the figures, but contents himself with laying them before the meteorologists of the world as a contribution to the knowledge of a country long, but erroneously, considered as meteorologically unexplored. He points out, however, the value which such a set of data has for the study of the connection between solar heat and the annual variation of temperature. There are, indeed, a number of problems clustered round this point which can be solved only by a study of the daily means of temperature—for example, the cold spells of spring and the warm spells of autumn. The reality and periodicity of these—the Ice Saints and the Indian summer—can be determined only by a study of daily averages. The tables, for instance, appear to show that over the whole seaboard of China there is a quite decided lapse of temperature between June 4 and 11, and there are possibly others which would be revealed by a detailed study. Another problem is the incidence of the monsoon in China, in which, of course, temperature is the ruling factor. The details of the complete reversal of type from the cold, dry, anticyclonic conditions of winter to the maritime conditions of summer, and still more the reverse changes from summer to winter, cannot be brought out entirely by monthly charts. For example, those of August and September in Middle China show a reversal of type from the land warmer than the sea to the land colder than the sea, with a corresponding change in the predominant wind direction, and the intervening period of transition, which is not without interest, is unrepresented until the daily charts are drawn.

The progress of the seasons is further illustrated by marginal notes of a phenological nature, especially dealing with the migration of birds, and by meteorological details showing the conditions under which extremes have occurred. It appears that there is a tendency for individual days to be hot or cold over a large extent of eastern Asia. The cold days occur, as one would expect, with large and intense areas of high pressure in the north or north-west of China, while the warm days occur in the presence of depressions, especially when the latter are so situated that they cause south-easterly winds in winter or south-westerly winds in summer; thus the great heat-waves occur when shallow depressions, not sufficiently intense to cause great cloudiness, pass north-east of Shanghai.

The author expresses his conviction that the value of his work will rise above its possible deficiencies. That conviction is certainly justified, but may one add a hope that, in the full volume of plates which is promised to accompany the tables, the printer will succeed in making the denominations of the isotherms more legible?

C. E. B.

OUR BOOKSHELF.

Tables of Refractive Indices. Vol. i. "Essential Oils." Compiled by R. Kanthack. Edited by Dr. J. N. Goldsmith. Pp. 148. (London: Adam Hilger, Ltd., 1918.) Price 15*s.* net.

THIS volume is the first of a series, in which it is proposed to publish the values of the refractive indices appertaining to various technical products.

Used with discretion, the refractive index is a property which will often give valuable information as to the purity of a liquid, and it is a property which is readily determined. Another advantage is that, given a suitable refractometer, a very small quantity of the substance suffices for the determination. In examining essential oils the value of the refractive index is a very useful *datum*, and it is convenient to have the numerous recorded observations, hitherto scattered over the literature, selected, scrutinised, and brought together in a handy form such as that of the book before us.

The data which Mr. Kanthack has collected are arranged in tables occupying the right-hand pages of the book, the opposite pages being left blank for notes. In the first column of the table are the names of the oils in alphabetical order, with their botanical origin, and often their geographical source also. Then follows the refractive index, the temperature of the observation being given in every case. With respect to this last point, abstractors of chemical literature would do well to note the author's remarks upon the futility of stating a refractive index unless the temperature of the observation is also given. Finally, there is a reference to the authority, and this will be found an important feature, because there are some two hundred and eighty of these references, and they form a good guide to the literature of the subject. In fact, some of the index-values, which would otherwise be redundant, have been purposely utilised for introducing references to important work or special information. Chemists who are concerned with the examination of essential oils will find the book decidedly helpful.

An Introduction to the Study of Biological Chemistry. By Prof. S. B. Schryver. (Modern Outlook Series.) Pp. 340. (London: T. C. and E. C. Jack, Ltd., n.d.) Price 6*s.* net.

THE author is to be congratulated on a very useful addition to chemical literature. The special feature of the book is a careful choice of examples which are of peculiar interest to students of biological chemistry. The first 178 pages are devoted to a description of general chemical methods, and to a study of the chief groups of organic substances; and, while no attempt has been made to give full details of the properties of the individual compounds, a succinct account has been given of the relationships between the various groups.

A specially good feature is the inclusion of, and the prominence given to, synthetic methods, and careful accounts are given of Grignard's reaction, Friedel and Crafts' reaction, the malonic ester reaction, Kiliani's reaction, and Sandmeyer's reaction, as illustrative of general synthetic methods. A very useful chapter deals with optical activity and the chemistry of stereoisomerism. The treatment of the aromatic substances is brief, but sufficient for the purposes for which the book is intended. The remainder of the book is devoted to the study of the chief chemical constituents of the animal body, and the chemistry of the fats and carbohydrates is given in more detail than is usual outside special monographs. To the student of bio-chemistry the constitution and properties of the proteins are questions of fundamental importance, and have been fully treated. The purely chemical part of the book is completed by special chapters on the methods employed for the investigation of the chemical changes within the animal organism, and on the chemical processes in plants. In these chapters the main features of enzyme action are dealt with, and the nature of the changes which occur during the intermediate metabolism of the foodstuffs is discussed.

In conjunction (as the author suggests) with suitable practical exercises worked in the laboratory, the book should prove very useful, and forms an excellent basis for the preliminary training of medical students or of agricultural students in those lines of thought which are of service to them. The book is tersely and continuously written, each chapter carefully summarised, and an efficient index is provided.

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.*]

Globular Clusters, Cepheid Variables, and Radiation.

I WAS much interested to see in the letter by Dr. Harlow Shapley bearing the above title (NATURE, March 13, p. 25) that new astronomical evidence makes it necessary again to challenge the almost universal assumption that radiation is uniformly propagated in all directions through free space. I have long felt that this unjustifiable assumption was at the bottom of the difficulty of accounting for the maintenance of solar and cosmical energy even over the periods of time demanded by geological history, and I have often thought that, even though no actual crucial test is possible, experimental evidence on such an important question ought to be attempted. In a review of Dr. N. R. Campbell's "Modern Electrical Theory" (NATURE, vol. xcii., p. 339, 1913) I pointed out that experiment and observation justify only the conclusion that radiation is propagated between portions of space occupied by matter, and that elsewhere it may not be propagated at all. The frank confession of complete ignorance on this, the simplest first question as to the nature of radiation in its cosmical aspect, would put an entirely different complexion on the doubtful generalisations from laboratory science to cosmology. As Dr. Shapley calculates with regard to solar radiation, the ordinary assumption demands a loss of energy one hundred million times greater than experimental evidence justifies.

FREDERICK SODDY.

Graphical Methods in Nautical Astronomy.

As the author of the article in NATURE of October 24, 1918, in which the diagram referred to by Dr. Hutchinson last week was first brought to the notice of your readers, may I be permitted to supplement the information as to previous efforts in the same direction? When the diagram first appeared in this country Rear-Admiral Parry, Hydrographer to the Admiralty, also set on foot an inquiry similar to that of Dr. Hutchinson, and very courteously sent me the result of his investigation. From his report it appears that "an account of the 'Nomogramme' was published in *Petermann's Mittelungen* (vol. ii., pp. 182 and 249, 1913), and was illustrated by a skeleton diagram similar in principle to these charts, and the method for using it was fully explained." This, in point of time, is fifteen years later than the date of the paper of M. d'Ocagne, who, so far as appears at present, is clearly entitled to the credit claimed for him as first in the field.

The share of Mr. Littlehales, however, is marked by two features of interest:—(1) That he seems to have been the first to prepare and publish the diagram in a form that promises to be useful in the navigation of air and ocean, and (2) that the simplicity of treatment which deduces the principle and graduation of the chart directly from a general formula of spherical trigonometry renders the theory of the matter intelligible to many nautical persons to whom the mysteries of "Nomographie" are as a sealed book.

H. B. GOODWIN.

March 15.

The Oldest Mosquitoes.

THE REV. PETER BELLINGER BRODIE, in his "History of the Fossil Insects of the Secondary Rocks of England," gave a figure of a small fly which he named *Culex* (?) *fossilis*. This insect, from the Purbeck strata, would be by far the oldest mosquito known, were it a veritable Culex. Unfortunately, it is impossible to form any definite opinion, and as positive evidence of the antiquity of the Culicidæ the specimen must be dismissed as valueless. On general grounds it is very improbable that the group is so ancient. In Handlirsch's great work on fossil insects several Culicidæ are listed from the Oligocene Tertiary; but Handlirsch did not know that two species described by Scudder, from Wyoming and Utah respectively, are actually much older, coming from Eocene rocks. The one from Utah is of little value, and presumably not a true Culex; but that from the Green River beds of Wyoming has the unmistakable features of a genuine mosquito, showing the long proboscis and the short palpi of the female. According to Schuchert's estimates of geologic time, this should be more than two million years old at the very least. Scudder's insect, called *Culex damnatorum*, is 6 mm. long, with a proboscis 1·9 mm. It doubtless tormented the Eohippus and related mammals of this general period. Whether it carried any pathogenic protozoa we can, of course, never know. It is now possible to put on record a second Eocene mosquito, found by Mr. Dean E. Winchester, of the U.S. Geological Survey, at Smith's Ranch, in the vicinity of the Cathedral Bluffs, in western Colorado. It is represented by a female, preserved in lateral view, 5·2 mm. long, the wing about 4·2 mm., thorax about 2 mm., palpi about 0·4 mm., and the distinctly curved proboscis 3 mm. The stout abdomen is like that of true Culex, obtuse at the end, not tapering as in Aëdes. The longer proboscis readily separates it from Scudder's insect, so it must stand as a new species, to be called *Culex winchesteri*, after its discoverer. The horizon is considered to be Green River, approximately equivalent to that of the Wyoming locality.

The oldest British mosquitoes, setting aside Brodie's very dubious Purbeck specimen, are three species from the Oligocene of Gurnard Bay, in the Isle of Wight, also collected by Brodie. These were described by the present writer in 1915, and are in the U.S. National Museum. One of them is so beautifully preserved that it shows the wing-scales.

While writing on fossil Diptera I take occasion to note that my *Mesomyites concinnus*, another of the Gurnet Bay fossils, is evidently a member of the peculiar Tipulid genus Styringomyia, and should be called *Styringomyia concinna*. I am indebted to Mr. C. P. Alexander for suggesting the correction. The specimen is in the British Museum.

The Gurnard Bay locality, which furnished Brodie with large and important collections, seems not to have been investigated in recent years. Most of Brodie's collection is at the British Museum, and will, when fully described, add greatly to our knowledge of Tertiary insects.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado.

Proposed Magnetic and Allied Observations during the Total Solar Eclipse of May 29, 1919.

SPECIAL magnetic and allied observations will be made at certain stations inside and outside the shadow belt of the total solar eclipse of May 29 next by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and by various magnetic observatories, institutions, and individuals. The probable stations of the Department of Terrestrial Magnetism are (1) La Paz, Bolivia; (2) Huancayo (north of belt of totality); (3) near Sobral, Brazil; (4) Ile Principe or Libreville, French Congo; and (5) various field stations within the zone of visibility. At station (3) complete magnetic and electric observations will be made.

The general scheme of work proposed by the Department of Terrestrial Magnetism is as follows:—

(1) *Simultaneous magnetic observations* of any or all of the elements, according to the instruments at the observer's disposal, every minute from May 29 next, 9h. 58m. a.m. to 4h. 32m. p.m. Greenwich civil mean time, or from May 28, 21h. 58m. to 4h. 32m. May 29, Greenwich astronomical mean time.

(To ensure the highest degree of accuracy, the observer should begin to work early enough to have everything in complete readiness in proper time. Past experience has shown it to be essential that the same observer should make the readings throughout the entire interval. If possible, similar observations for the same interval of time as on May 29 should be made on May 28 and 30, to afford some means of determining the undisturbed course of the magnetic declination.)

(2) *At magnetic observatories* all necessary precautions should be taken to ensure that the self-recording instruments will be in good operation, not only during the proposed interval, but also for some time before and after, and eye-readings should be taken in addition wherever it is possible and convenient.

(It is recommended that, in general, the magnetograph should be run on the usual speed throughout the interval, and that, if a change in recording speed be made, every precaution possible should be taken to guard against instrumental changes likely to affect the continuity of the base line.)

(3) *Atmospheric-electric observations* should be made to the extent possible with the observer's equip-

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Eclipses, Solar

ment and *personnel* at his disposal. At least observations of potential-gradient and conductivity (preferably both positive and negative) should be made.

(4) *Meteorological observations* in accordance with the observer's equipment should be made at convenient periods (as short as possible) throughout the interval. It is suggested that at least temperature should be read every fifth minute (directly after the magnetic reading for that minute).

(5) *Observers in the belt of totality* are requested to take the magnetic reading every thirty seconds during the interval, ten minutes before and ten minutes after the time of totality, and to read temperature also every thirty seconds before the magnetic readings.

It is hoped that full reports will be forwarded as soon as possible for publication in the journal *Terrestrial Magnetism and Atmospheric Electricity*. Those interested are referred to the results of the observations made during the solar eclipse of June 8, 1918, the publication of which was begun in the September (1918) issue of the journal. A summary of the results obtained is given in the March (1919) issue.

LOUIS A. BAUER.

Carnegie Institution of Washington, Department of Terrestrial Magnetism, Washington, D.C., February 15.

A Proof that any Aggregate can be Well-ordered.

ALL the critics of my method sketched or described in my two letters to NATURE (vol. ci., pp. 84 and 304, 1918), in my two notes in *Comptes rendus* (vol. clxvi., pp. 520–23 and 984–86, 1918), in *Mind* for July, 1918, and in *Science Progress* for October, 1918, wish to see a certain particular case solved in detail. Although this case does not throw so much light on the problem as the equally simple method of dealing with the general case, which I happen to have discovered long before I applied it to special cases, I here give the treatment of the particular case referred to.

Suppose that an aggregate M is such that there are classes x_1, x_2 . . ., where x_n is the class of all those chains of M of type n, and the suffixes of the x's are all the finite ordinal numbers (that is, those less than ω); we are to prove that M has a chain of type ω. We will define by complete induction a rule for actually constructing out of the x's *many* (we can prove afterwards that the *many* are *all*; we do not, of course, merely postulate that there is a non-null class of all such classes) classes of direct continuations of which each contains one chain from each x. The rule, though it is, accordingly, split into two parts, is to be regarded as one whole; and it can be so regarded, since it does not involve an infinity of arbitrary selections.

(1) With each member K_2 of x_2, class that member of x_1 which is the sole segment of K_2. Thus each member of x_1 is classed with many of x_2, and each member of x_2 is classed with a definite one of x_1 so that together these members form a class of direct continuations with members of types 1 and 2.

(2) In general, for $2<n<\omega$, with each member K_n of x_n classify (*a*) that member (K_{n-1}) of x_{n-1} which is a segment of K_n, and (*b*) also those chains of types $n-2$, . . . 2, 1 previously classed with K_{n-1} by the rule. Remember not to regard here a class of y and z as anything more than just y and z. For instance, each member of x_3 forms, with the chains classed with it, a class of direct continuation with three members; and we easily see that, in general, every class of direct continuations with n members is added to, provided that the whole rule is applied and not merely a part of it which stops at n.

Thus we have defined a means of rearranging all the members of all the x's so that they form classes of direct continuations of the kind we wished and stated above. Since any class of *direct continuations* which is formed from the members of M, and contains chains of all types less than ω, plainly defines a chain of type ω, each of the classes of direct continuations formed by the rule defines a chain of type ω. This is what we had to prove. We have, indeed, a set of classes of direct continuations such that each class has at least two terms, and, if it has n terms, it has $n+1$.

PHILIP E. B. JOURDAIN.

The Bourne, Basingbourne Road, Fleet, Hants, March 11.

Coal in Thrace.

ANTIGONOS, a Greek writer about the beginning of our era, made a collection of the accounts of the natural wonders of his time. Among them he mentions—I translate from the Greek edition of 1568—that "they say that in the wild (uncultivated) region of Thrace there is a river called Pontos, which brings down in its course stones resembling *anthrax* (charcoal), and that these burn, but differ in combustion from charcoal, inasmuch as the use of bellows extinguishes the fire. On the other hand, sprinkled with water they burn all the better." Where was this river? Kiepert does not mention it, but it seems to have flowed into the Black Sea, then called Pontos. It would be interesting to know if anthracite has been found so near Constantinople.

EDMUND M'CLURE.

80 Eccleston Square, S.W.1, February 27.

THERE is no warranty for suggesting that "stones resembling anthrax" are anthracite; they are far more likely to have been bituminous coal or lignite, both of which burn more readily than does anthracite, which latter is decidedly difficult of ignition. Whilst European Turkey has not been fully explored for coal, the existence of coal is known in various places; a bituminous coal-seam is reported near Keshan, in the province of Adrianople, and along parts of the northern coast of the Sea of Marmora; and there are lignite deposits known near Rodosto, near Dedeagatch, and even within a short distance of Constantinople. Obviously any of these deposits might have given rise to the stones referred to by Canon M'Clure.

It would be interesting to know whether the Greek text excludes the possibility of its reference being to the district of Pontos, on the south shores of the Black Sea, as the best-known coal-mines of all the region are those to the south of Heraclea in that district.

HENRY LOUIS.

Armstrong College, Newcastle-upon-Tyne, March 3.

Curious Markings on Chalk.

DR. ANDREWS (NATURE, March 13, p. 25) probably knows more about the natural forms assumed by chalk than I do, but I think, nevertheless, that the specimen described by me in the February issue of *Man* (p. 17, pl. B) cannot be disposed of quite so summarily as he supposes. And I would suggest that it is generally considered unwise, in such matters, to publish a definite opinion before an examination of the actual specimen has been made.

It is my hope that before long Mr. Gathorne-Hardy may exhibit his discovery at a meeting of

some learned society where those interested will have the opportunity of making such an examination.

J. REID MOIR.

One House, Ipswich.

Protozoal Parasites in Cainozoic Times.

IN the issue of NATURE for October 3, 1918 (p. 95), which has just reached me, is a note on Prof. T. D. A. Cockerell's discovery of two new species of Glossina in the Miocene shales of Colorado. It is said that "Osborn's suggestion that many large Cainozoic mammals in America may have been destroyed by fly-borne parasites is rendered highly probable by the wider range of tsetse-flies now indicated by Prof. Cockerell."

I do not see that the conclusion is justified. The co-existence in space and, possibly, time of a species of blood-sucking fly and certain large mammals affords no grounds for concluding that protozoal parasites carried by the former destroyed the latter. Do blood-sucking flies in America at the present day destroy wild animals through the medium of the Protozoa they carry?

I am unaware of any evidence at present that wild animals in Africa are destroyed by the Trypanosomes of which they are the hosts and Glossina the vector; indeed, there is very definite evidence to the contrary that buck do not suffer in the least from the continued presence in their blood of Trypanosomes which are pathogenic to man and his domestic animals.

What grounds, then, are there for the assumption that the adaptation of such Protozoa to their hosts was any less perfect in Cainozoic times than at present?

G. D. HALE CARPENTER,
Uganda Medical Service.

Kome Island, Lake Victoria, January 12.

THE PERU-BOLIVIA BOUNDARY COMMISSION.[1]

THE search for a scientific frontier has taken men into many wild and unexplored regions of the earth's surface, and has, in the aggregate, helped in the accumulation of no mean amount of new geographical knowledge. Those familiar with the true foundations of the map of Africa know well that in many areas the surveys executed by boundary commissions are still the only authorities for geographical positions, and that the boundary surveyor was often the first white man to force his way into hitherto unknown parts. As, further, the surveyor brings with him both the equipment and the trained technical skill necessary to garner the very utmost amount of detailed and trustworthy information in the course of his rapid traverse of the country, it follows that, next only to the closely settled districts, the boundary lines in Africa are now the best known regions of the continent.

FIG. 1.—Cojata Pampa, wind-eroded rocks. From "Peru-Bolivia Boundary Commission, 1911–13."

The conditions in South America are somewhat similar, but, owing to the fact that most of the international boundaries are almost inaccessible, lying either on the great heights of the Andine Cordillera or hidden in the impenetrable forests of the Upper Amazon and its tributaries, the need for actually defining these frontiers on the ground has not generally

1 "Peru-Bolivia Boundary Commission, 1911–13." Reports of the British Officers of the Peruvian Commission. Edited for the Government of Peru by the Royal Geographical Society of London. Pp. xi+242+maps. (London: Cambridge University Press, 1918.)

arisen as yet, except in places where the discovery of mineral wealth has compelled such definition. In the case of the Peru-Bolivia boundary, however, though evidences of rich mineral deposits are found by the most casual explorer, it was not the mineral so much as the vegetable wealth which was the final determining cause inducing the States concerned to attempt the settlement of a dispute dating back to their foundation. The rise in the value of rubber, the exhaustion of the more readily accessible rubber forests, and the consequent pushing out of the rubber-collector into more and more remote fastnesses, brought forward the question of this boundary, running for a large part of its length through either actual or possible rubber-bearing forest, as one imperatively demanding a final solution.

We may remark in parenthesis that there is another source of natural wealth, scarcely seriously taken into account yet, but which will have a vital influence on the future of civilisation, and with which boundary surveys, especially such as lie in mountain regions, are most intimately concerned. The wealth in question is that of natural sources of water-power. What the aggregate horse-power now running to waste off the gigantic mountain system of the Andes amounts to is beyond the range of human conjecture, but we may safely predict that within at most a generation or two this power will be of enormous, realisable value. Boundary agreements of the future may have to pay special attention to this point.

It would be out of place to recount here the successive steps that led up to the appeal by the States concerned to the Royal Geographical Society to nominate officers to carry out the survey and demarcation, fully set forth in the volume under review. The work was almost completed in 1914, when the officers engaged were, of course, recalled for service. Two of them fell in the early months of the war, and as the others were still engaged on service, and no date could be fixed for their release, it was decided in 1917 that the preparation and publication of their report should be undertaken by the society under the editorship of Sir T. Holdich, assisted by Mr. Arthur Hinks. The splendid volume before us is, therefore, due to the able labours of these editors, assisted in a large measure by the very excellent and exhaustive records kept by the members of the commission. We may safely say that no boundary has been described with more completeness, and it is to be hoped that this volume will form a model for the future. Our knowledge of Africa, for example, will advance by rapid strides if the demarcation of the new boundaries, presumably called for within the next few years, results in any comparable addition to our geographical knowledge, and is recorded in a volume of such permanent interest.

In one point the Peru-Bolivia commission was exceptionally fortunate in that one of its members,

FIG. 2.—Calijon from the Rinconada Glacier. From "Peru-Bolivia Boundary Commission, 1911–13."

Major Toppin, was a trained naturalist, and was able to make the most of his opportunities. Several new butterflies and a new monkey were the permanent testimonials to his skill. One is rather inclined to lament that it is not always possible to take the opportunity of a boundary survey and, by attaching, say, a naturalist, a geologist, and possibly a botanist to the commission, gain much knowledge without great cost. Doubtless this practice might be often followed, but it must be remembered that a boundary commission is always in a hurry; it never has enough time to carry out all the survey observations it would like, and routes, times, and halting-places must be regulated solely by survey considerations. It would, therefore, often result that the naturalist or geologist would have to leave almost untouched the regions most fruitful of promise for him, and might return from the expedition with feelings of disappointment at opportunities missed.

We have no space here to enter upon any close discussion of the technical points raised in this report. The survey was of the class already familiar in similar undertakings, and was subject to the same obstacles as those found in previous surveys, both in high mountains and in dense forests; the difficulties of transport, the prevalence of mist and cloud, the impossibility of getting distant views from the constricted valleys, and, in the forest portion of the line, a horrible abundance of malignant insects. Once again, possibly for the last time, an effort was made to determine longitudes by occultations, a method which cannot attain the precision requisite for such work, and should be entirely superseded by wireless signals, which can now be received upon instruments of almost any desired degree of portability. In any case, astronomically determined positions are of little value as a check upon a triangulation even of the second order, and are of more interest to the geophysicist than to the boundary surveyor. This commission was fortunate in finding a well-established initial point for the astronomical work in the observatory at Arequipa, the southern station of the Harvard College Observatory.

An interesting little note by Sir C. Close is embodied in the report discussing the gravity deflections in the boundary region, and showing that the local attractions are quite similar to those found in the region of the Himalayas near Mussoorie and Dehra. The volume, produced in the accustomed high standard of the Cambridge University Press, is furnished with all the necessary maps and a rich selection of illustrative plates. We can heartily commend it, both to the reader of the present day as an account of a highly successful piece of geographical survey, and to the reader of the future as an imperishable record of the work that can be accomplished, in spite of innumerable difficulties and in face of great natural obstacles, by a small but thoroughly proficient British survey party. E. H. H.

THE AIR FORCE ESTIMATES AND AERONAUTICAL RESEARCH.

THE development of military aviation has been one of the wonders of the war, but we have naturally been kept somewhat in the dark as to the exact extent of such development while the war was still in progress. The veil has now been lifted, and Gen. Seely, in speaking on the Air Estimates in the House of Commons on March 13, has given us a striking summary of the progress made during the past four years. The fact that the expenditure on the Air Force has increased two-hundred-fold since the outbreak of hostilities is a sufficient comment on the enormous advances that have taken place in the aeronautical world. Gen. Seely states that if the armistice had not been signed, this year's Estimates would have reached the sum of 200,000,000*l.*—an amount which is practically four times our pre-war expenditure on the entire Navy! Even with the signing of peace in sight the sum of 66,500,000*l.* is asked for, in order to ensure the maintenance of the aerial supremacy which we have gained during the war.

It is exceedingly gratifying to note that the true value of research is at last being appreciated, and the specific provision of 3,000,000*l.* for "civil aviation, experiments, and research" will be welcome news to those who hope for the scientific development of commercial flying. Gen. Seely further points out that this sum does not by any means represent the total amount that will be spent on research beneficial to the civilian aviator, since the results of experiments carried out for military purposes and paid for out of the Army Estimates will be equally available for the improvement of commercial machines.

The Government has decided that it cannot itself undertake commercial flying, but that it will do everything in its power to give encouragement and protection, and it is already announced that the Postmaster-General is prepared to give contracts to private firms which are able to offer approved machines for postal services. Moreover, the Government will place most of the military aerodromes of the country at the disposal of civilian pilots for a small fee, and this alone should do much to encourage civilian flying.

In the course of his speech Gen. Seely announced that an important invention in wireless telephony had recently been made, by means of which the wireless operator in an aeroplane was able both to send and to receive messages. It was possible during the war for the leader of a scouting aeroplane squadron to communicate with the others, but it was not practicable to receive an answer. A vacuum valve generator was employed to generate smooth oscillations in the hanging aerial, and a vacuum valve magnifier with a crystal rectifier was used as the receiver. The experimental apparatus was in use in pre-war days, but it required years of research to make it practical and trustworthy. We congratulate the

Air Board research department on having overcome all the difficulties.

The promise for the future of aviation is very bright, and the recognition of the necessity for continuous research in the development of both military and civilian aeronautics leaves little doubt that the resources of scientific investigation, which have been of incalculable value during the war, will be fully employed in the solution of the problems of the future.

LUDVIG SYLOW.

THE death of Ludvig Sylow (September 7, 1918), at the age of eighty-five, has removed an eminent mathematician, whose career was in many ways remarkable. Sylow's seventh published paper ("Théorèmes sur les groupes de substitutions") occupies less than ten pages in vol. v. of the *Mathematische Annalen* (1872); this contains the proof of his justly celebrated theorem about groups, which has perhaps done more than any other single proposition to advance our knowledge of groups in general. In spite of this great achievement, Sylow had to earn his living as a secondary-school teacher until he had served a term of forty years. Recognition came at last; he was made professor at Christiania at the age of sixty-five, and filled the chair successfully for twenty years.

It may be of interest to recall Sylow's own statement of his theorem: "Si n^a désigne la plus grande puissance du nombre premier n qui divise l'ordre du groupe G, ce groupe contient un autre g de l'ordre n^a; si de plus $n^a v$ désigne l'ordre du plus grand groupe contenu dans G dont les substitutions sont permutables à g, l'ordre de G sera de la forme $n^a v(np+1)$." It should be noted that Sylow gives a proof that, if n^a is the highest power of n contained in the order of G, then G contains a subgroup of order n^a.

Sylow wrote a number of other papers, dealing with such topics as group-theory, solution of equations by radicals, elliptic functions, modular functions, etc. In collaboration with Lie he undertook the arduous task of editing the second issue of Abel's works. In this the misprints and oversights of the original edition are corrected, and a number of valuable notes and comments by the editors are added. G. B. M.

NOTES.

THE appointment of Dr. S. F. Harmer to succeed Sir Lazarus Fletcher as director of the Natural History Museum, South Kensington, is a happy solution of the question raised by the letter from twenty-three naturalists published in NATURE of March 6, and commented upon by us in the same issue. Dr. Harmer has been keeper of the Department of Zoology of the museum since 1907, and he will retain this position until the end of next year. During this transition period Mr. C. E. Fagan, the assistant secretary, will assist him in the control of the museum, and, in recognition of his valuable services, will occupy a considerably improved position on the staff. Mr. C. Tate Regan has been appointed assistant keeper of zoology in succession to Mr. W. R. Ogilvie Grant, who has retired. As the Trustees have appointed a distinguished naturalist to the directorship of the museum, the series of eminent scientific men who have occupied that post remains unbroken. It is the duty of men of science to guard jealously their claims to direct the affairs of scientific institutions, and to protest when any encroachment upon them is contemplated. In the present instance Mr. Fagan was more than a purely lay administrator, and his scientific services have been appropriately recognised by the Trustees. The tendency is, however, to place lay administrative officers in control of State institutions concerned with scientific work, on the ground that a man of science cannot be a good administrator. Even if this general belief, cherished in the Civil Service, could be justified—and we do not accept it for a moment—the highest office in a scientific institution should be held by a scientific man, and not by a lay official. That is the whole point of our contention, and we are glad that the Trustees have accepted what is the feeling of scientific men generally in regard to it by appointing Dr. Harmer to the vacant post, which he is highly qualified to fill.

LORD SUDELEY is to be thanked for having brought the House of Lords to such a high appreciation of museums as educational instruments that, on March 12, in the face of some Government objections, it wholeheartedly agreed to his motion:—"That his Majesty's Government should, without further delay, reinstate the system of providing official guide-lecturers for the museums and picture galleries under the control of the Government, which, with one exception, has been in abeyance during the war, making such addition to the numbers and in the salaries and status of the guides as may be found necessary." The Government, it seems, is prepared to reinstate the pre-war conditions, but is not prepared to increase the numbers or salaries of the guide-lecturers; neither does it act with promptness in clearing the museums of alien departments. There can be no doubt as to the popular feeling in this matter, and when, twice within a fortnight, it is supported in the Upper Chamber by men of such weight as Lords Crewe, Harcourt, Meath, Morris, Gainford, and Rathcreedan, then a Government which contains many sympathetic elements should surely be emboldened to spend the relatively minute sum needed to set all this valuable educational machinery in motion. His Grace the Archbishop of Canterbury urged that an increased number of guides would permit the extension of co-operation between the British Museum and the primary schools through lectures to the teachers, who would then take their classes to the museum; there could also then be an extension of similar aid to schools of art and secondary schools. Incidentally, the Primate took occasion to extol the merits of the British Museum guide-books, from which, he rightly said, visitors might derive much advantage. Can he be aware that the General Guide to the Natural History Museum has been out of print for some years, and that a sale of many thousands to the visiting troops and others has thus been lost? A new edition of this guide should be an early claim on the time of the new director.

THE question of long-distance wireless telegraph communication is now engaging the attention of a Committee recently appointed by the War Cabinet, with Lord Milner as chairman. The need for action

has long been felt, and the recent traffic delays in cable messages have accentuated the position. It is scarcely likely that the construction of stations will proceed on the lines decided upon some time before the outbreak of the war. For one thing, the developments which are said to have been made in long-distance wireless communications during the past four and a half years will bring about a modification of the engineering features of the original scheme, while the changed political situation will doubtless lead to some alteration in the location of stations. It is also a decided gain that some attempt at co-ordination is now being made in this country. Hitherto, while no fewer than five home Departments have been directly concerned in the matter, the Post Office has been the only Department to act for the State. The result has been long-drawn-out correspondence with other offices, very commonly culminating in nothing being done. Under the new plan each of the Government Departments concerned will be represented on the recently appointed Telegraph Communication Board. Thus the individual delegates, meeting round a table, will be able to thresh things out comparatively quickly and in a far more satisfactory manner than hitherto.

ONE result of the war is that the military objections to the construction of a tunnel between this country and France have been overcome, and the work may be sanctioned within a short time. In 1875 the Channel Tunnel Co. obtained powers for preliminary works at St. Margaret's Bay, Dover, and at the same time the French Submarine Railway Co. made surveys and started a heading at Sangatte. But in 1883 a Joint Select Committee of the two Houses of Parliament decided that it was inexpedient that sanction should be given for the construction of a tunnel. Investigations have, however, continued, the promoters believing that opposition would in time be overcome. The chalk cliffs on the two sides of the Channel are similar in all respects, and rest on a stratum of grey chalk 200 ft. thick, which is impervious to water. This overlies Gault, also impervious. The tunnel is to be constructed in the grey chalk, except that at one end it may possibly enter the Gault. The excavation is easy, and no exceptional engineering difficulties are anticipated. Two parallel tunnels, 20 ft. in diameter, will be constructed for up and down traffic. One or both ends will be carried some distance inland. The total length will be thirty-three miles, about twenty-four being under the sea. It is estimated that the tunnel can be completed in six or seven years at a total cost of 20,000,000*l*. Electric traction will be adopted, which diminishes the difficulty of ventilation, and the transit will occupy about forty minutes. A small difference in the track gauge here and in France presents no difficulty. But the French loading gauge is wider than ours, so that some trains could not pass over our lines unless an alteration is made on our side. The variety of loading gauges on different lines in this country is very objectionable.

OUR contemporary the *Chemist and Druggist* for March 8 is dissatisfied with the attempt made in our article on "The Profession of Chemistry" (February 27) to differentiate chemist and pharmacist. Exception is taken to "the desire to monopolise for professional chemists the title which, first of all, indicates the seller of poisons and dispenser of medicines. It is as unreasonable to claim the monopoly of the word 'chemist' for a small class of persons as it would be to restrict the title 'engineer' to those who build a bridge or the word 'doctor' to those men who hold a medical degree." Unreasonable or not, it has to be done, sooner or later, in the interest of the public, not of "a small class of persons." English is a strange language; the meanings of words are often curiously varied in course of time and whilst rich in many ways, in others it is remarkably deficient. Etymologically, "apothecary" is the keeper of a shop, a "pharmacist" or "pharmaceutist" one who has to do with medicines; the meaning of "druggist" is clear to everyone; "chemist" has no original meaning. Having the choice of three terms with definite, well-understood connotations, the sellers of drugs and poisons may surely be satisfied; they may well agree to relinquish the vague fourth term to those who are chemists in fact. "Doctor" is the equivalent of "Dozent" and well known to be a courtesy title like "esquire," no more descriptive as applied to medical practitioners, though a volume might be written on its history and the strange and careless way in which a specialised meaning has been attached to it, whilst "esquire" has lost its original value. The medical man, it may be said, who is neither a physician nor a surgeon is even worse off than the chemist, having no name which is distinctive of his status.

THE lively discussion which was waged over the Foxhall human mandible in the sixties of last century is likely to be again revived by the advertisement inserted by Mr. Reid Moir in the personal column of the *Times* and in last week's NATURE. Mr. Moir, as is well known, has discovered and described many worked flints in the detritus bed which underlies the Red Crag of Suffolk, but no particle of man's body has yet been found at the same geological horizon with the exception of the Foxhall jaw, which, it is alleged, was derived from the detritus or coprolite bed. The mandible was in the possession of Dr. R. H. Collyer, who described it in the *Anthropological Review* of 1867; Dr. Collyer is said later to have gone to the United States, and with him the disputed specimen disappeared. It will be interesting to see if Mr. Moir's advertisement will succeed in recovering the missing mandible. Dr. Collyer's figure shows very plainly that the mandible belonged to a man of the modern type, and is remarkably similar in form to the equally hotly contested Moulin Quignon specimen found by Boucher de Perthes in the earlier Palæolithic strata near Abbeville in 1863. When Dr. Hugh Falconer and Mr. George Busk subjected the Moulin Quignon jaw to certain tests, they also applied them at the same time to the Foxhall specimen, and came to the conclusion, because of the amount of organic matter contained in them, that neither specimen could be regarded as contemporary with the strata in which it was alleged to have been found. The criteria which they applied, however, cannot be regarded as definitely deciding the authenticity of these two human "documents."

THE opposition raised both inside and outside the House of Commons, by members of the medical profession particularly, against the proposal in the Ministry of Health Bill to reconstitute the Medical Research Committee under the direction of a Committee of the Privy Council rather than under the Health Ministry was apparently not without its effect. Dr. Addison has, indeed, now issued a memorandum on the subject, setting out the advantages likely to follow the adoption of the proposed scheme, and the disadvantages which would result from its rejection. The claims made on behalf of the scheme of reconstruction are briefly that, in the realm of medical research, there will be obtained complete concentration in a central body acting for the United Kingdom as a whole, and not only for England and Wales, the area in which the new Ministry will operate; also that, in respect of all medical research questions, a

wider exchange of knowledge will be secured, for the reason that the Privy Council is the only body having an Imperial range. Finally, under such a scheme, the Committee would be freed from undue pressure by the immediate interests of any one Department, particularly the Ministry of Health. So far as the latter is concerned, the memorandum hastens to point out that there must be very special links as between it and the Committee, and arrangements to secure these would have to be made. Another point to which prominence is given is that, even with a Research Committee and special researchers, there need be no limiting of the efforts of the Ministry in the matter of scientific investigations, and at any time researches could and would be made through the staff of the Ministry. The memorandum, which is signed by Dr. Addison, is supported by a statement by Sir W. M. Fletcher, the secretary to the Research Committee, in favour of centralisation, for the reason chiefly that researches carried out on behalf of one Department so frequently yield accessory results of value to others. There was a considerable amount of discussion upon the subject when the Bill came before the Standing Committee on March 13, and Major Astor was obliged to accept an amendment making it clear that, in addition to an independent Medical Research Committee under the Privy Council, there would be a definite research department under the new Ministry. Probably this is the best way out of the difficulty, and both parties may be content to accept the compromise. The Standing Committee of the House of Commons adopted on March 18 an amendment providing that all the powers and duties of the Board of Education with respect to the medical inspection and treatment of children and young persons should be transferred to the Ministry of Health.

THE death is announced, at seventy-five years of age, of Col. F. P. Washington, R.E., for many years connected with the Ordnance Survey, and from 1898 to 1908 a director of the Survey and Map Department of the Land Registry.

A WIRELESS PRESS message states that the German Government has decided to return to China the astronomical instruments which were transported from Pekin to Germany in 1900. Negotiations have been opened for the shipping of the instruments to China.

THE annual general meeting of the Chemical Society will be held at Burlington House on Thursday, March 27, at 4 o'clock, when the retiring president, Sir William J. Pope, will deliver his address, and a ballot for the election of the new council will take place. The anniversary dinner of the society will be held the same evening at the Connaught Rooms, Great Queen Street, W.C.2.

DR. L. A. BAUER left Washington early in March for England, where he will organise an expedition, of which Mr. Frederick Brown, of London, will be a member, for magnetic and electric observations during the solar eclipse of May 29 next at a station in South Africa. Dr. Bauer expects next to proceed to South America and arrange for similar observations during the eclipse there. While in South America he will visit various institutions, and return to Washington next July.

THE death is announced, in his seventy-third year, of Mr. Louis E. Levy, of Philadelphia, who took out in 1875 the first patent granted to an American citizen in the field of photo-chemical engraving. Mr. Levy received medals from the Franklin Institute for his invention of the "Levy line screen," the "Levy acid blast," and the etch-powdering machine. His discoveries were also recognised by the expositions at Chicago in 1893, Paris in 1900, and St. Louis in 1904. Mr. Levy had been president of the Graphic Arts Co., of Philadelphia, since 1908.

THE deaths of the following engineers are recorded in the *Engineer* for March 14:—Alderman Thomas Canning, associate member of the Institution of Civil Engineers, who was appointed engineer and manager of the Newport Gas Co. in 1874, and held office up to the time of his death; Mr. R. W. A. Southern, member of the Institution of Mining Engineers, a mining engineer well known in South Wales as a colliery manager, and in private practice; and Mr. G. H. Hill, member of the Institution of Civil Engineers, and largely responsible for the water supply of Manchester, especially in connection with the Thirlmere scheme.

THE Salters' Institute of Industrial Chemistry has awarded fellowships for post-graduate study in the universities or colleges indicated to Messrs. W. H. Gough and W. A. Haward (Imperial College of Science and Technology), Capt. L. J. Hudleston (Reading), Lieut. K. H. Saunders and Mr. Gordon M. Wright (Cambridge), Mr. P. N. Williams (Liverpool), and Mr. Dudley C. Vining (Finsbury Technical College). Through the generosity of certain leading firms, the institute hopes shortly to announce further appointments; those who have already provided funds for assisting the purpose of the institute are Messrs. Borax Consolidated, the Mond Nickel Co., and Lever Brothers.

THE council of the Royal Institute of Public Health is arranging for a conference in the Guildhall, London, on "Problems of Reconstruction in Relation to Public Health" on June 25–28. The opening meeting will be held in the Egyptian Hall of the Mansion House on Wednesday, June 25, when the Lord Mayor of London will preside. The conference will be devoted to the work of the Ministry of Health, the prevention and arrest of venereal disease, housing in relation to national health, maternity and child welfare, and the tuberculosis problem under after-war conditions. Full particulars may be obtained on application to the Secretary, Royal Institute of Public Health, 37 Russell Square, W.C.1.

THE *Times* of March 17 gives an account from its correspondent at Sydney of a remarkable Australian rainfall. It states that "the extraordinary rainfall at Melbourne threatens the greatest flood since 1891. The south-eastern corner of Victoria and New South Wales is almost engulfed. At Port Melbourne factories have been swamped." At the time of the report, March 7 (delayed), rain was still falling. "At Macedon 8 in. were registered in twenty-four hours, and other watersheds have been converted into lakes. Thousands of persons are homeless. Thirteen inches of rain in twenty-four hours has practically drowned the township of East Bellingen, in New South Wales. . . . Although the damages are estimated to aggregate tens of thousands of pounds, the benefits from the breaking of the drought will be represented by hundreds of thousands."

WE regret to have to record the death on February 16, from pneumonia following influenza, of Mr. R. W. H. Row, lecturer in zoology at King's College, London. Although only thirty-four years of age, Mr. Row had already done much to advance the science to which he had devoted himself, both as a teacher and as an

investigator. He had, partly in co-operation with Prof. Dendy, published several memoirs on sponges, on which he had become a recognised authority. Since 1914 Mr. Row had been responsible for the section of the Zoological Record and International Catalogue of Scientific Literature dealing with this group of animals. After the outbreak of the war he devoted himself largely to protozoology from the pathological point of view, working under Sir Ronald Ross, and at the time of his death, in addition to his ordinary duties, he was in charge of the malaria laboratory at the 4th London General Hospital. Besides the routine work of blood examination, etc., Mr. Row managed to do a good deal of original work in this branch of zoology. He left much unfinished work behind him, and the loss to zoological science occasioned by his death is great.

THE Royal Geographical Society announces that the King has been pleased to approve the award of the Royal medals as follows:—The Founder's medal to Col. E. M. Jack for his geographical work on the Western Front, and the Patron's Medal to Prof. W. M. Davis, of Harvard University, for his eminence in the development of physical geography. The Victoria medal is awarded by the council to Prof. J. W. Gregory for his many and important contributions to geographical science; the Murchison grant to Dr. W. M. Strong, of the North-Eastern District, Papua, for his journeys and surveys in New Guinea; the Cuthbert Peek grant to Prof. Rudmose Brown for his geographical work in the Antarctic and in Spitsbergen; the Back grant to the Ven. Archdeacon Stuck, of Fort Yukon, for his travels in Alaska and ascent of Mount McKinley; and the Gill memorial to Mr. W. J. Harding King for his investigations of desert conditions in northern Africa.

THE *Times* of March 13, under the heading of "Influenza Worse than Many Plagues," gives a startling statement from its Delhi correspondent based on a Government report of the influenza epidemic by Major Norman White, who has just vacated the position of Sanitary Commissioner, which he had filled with distinction. "Major White declares that from the incomplete information available it would appear that no country has suffered as severely from the disease as India during the last quarter of 1918. Without fear of exaggeration, it can be stated that influenza was responsible for six million deaths, equivalent to more than half the mortality attributable to plague in the twenty-two years during which plague has been epidemic in this country. Five million deaths occurred in British India, and one million in the native States." Major White states that the incidence of the epidemic "was very high among the well-fed British troops, higher, indeed, than among the Indian troops." In his report he says: "It can be stated without exaggeration that from 50 to 80 per cent. of the total population have recently suffered from influenza."

THE Registrar-General's return for the week ending March 8 gives the following highly satisfactory statement:—"The influenza epidemic appears now to have passed its most severe stage, the number of deaths registered in the ninety-six great towns having declined from a maximum of 3889 in the week ended March 1 to 3218 last week, and in London from 808 to 597." The general health of London has also improved, the annual death-rate per thousand of the aggregate population having further decreased from 32·4 in the preceding week to 26·6 in the week ending March 8. The deaths from influenza are, however, still very high, being more than double those in any week during the summer epidemic of 1918, and more than one-half of the total deaths in the eight weeks of that epidemic, also larger than in any week of any previous epidemic since 1890, 560 deaths in a single week during the attack in 1892 being until the present epidemic the highest on record. The epidemic which started in London during the week ending October 12, 1918, has now continued for twenty-two weeks, causing 14,344 deaths out of 45,262 total deaths from all causes; the deaths, however, fell below 100 during each of the six weeks from the end of December last year to the commencement of February this year.

ON March 5 the Natural History Museum Staff Association held in the board room of the museum, by permission of the Trustees, its inaugural scientific reunion. The object of these meetings, which it is intended at first to hold about four times a year, is twofold: in the first place, members of the staff will be afforded an opportunity of meeting one another and of seeing something of the work done in departments other than their own, and, in the second, scientific workers outside the museum, who are invited to attend, will have an opportunity of seeing some of the more interesting of the specimens which have been recently added to the collections, and also of becoming acquainted with some of the research work carried on at the museum. The number of visitors is necessarily limited, because the capacity of the board room—the only room available—is not great. Major E. E. Austen, of the Entomological Department, gave an interesting lecture on the anti-mosquito work carried out in Palestine during the campaigns of 1917 and 1918. The exhibits included the following:—A series of skulls of whales found round the British Isles, a case illustrating the depredations of marine boring animals, the Church collection of precious stones, a slice of the Skookum meteorite, specimens illustrating curvature in crystals, Carragheen moss and invalid dishes made with it, specimens showing mechanical adaptation in labroid fishes, some of the suite of butterflies in the Dollman collection, German substitute tobacco, etc.

THE British Association Fuel Economy Committee, which was originally appointed in 1915, and issued its first report in 1916, has, owing to the urgency and importance of the coal situation and fuel economy in connection with reconstruction problems, been reappointed to continue its investigations upon the various economic, scientific, and technical issues connected with the production and utilisation of coal and other fuels. Prof. W. A. Bone has been reappointed chairman, with Mr. H. James Yates as vice-chairman, and Mr. Robert L. Mond as secretary. The general committee of thirty-three members includes representatives of the Association of British Chemical Manufacturers, Coke-Oven Managers' Association, Federation of British Industries, Institution of Electrical Engineers, Institution of Gas Engineers, Institution of Mechanical Engineers, Institution of Mining and Metallurgy, Institution of Mining Engineers, Iron and Steel Institute, Society of British Gas Industries, and Society of Chemical Industry. The executive committee, which consists of Sir Robert Hadfield, Sir Joseph Walton, M.P., Profs. W. A. Bone, Henry Louis, and W. W. Watts, Dr. H. S. Hele-Shaw, Messrs. A. Hutchinson, Robert Mond, W. H. Patchell, H. Woodall, C. H. Wordingham, and H. James Yates, meets in London on the second Wednesday in each month. The Committee is now compiling data

and information concerning a number of subjects of public interest, including, *inter alia*, such questions as (1) the economic aspects of coal production in Great Britain, (2) low-temperature distillation of coal, (3) future standards for public gas supplies, and (4) the proposed electric power scheme, etc., and invites individuals, firms, or institutions who may possess information of value to place it at the disposal of the Committee. All communications should be addressed to Prof. W. A. Bone at the Imperial College of Science and Technology, South Kensington.

WE regret to record the death on February 28, in his fifty-eighth year, of Mr. F. C. Forth, principal of the Municipal Technical Institute, Belfast. Mr. Forth's death has removed from that city, and from Ireland generally, a potent force in the promotion of scientific and technical instruction and training. On the passing of the Agriculture and Technical Instruction (Ireland) Act of 1899 the Corporation of Belfast took immediate steps to inquire into the facilities for technical instruction existing in Belfast and found them totally inadequate, only five institutions existing with some seven or eight hundred students enrolled. It thereupon decided to appoint a principal and director of technical instruction and to prepare a scheme for a new building, and in 1901 Mr. Forth, then vice-principal of the School of Technology, Manchester, took up the post. An admirable site was secured, and with the aid of the new principal, whose knowledge and experience gained in Manchester proved of singular service, a splendid building, standing on upwards of 5000 square yards in one of the principal avenues of Belfast, was erected, calculated to serve the best interests of the great engineering, textile, and other industries of the city. The foundation-stone was laid in November, 1902, and the building opened by the Lord-Lieutenant in 1907; and the institute has now an enrolment of 7000 individual students. Mr. Forth was a born teacher and organiser, able to infuse his enthusiasm into both students and colleagues. In 1915 he was elected a fellow of the Royal College of Science, Ireland, "in consideration of the manner in which, through your work as an educationist in the field of technical instruction, you have contributed to the advancement of science in Ireland." At a special meeting of the Library and Technical Instruction Committee of the Belfast Corporation a resolution was passed recording its sense of the profound loss sustained by the corporation and the city generally in the death of the highly esteemed and brilliantly successful principal of the Municipal Technical Institute, Mr. F. C. Forth.

A MEETING of the Illuminating Engineering Society on February 25, when the lighting of railways was discussed, was attended by representatives of a number of the leading railways. Mr. A. Cunnington, lighting engineer to the London and South-Western Railway, who read the introductory paper, remarked that by the aid of available experience tentative standards for the lighting of platforms, goods sheds, and goods yards could now be formulated. Stations were divided into three classes, the specified illumination being 0·5, 0·25, and 0·035 foot-candle respectively, measured in a horizontal plane 3 ft. above the platform. In goods sheds, values about twice as high were suggested. A number of special installations were described, including corridors, parcels offices, and signal-boxes. In the discussion, the importance to railway companies of employing an expert in lighting to deal with all problems connected with illumination was strongly emphasised.

OUR ASTRONOMICAL COLUMN.

PHOTO-ELECTRIC DETERMINATIONS OF STELLAR MAGNITUDES OF PLANETS.—*Astr. Nach.*, No. 4976, contains a paper by P. Guthnick on the application of this very accurate method to the determination of the stellar magnitudes of Saturn and Mars. The individual results show that the probable error of a determination is in the neighbourhood of 0·01m. The results of a comparison of Saturn with Pollux are given for four oppositions; after allowing for the changing aspect of the ring they are practically constant, and show that without the ring the planet is just 1/3 mag. brighter than the star. As two of the oppositions were at sun-spot minimum and two at maximum, the inference is also drawn that there is no sensible variation of sunlight in the course of the cycle. Very numerous comparisons of Mars with standard stars were made; the results are grouped according to longitude of central meridian, and show that the planet is variable to the extent of 1/6 mag., according to the portion presented to us. The light-curve obtained is consistent for the same opposition, but varies from one opposition to another with the different pose of the planet's equator and the amount of snow or cloud that is present on the disc.

NOVA AQUILÆ.—The Monthly Notices of the Royal Astronomical Society for December last contains papers on this nova's spectrum by the Rev. A. L. Cortie and Dr. J. Lunt. The former reproduces six spectra photographed in June and July, which illustrate the development of the hydrogen bands. Both papers give wave-length tables and identifications; lines due to iron, titanium, chromium, scandium, barium, helium, calcium, etc., are identified. Both also note that the line-of-sight velocities fall into two groups, one of the order of −1500 km./sec., the other of the order of −800 km./sec.

The same issue of the Monthly Notices contains a paper by Dr. A. A. Rambaut on the visual magnitudes of the nova from June 9 to December 10; the table shows a well-marked periodic variation with a period of eleven days during July and August; after correcting for the progressive decline, the range from maximum to minimum was just half a magnitude.

THE VARIABLES OF LONG PERIOD.—Many astronomers have of late inclined to the theory that the red variable stars, of types M and N, are dwarf stars, near the end of their career as suns, on which an incipient crust is forming. Mr. W. Gyllenberg, of the Lund Observatory (*Arkiv för Matematik, Astronomi och Fysik*, K. Svenska Vetenskapsakademien, Band 14, No. 5), examines the question of their distances by means of their proper motions. Contrary to the above dwarf theory, he finds that the stars are very distant, and must be classed as giants, their mean absolute magnitude at maximum (at a distance of 10 parsecs) being −0·65, making them comparable in absolute lustre with stars of the types B8 to A2. The mean velocity in all directions comes out as 37·7 km./sec., in admirable accord with the value 36·4 found by Mr. Paul W. Merrill (*Astrophysical Journ.*, xli., 247) from motions in the line of sight.

Adopting the above mean absolute magnitude, and plotting the distances of the stars from their brightness, they show greater extension in the galactic plane than perpendicular to it, which confirms the conclusion that they are distant. The denser parts of the system extend to 3000 L.Y. in the plane, 1000 L.Y. perpendicular to it. The distances found for the M variables accord well with those previously found for non-variable giant stars of type M. It thus appears that long-period variability is an incident in the early history of star-life.

REPORTS OF THE AUSTRALIAN ANTARCTIC EXPEDITION.

THE scientific results of the Australian Antarctic Expedition are being published with commendable promptitude. Of the five parts recently received the most generally interesting is the report on the Brachiopoda by Dr. J. Allan Thomson, Wellington, N.Z. The Brachiopods recorded, though not many in number, are relatively rich in species, a new genus, Amphithyris (family Terebratellidæ), and new species of seven other genera being described. The author gives a summary of the known distribution of Brachiopods in South Temperate and Antarctic seas, and discusses the bearing of the facts on the theories of southern land connections, "which it is one of the aims of Antarctic expeditions to prove or disprove." He points out that the known larvæ of Brachiopods, with the exception of those of Lingula and Discina (*sensu lato*), have no mouth during the free-swimming stage, and that they soon settle down. Consequently, the deep oceans are barriers which Brachiopods, the majority of which live on the submarine slopes of continents and adjacent islands, and their larvæ cannot cross, and therefore cases of discontinuous distribution of these shallow-water forms have an important significance.

Dr. Thomson considers there is abundant evidence, from the associated molluscan fauna, that the Patagonian (Miocene) of South America and the Oamaruian (older Tertiary) of New Zealand had a much warmer climate than the present, and that the occurrence of the same Brachiopod genera and species in the Oligocene-Miocene of the Antarctic strongly suggests that at this period the Antarctic seas were also warmer. Mr. Tate Regan, in his report on the *Terra Nova* fishes, inclined to the view that the coasts of Antarctica were washed by cold seas probably throughout the Tertiary period, but in Dr. Thomson's view the geological evidence all points the other way.

From a consideration of the distribution of the Brachiopods he arrives at the following conclusions: Connections—not necessarily land-bridges, but chains of islands or shallow submarine ridges—must have existed between Australia and South Africa at some date prior to the Tertiary, by which the primitive genera of the Terebratellidæ attained their present distribution in South Africa, St. Paul's and Marion Islands, Australia, and New Zealand. The specific and generic distinctness of the recent New Zealand and Australian forms precludes any land connections between these areas in Pliocene or later times. The two groups of Terebratellidæ concerned would seem to have originated on the coasts of Gondwana Land, on the remnants of which they now survive; the Kerguelen area apparently did not share in the connection with Gondwana Land. Connections between Australia, New Zealand, the Macquarie Islands, Kerguelen, Antarctica, and South America must have occurred in the early Tertiary, but New Zealand was not connected at the same time with Australia and Antarctica. The connections between New Zealand, Antarctica, and South America may have existed from an earlier period. It does not appear probable that Australia was connected directly with Kerguelen and Antarctica during the Cretaceous or early Tertiary. The southern connections were broken, much as at present, by Miocene times, and since that period there have been no renewed connections between the southern continents and island areas except, possibly, between South America, Antarctica, and the adjacent islands.

Dr. W. G. Ridewood records (vol. iii., part 2), from off Adelie Land and Queen Mary Land, four species of Cephalodiscus—*hodgsoni*, *nigrescens*, *solidus*, and *densus*—and gives details of the external features of the colonies and notes on the colour and structure of the zooids. For further details of these species reference may be made to Dr. Ridewood's recent report on the specimens of Cephalodiscus collected by the British Antarctic (*Terra Nova*) Expedition, a notice of which will appear in another issue of NATURE.

A brief account of the Euphausiacea and Mysidacea is given by Dr. W. M. Tattersall (vol. v., part 5), and of the Cumacea and Phyllocarida by Dr. W. T. Calman (part 6).

Prof. A. Dendy (vol. vi., part 1) reports on the calcareous sponges. The Antarctic forms comprise two new species of Leucetta, a new species of Leucandra, and a new variety of Grantia. In the account of the monaxon spicules of a variety of *Leucosolenia botryoides* from Macquarie Island, Prof. Dendy takes the opportunity of correcting an error in the late Prof. Minchin's well-known memoir on the British species of this genus. Minchin considered that the monaxons of Leucosolenia were separable into two kinds, one very refringent, the other much less so, the refringent monaxons being fewer, straighter, more slender, and having the distal barb less distinct or absent. Prof. Dendy points out that the explanation of these differences is simply that some of the monaxons were viewed as they lay on edge, while others were seen lying flat.

NEW PROCEDURE AT AMERICAN MAGNETIC OBSERVATORIES.

IN accordance with the usual practice of the United States Coast and Geodetic Survey, two years, 1915 and 1916, are dealt with in the *Results of Observations* at the magnetic observatories at Sitka and Honolulu, which have recently been published. In previous years the curves were read unsmoothed exactly at the hour local mean time. Commencing with 1915, the hourly value represents the mean ordinate for sixty minutes ending with the hour of the 135th meridian at Sitka (135° 20·1′ W.), and of the 165th meridian at Honolulu (158° 3·8′ W.). The value entered, for instance, under 2h. really belongs to 1·5h. Diurnal inequalities continue to be given, as in the past, only for 10q (quiet) days a month chosen locally, and for the 5q (international quiet) days, but hourly means are given for all days. The adoption of mean ordinates instead of instantaneous readings is in accordance with what is now probably the usual practice. Unless it is followed, all-day diurnal inequalities for disturbed months are apt to be very ragged. But the adoption of means for sixty minutes ending at the hour, instead of sixty minutes centring at the hour, is a practice not generally followed except in Germany. Even if the procedure had distinct advantages over the ordinary one, its spasmodic adoption by individual observatories or in individual countries has the serious drawback of introducing diversity where uniformity is desirable. This is especially true of the international quiet days, the special object of which is to supply exactly corresponding data from different observatories.

The advantage claimed for the new procedure is that it makes the day self-contained, whereas with the ordinary procedure the values for the first and last midnights depend, one on the last half-hour of the previous day, the other on the first half-hour of the following day. This argument has much weight in the case of elements like rainfall or duration of sunshine, where we deal with aggregates. But in the case of magnetism the procedure does not really make

the day self-contained unless we neglect the n.c. (non-cyclic) changes, which are seldom really negligible. These changes should, in any case, be explicitly shown, as they are generally in part of instrumental origin. The only reference to them at Honolulu seems to be a statement that they have been allowed for in the case of the 5q-day inequalities. At Sitka there is the further statement that, so far as possible, days with large n.c. changes have not been chosen for the 10q days. It would be interesting to know how the n.c. corrections were found for the 5q days, and whether they were entirely omitted for the 10q days.

An idea of the size of the n.c. changes on quiet days can usually be derived from the size of the difference between the mean daily values for these days and for all days. From the twenty-four monthly means of 1915 and 1916 given for all days and for the 10q days, we find for the mean algebraic excess of the latter class over the former +6·0γ in H (horizontal force) and +5·4γ in V (vertical force) at Sitka, and +7·5γ in H and −1·1γ in V at Honolulu. In D (declination) the mean difference between the two sets of mean values is only about 0·05′ at both stations. The 5q days give very nearly the same mean daily values as the 10q days. We should naturally infer that while the n.c. change may be negligible in D, it is probably by no means negligible in H at either station, or in V at Sitka. Confirmatory evidence is derivable from the highly disturbed days, the characteristics of which are usually the direct opposite of those of quiet days. If we take as representing disturbance the five days of largest daily range in each month, we find that on the average the monthly mean values derived from these days fall short of the corresponding all-day means by 14·4γ in H and 15·3γ in V at Sitka, and by 9·1γ in H and 2·3γ in V at Honolulu. Disturbance in V is unusually large at Sitka, and exceptionally small at Honolulu, which, presumably, explains the large difference between the mean values from the 5q and 5d days at the former station, and the small difference at the latter station. If a diurnal inequality were to be derived from the 5d days, as has recently been suggested, the n.c. element would almost certainly be of great importance at Sitka in H and V.

Another feature wanting explanation is that the 5q days are shown in the tables as days of 165° W. at Honolulu, and as days of 135° W. at Sitka, whereas they are really 24-hour periods commencing at Greenwich midnight. It is to be hoped that this is only camouflage, just as when values belonging really to 1·5h. are entered under the heading 2h., because considerable disturbance is occasionally experienced within less than nine hours of the end of true international quiet days. Explanation on this point, on the n.c. changes, and on the effect on the ranges of the diurnal inequalities consequent on the change of procedure would be welcome in the next issue of these valuable publications.

C. CHREE.

FOREST RESEARCH IN EUROPE.

A USEFUL account of forest research in Europe by Mr. S. Howard has appeared in the *Indian Forester* for September last. "Forest research, in many instances, necessitates observations over long periods of time, longer than an individual man's working years, and over widely separated areas. Some institution is necessary, therefore, to direct methods for the sake of uniformity, and to continue ideas, despite the necessary changes in the research *personnel*." Germany was the first country to organise research, this movement dating from 1868, when it was proposed at a meeting of prominent foresters at Regensburg that the larger States, Austria, Prussia, and Bavaria, should have independent research institutes. It was finally decided in 1870 that forest research should be properly organised, and that the research institutes in all the States were to be combined with the educational branch—that is to say, the president of the forest college was also to be president of the research institute. In 1912 all German States of importance had their forestry institutes (in each case combined with the college of forestry) united under the German Forest Research Association, which meets, as a rule, twice a year. The Prussian Research Institute, united with the Forestry College at Eberswalde, has six branches, dealing with sylviculture, physical chemistry, meteorology, plant physiology, zoology, and mycology.

Besides the headquarters at Eberswalde, there are numerous experimental plots of trees all over Prussia. These were at first put under the local forest officer, but this proved a failure; and for more than twenty years all work connected with the plots has been done by the research staff at Eberswalde. The sylvicultural branch compiles yield tables and statistics, and has carried out investigations on exotic trees, root-formation, manures, technical properties of wood, seed tests, etc. It is to be noted that the tests of strengths of wood and the like are done by technical experts at Charlottenburg, and not by the Forest Research Institute. The meteorology branch is especially concerned with experiments on the influence of forests on climate. The plant physiology branch is purely botanical, and takes up subjects like the formation of annual rings, the influence of locality on seeds, the influence of soil factors on trees, etc. The zoology branch is concerned with zoological researches, so far as they concern forests, and with control methods; the physical chemistry branch with the chemistry of soils, the formation of humus, the formation of pan, etc.; and the mycology branch with mycology in its relation to forestry and control methods.

Forest research was organised in France in 1882, but was hopelessly carried out. Experiments were begun, but were usually badly organised and badly performed, and ceased absolutely between 1896 and 1902. The research work proposed in France was to cost 1200*l.* per annum. Germany has actually been spending 6000*l.*, Switzerland 2000*l.*, and Sweden, roughly, 880*l.* a year.

Mr. Howard gives also an account of the International Forest Research Association, which met at Mariabrunn in 1893 and 1903, at Brunswick in 1896, at Zurich in 1900, and at Brussels in 1910. Most European countries are members, but France is not, or, if she is, has taken no active part. The usefulness of these international meetings was undoubted. For example, it was soon found essential to have some classification of thinnings, if results were to be comparable. The Prussian classification was adopted in 1903.

THE CONSERVATION OF OUR CEREAL RESERVES.[1]

THE dangers to which grain stored under ordinary conditions is exposed may be classified under four heads:—(1) The attacks of rats and mice, (2) those of insects and mites, (3) those of moulds and bacteria, and (4) the process known as "heating." The amount of damage due to rats and mice is, no doubt, enormous, but might be avoided by any rational system of storage, and is a matter

[1] Abstract of a lecture delivered at King's College, London, on March 12, under the auspices of the Imperial Studies Committee of the University London, by Prof. Arthur Dendy, F.R.S.

for legislation rather than for scientific investigation. The chief insect pests in this country are the two grain-weevils, *Calandra granaria* and *C. oryzae*, while in India two other beetles, *Rhizopertha dominica* and *Trogoderma khapra*, are also responsible for much direct injury. Experiments on the rate of multiplication of the weevils show that at suitable temperatures they breed all the year round, but in this country normally only in the warmer months. At about 28° C. a single pair of rice-weevils increased about seven-hundred-fold in four months. The accumulated excrement of the weevils attracts moisture and promotes decomposition, accompanied by the evolution of large quantities of ammonia, and in this way the destruction commenced by the ravages of the insects is completed. The process of heating is the result of enzymic action in the wheat itself, sometimes inaccurately spoken of as respiration, though fermentation would be a better term, which increases with rise of temperature (up to about 55° C.) and moisture content (Bailey and Gurjar). In the eyes of the trade, heating appears to be a much more serious danger than weevilling. It is at present avoided by abundant ventilation, the grain being turned over as soon as the temperature becomes dangerously high, so as to cool it and carry off moisture.

As an effectual means of preventing damage from all these sources, airtight storage should be resorted to. Unfortunately, however, considerable doubt has been thrown on the efficacy of this ancient method by a widespread belief in the ability of weevils to withstand such treatment. This belief rests entirely upon inaccurate observations. Thus we find that tins which are supposed to be hermetically sealed, and look perfectly sound, are often leaky, as can easily be shown by placing them in hot water, when air bubbles out. Numerous experiments made at King's College by the lecturer and his colleague, Mr. H. D. Elkington, who is responsible more especially for the chemical analyses, prove conclusively that all insects present are more or less rapidly destroyed when weevilly wheat is sealed up in airtight receptacles which it nearly fills. This method of treatment destroys the weevils in all their stages, and is also fatal at any rate to adult mites. The same treatment also prevents the growth of moulds and the process of heating. Two Dewar flasks, filled with grain having a moisture content of 20·7 per cent., were incubated at about 28° C. One was merely plugged with cotton-wool and the other hermetically sealed. In the former the temperature gradually rose to 49·4° C., while in the latter it remained almost stationary. The life of insects and moulds and the process of heating alike depend upon the supply of oxygen, and where this is cut off no damage from these sources need be feared.

It has been demonstrated experimentally, not only that weevils require an abundant supply of oxygen, but also that carbon dioxide, if present in sufficient quantity, has a directly poisonous action upon them. In pure, moist carbon dioxide they become motionless in three minutes, and can remain in this condition for as much as four days (at room temperature) without losing the power of recovery. A mixture of carbon dioxide with 20 per cent. of oxygen is far more fatal than pure carbon dioxide. This is probably because, in the absence of oxygen, their metabolism is more or less completely suspended, so that the carbon dioxide is unable to exercise its poisonous effect. In a mixture of 56·4 per cent. nitrogen, 20·36 per cent. oxygen, and 23·22 per cent. carbon dioxide weevils became motionless in forty-three hours (at about 30° C.), and after ninety-one hours' exposure, though 19·09 per cent. of oxygen still remained, none revived when supplied with ordinary air.

When wheat is sealed up in a normal atmosphere carbon dioxide accumulates naturally owing to the so-called respiration of the grain, the rate of accumulation depending upon temperature and moisture conditions. At ordinary room temperature (July to October) in three months 300 grams of English wheat, having a natural moisture-content of 15·9 per cent., gave off 58·6 milligrams of carbon dioxide, sufficient to raise the percentage of that gas in the air in the receptacle (which was nearly filled with wheat) to 18·13. If insects also be present, the carbon dioxide accumulates more rapidly owing to the large amount which they themselves give off. It thus appears that in hermetically sealed granaries completely filled with grain there should be no need for any artificial addition of carbon dioxide such as has sometimes been recommended, and, indeed, actually made, for the purpose of destroying weevils. Under proper conditions, which ought to be experimentally determined on a large scale, the grain must become self-protective as regards weevilling, mildew, and heating, to say nothing of rats and mice. Any damage which might arise while the carbon dioxide was accumulating would probably be negligible.

The construction of airtight granaries or silos is a problem for the engineer, but there seems to be no insuperable difficulty in the way. If such granaries existed in the large wheat-growing countries the grain might be completely sterilised as regards insect-life by storing for a suitable period before shipment, and the very serious weevilling which often takes place on board ship might be avoided. Moreover, it would be possible to equalise shipments all the year round and avoid the rush to get the grain away after harvest. Airtight storage would also, in all probability, afford by far the best means of maintaining reserves of grain to meet emergencies such as war and failure of crops.

Further details have been, and will be, published in the reports of the Grain Pests (War) Committee of the Royal Society, under the auspices of which these investigations have been carried out.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Joseph Barcroft, F.R.S., of King's College, has been appointed reader in physiology; Mr. A. V. Hill, F.R.S., of King's College, University lecturer in physiology; and Dr. Hartridge, of King's College, University lecturer in the physiology of the senses.

The adjudicators for the Adams prize have proposed as the subject for the prize for the period 1919–20 "The Nature and Analysis of Optical Spectra."

LIVERPOOL.—The council of the University has accepted with great regret Prof. Herdman's resignation as from September 30 next of the Derby chair of natural history, which he has held since 1882. As announced in NATURE of February 27, Prof. Herdman will occupy the new chair of oceanography, without salary, for a period of one year from October 1 next, and this tenure will perhaps lessen the severity of the wrench he must feel at severing his long professorial connection with the University. He will be greatly missed by the University staff and students, but freedom from lectures and administrative duties will give him much more time for research, to which he proposes to devote his remaining working years.

Throughout his long period of service in the University Prof. Herdman's interest in marine biology and oceanography has made the department a very notable one, and established a tradition for it which scientific men will hope to see maintained. In 1885 he brought together the local biologists and started the Liverpool Marine Biology Committee, and a year later the Liverpool Biological Society. The committee established itself in its first biological station at Puffin Island, in Anglesey, and five years later at Port Erin, in the Isle of Man, in a laboratory which has grown continuously since its foundation, and has now become very well known. In 1892 Prof. Herdman became honorary scientific adviser to the Lancashire Sea Fishery Committee, which established the present fisheries laboratory at the then University College, and some years later the Biological Station and Hatchery at Piel, in Barrow. As the result of all these activities the general and fishery biology of the sea off Lancashire, Wales, and the Isle of Man has now become better known than any other similar area off these islands. Two years ago Prof. and Mrs. Herdman endowed a chair of geology at Liverpool in memory of their son George, who was killed in the war, and the chair of oceanography recently established by them will be a most suitable means of maintaining and extending those investigations which Prof. Herdman began and has done so much to stimulate and promote.

AT the recent commemoration day exercises of the Johns Hopkins University, it was announced, says *Science*, that a sum of approximately 80,000*l.* had been given anonymously for the erection of a building to serve as a woman's clinic at the Johns Hopkins Hospital.

THE committee appointed by the British Association comprised of Mr. C. A. Buckmaster (chairman), Mr. D. Berridge (secretary), Mr. C. H. Bothamley, Dr. Lilian J. Clarke, Prof. Barbara Foxley, Dr. W. Garnett, Prof. R. A. Gregory, Prof. H. B. Smith, Dr. H. L. Snape, and Miss C. M. Waters, to consider the policy and results of the "free place system" in secondary schools in England and Wales, under which largely increased grants are given to such schools conditional upon their admitting 25 per cent. of pupils from elementary schools or such lower percentage approved by the Board of Education, has issued an instructive and suggestive report after exhaustive inquiry into the working of the system in various classes of schools, both urban and county. The results of the committee's investigations go to show that the system is on the whole bearing satisfactory fruit, enabling a considerable number of children attending public elementary schools, who in ordinary circumstances would cease their education at or below fourteen years of age, to continue it to their great advantage up to and beyond sixteen, and in some cases to pass into the universities. The committee makes certain specific recommendations for the improvement of the system, such as: free places should not be awarded to children above twelve years of age; the necessity for a good mid-day meal is enforced; in many cases maintenance grants should also be given; greater facilities should be offered for the effective support of secondary-school children of exceptional ability to enter the universities and technical high schools; power should be given for the removal of children from the free place list who are reported for habitual laziness; the award of free places should depend upon an oral as well as upon a written examination; and finally, the free place system should be made available for all classes of the community, say, under the condition that the candidates must have been educated for two years in a school classed by the Board of Education as "efficient." The report is accompanied by interesting tabular statements illustrating the results of the inquiries made.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 6.—Sir J. J. Thomson, president, in the chair.—L. F. **Richardson**: (1) Atmospheric stirring measured by precipitation. The equation for diffusion is investigated in the general case in which atmospheric density and degree of turbulence must both be regarded as varying with height, and it is found that the stirring is best measured by the coefficient ξ in the equation

$$\frac{\delta\mu}{\delta t}=\frac{\delta}{\delta p}\left(\xi\frac{\delta\mu}{\delta p}\right),\text{ in preference to }\kappa\text{ in }\frac{\delta\mu}{\delta t}=\kappa\frac{\delta^2\mu}{\delta h^2}.$$

Here p is pressure, h height, and μ either entropy per unit mass, or mass of water per unit mass, or horizontal momentum per unit mass in a fixed azimuth. In place of entropy per mass we may, with advantage, take potential temperature. From estimates of precipitation and vertical gradient of water per mass of atmosphere, as means over the whole globe, it is found that ξ has the following mean values:—

Height		ξ
8500 metres	...	3 to 180 cm.$^{-2}$ grm.^{2} sec.$^{-5}$
500 „	...	140,000 „ „
0·5 „	...	possibly as low as 1000 or even less.

The value at 500 metres is in fair agreement with ξ as deduced from κ, calculated by Akerblom, by Hesselberg, and by Taylor, for heights of a few hundred metres. The values of ξ at other levels are remarkably smaller. (2) Measurement of water in clouds. Photometric methods enable an estimate to be made of the amount of water in clouds in terms of the diameter of the cloud droplets. For thin cloud, through which the sun can be seen, it is the contrast of brightness between the sky and the sun which is measured. For thick, uniform stratus it is the total light transmitted to earth which is measured as a fraction of the incident sunlight. If the cloud were compressed into a homogeneous horizontal lamina, of water or of ice according to its temperature, the thickness of this lamina would appear to have the following values when expressed as a multiple of the diameter of the cloud droplets:—For cirrus, cirro-stratus, and cirro-cumulus, on the average about 0·5; for stratus which only just permitted the sun to be seen, 4·1, the sun's zenith distance being 49°; for a strato-nimbus of ordinary appearance, 24.

Aristotelian Society, March 3.—Prof. Wildon Carr in the chair.—Mrs. N. A. **Duddington**: Our knowledge of other minds. On the basis of a realistic theory of knowledge, our knowledge of other minds must be pronounced to be as direct and immediate as our knowledge of physical things. Mental states "lived through" by one person may be discerned or discriminated by another. Thus if we see someone weep we become aware of his grief simultaneously with his sobs, dejected attitude, etc.; the grief is revealed to our contemplation in precisely the same sense as the bodily changes are. We may sometimes infer people's emotions from their bodily attitude, but if there were no direct acquaintance with other mental lives we should have no clue for the interpretation of their expressive behaviour, and it would

have no meaning for us. The existence of other selves cannot be inferred, as is usually supposed, from the analogy which their behaviour presents to our own, because (1) no priority attaches to the awareness of our own selfhood; (2) the alleged inference would have to be made for the first time at an impossibly early age; (3) the behaviour of others presents, from the point of view of the percipient, no analogy to his own; and (4) if other selves were merely inferred entities, human affections and relationships could not be what they are. It is consistent with any theory of the ultimate nature of mind to maintain that the presence of other selves and the affective aspect of them can be directly apprehended.

Mathematical Society, March 13.—Mr. J. E. Campbell, president, in the chair.—J. **Hammond**: The solution of the quintic.—L. J. **Mordell**: A simple algebraic summation of Gauss's sums.—Major P. A. **MacMahon**: Divisors of numbers and their continuations in the theory of partitions.—S. **Ramanujan**: (1) Congruence properties of partitions. (2) Algebraic relations between certain infinite products.

Linnean Society, March 20.—Sir David Prain, president, in the chair.—Dr. Harold **Wager**: The colour-sense of wasps. The experiments described in this paper were made by observing the number of wasps flying towards, and settling upon, pieces of sugar placed upon sheets of coloured paper arranged in various ways. The results show that in seeking their food wasps (*Vespa vulgaris*) are guided by their social instinct, their remembrance of locality, and their power to distinguish conspicuous colours or colour-contrasts. They are probably also guided by smell, but no experiments were made to test this. Leaving out of account the probability that smell plays an important part in their activities, the experiments indicate that the governing principles which dominate wasps in their search for food are, first, the attraction exerted by the presence of other wasps; secondly, the tendency always to return to the same place; and, thirdly, the attraction due to conspicuous colours and colour-contrasts.

CAMBRIDGE.

Philosophical Society, February 17.—Mr. C. T. R. Wilson, president, in the chair.—Dr. **Doncaster**: Note on an experiment dealing with mutation in bacteria. It was noticed that the recorded ratio of occurrence in cases of meningitis of the four agglutination-types of Meningococcus corresponded very closely with the ratio of occurrence of the four iso-agglutinin groups of blood in a normal human population. It seemed possible, therefore, that by growing Meningococcus of one type in media containing human blood of different groups, mutation to other types might be induced. Experiment showed that considerable differences in type of agglutination resulted, but it was concluded that this was caused by the sorting out of races of different agglutinability from a mass culture rather than by true mutation.—Dr. **Shearer**: Electrical conductivity of bacterial emulsions.—Miss M. D. **Haviland**: The bionomics of *Aphis grossulariae*, Kalt, and *A. viburni*, Shrank. *A. grossulariae*, a pest of currant-bushes, appears to be identical with *A. grossulariae* found on the guelder rose. Experiments to see how far the descendants of the original migrants can be successfully transferred from the currant to the guelder rose, and *vice versa*, show that while the guelder-rose form can with some difficulty be cultivated on the currant, the currant form cannot be reared on the guelder rose.—J. E. **Purvis**: (1) The conversion of sawdust into sugar. (2) Bracken as a source of potash.—S. **Chapman**: Terrestrial magnetic variations and their connection with solar emissions which are absorbed in the earth's outer atmosphere.—W. J. **Harrison**: The distribution of electric force between two electrodes, one of which is covered with radio-active matter. It would appear from experimental results that the rate of ionisation per unit time due to an α particle is constant at all points of the path of the particle within the range of its ionising activity. It follows that, at a distance x from a large electrode covered with radio-active matter, the rate of ionisation is $q_0 \log (R/x)$, where R is the range of the particles. The differential equations involved are integrable in the case of the saturation current, and typical numerical solutions have been calculated

DUBLIN.

Royal Dublin Society, February 25.—Prof. J. Joly in the chair.—W. B. **Wright**: An analysis of the Palæozoic floor of north-eastern Ireland, with predictions as to concealed coalfields. The considerations which led up to the present search for coal beneath the basin of Lough Neagh are elaborated and supported by further evidence. These considerations were originally set forth in 1917 in a memorandum from the Geological Survey of Ireland to the Department for the Development of Mineral Resources, Ministry of Munitions. They are now extended to the prediction of coal basins in other parts of the concealed area. These basins are located at the intersection of certain well-marked north and south synclinal troughs with the continuation of the central trough-valley of Scotland, and a distinct doubly synclinal trough with Caledonian trend lying further north.

MANCHESTER.

Literary and Philosophical Society, March 4.—Mr. W. Thomson, president, in the chair.—F. H. **Carr**: The post-graduate training of the works chemist. There was scope for institutions devoted primarily to the post-graduate training of chemical students who intended to specialise in the applied aspects of their science. In such institutions instruction would be given, not only on a wide variety of technical processes for the manufacture of chemicals, and in operations in each technical department, from the drawing office and the power house to the special chemical plants, but also in the whole question of economic and statistical control of works processes. The chemicals produced should cover an extremely wide range, and be such as might be required in relatively small quantities such as existing manufacturing firms would not find it worth while to produce. In this way the institutions in question might, in course of time, accumulate stocks of chemicals comparable in variety with those in the possession of certain German firms on the resources of which research chemists in all parts of the world have had to rely.

SYDNEY.

Linnean Society of New South Wales, November 27, 1918.—Prof. H. G. Chapman, president, in the chair.—Dr. R. J. **Tillyard**: Studies in Australian Neuroptera. No. 6: The family Psychopsidæ, with descriptions of new genera and species. The paper begins with a study of the wing-venation of *Psychopsis elegans*, Guérin, which is compared with the precedent tracheation of the pupal wing. From this it is shown that the family is characterised by certain specialisations not found in other families, and that the cross-venation, which consists only of a variable number of gradate series, is to be considered as a comparatively late addition to the original Prohemerobiid-like venational scheme. The character of the cross-venation is shown to be essentially variable, and the classification of the family

based on it by Navás to be quite untenable. A new subdivision of the Australian species into three genera, based on quite new characters, is given, together with descriptions of two new genera and two new species. A number of new facts are given about the very rare *Psychopsis illidgei*, Froggatt, including figures of this species at rest in two positions. The characters of the family are given in full, together with a discussion as to its affinities, fossil and recent, and a full bibliography for the Australian species, which now number eight out of a total of sixteen known for the world.—A. M. **Lea**: Descriptions of new species of Australian Coleoptera. Part xiv. Four genera and thirty-one species are described as new.—Dr. C. **Hall**: A new species or form of Eucalyptus. A single tree only has been seen, which may be a hybrid, as it has some of the characters of the Stringybarks, especially in the seedling stage, yet differs from them in others, in the mature stage, as in bark, oil, and timber.—Dr. R. J. **Tillyard**: Australian Megaloptera or alder-flies, with descriptions of new genera and species. The only known Australian species of the order Megaloptera is *Archichauliodes guttiferus*, Walker, belonging to the archaic family Corydalidæ. No species of the family Sialidæ occurs in the Oriental region, and the nearest known species is found in Chile. In this paper two interesting new genera and species belonging to this family are described, one from Maria Island, Tasmania, and the other from Mount Tambourine, South Queensland. Both are related to the Chilian form, one by the structure of its wings, and the other by its coloration. The latter (the Tasmanian species) is also closely related to the Holarctic genus Sialis. The occurrence of these insects in Australia affords further evidence of the truth of the Antarctic theory, since they could only have arrived from the south.—Dr. J. M. **Petrie**: The occurrence of methyl lævoinositol in an Australian poisonous plant. The endemic Australian plant *Heterodendron oleaefolium*, Desf. (fam. Sapindaceæ), contains the methyl ester of lævorotatory inositol. The amount isolated was equivalent to 0·65 per cent. of the dried (at 100° C.) leaves. This substance is not optically isomeric with the pinite of Maquenne, which is the methyl dextroinositol possessing a different melting point and optical rotation. It is apparently identical with Tanret's quebrachite, and had been previously recorded from three plants only—*Aspidospermum quebracho* (Apocynaceæ), *Hevea braziliensis* (Euphorbiaceæ), and *Grevillea robusta* (Proteaceæ). The occurrence of this compound is, therefore, exceedingly rare, and in great contrast to the occurrence of *inactive* inositol, which exists as a plastic substance in most plants. Heterodendron also contains a cyanogenetic glucoside.—Dr. R. J. **Tillyard**: Studies in Australian Neuroptera. No. 7: The life-history of *Psychopsis elegans*, Guérin. The complete life-cycle occupies about two years, of which the greater part is spent in the larval state. The eggs are laid singly on the bark of eucalyptus trees, and the young larva lives in cracks or crannies of the bark, whence it attacks other insects, sucking them dry with its huge, calliper-like mandibles. There are three larval instars. The full-fed larva is brownish-grey, with whitish pruinescence; the hairs of the abdomen are modified into peculiar star-like processes, which the author terms *dolichasters* and *micrasters* respectively, according to their form and origin. The mouth-parts and anal papilla of the larva are fully described. The general form of the larva is intermediate between the slender type of the Hemerobiidæ and the stout form found in the Myrmeleontidæ and allies. The jaws are large, like those of the Myrmeleontidæ, but have no internal teeth. The cocoon, which is spun from the anus, is a beautiful spherical object, resembling a pearl. The pupa is of the usual Planipennian type, with very remarkable mandibles, used for cutting the cocoon open. The emergence of the imago from the pupa is fully described and figured, as are also the mouth-parts of the imago. The paper concludes with a short discussion as to the potential economic value of the Psychopsidæ as a beneficial group of insects, the conclusion being reached that experiments with these insects in orchards of old trees might help considerably in reducing the codlin moth and other kindred pests.—Dr. H. S. H. **Wardlaw**: Note on the temperature of *Echidna aculeata*. A series of some eight hundred observations of the rectal temperature of Echidna were submitted to Galton's method of statistical analysis. The most probable temperatures were:—Spring-summer period, morning, 30° C.; afternoon, 32·6° C. Autumn-winter period, morning, 29·7° C.; afternoon, 32·3° C. The results show that the temperature-regulating mechanism of Echidna only acts while the body-temperature lies between 27·6° C. and 32·6° C. Outside these limits Echidna behaves as a poikilothermal animal.—F. H. **Taylor**: Contributions to a knowledge of Australian Culicidæ. No. 4. Synonymical notes are furnished. The Australian species of Anopheles are tabulated. Ten species, referable to six genera, are described as new.—G. P. **Darnell-Smith**: (1) An account of some observations upon the life-history of *Phoma citricarpa*, McAlp., the cause of the "black spot" of citrus fruit in New South Wales. "Black spot" is a serious disease which develops on the sunny side of trees, and upon the parts of the fruit exposed to sunlight. Two kinds of spores have been obtained—normal pycnospores, which germinate readily in suitable media, and "*x*" spores, which could not be induced to do so. The details of the formation of the pycnidia and pycnospores have been worked out. Spraying with Bordeaux, 6:4:50, followed up by sprayings with weaker solutions, controls the disease. (2) The occurrence of an inverted hymenium in *Agaricus campestris*.

BOOKS RECEIVED.

Year-Book of the Royal Society of London. No. 23. Pp. 236. (London: Harrison and Sons, 1919.) 5*s*.

Records of the Survey of India. Vol. xi. (Supplementary to General Report, 1916–17.) Annual Reports of Parties and Officers, 1916–17. Pp. 115. (Dehra Dun: Printed at the Office of the Trigonometrical Survey, 1918.) 4 rupees or 5*s*. 4*d*.

Commonwealth of Australia. Advisory Council of Science and Industry. Memoir No. 1. The Australian Environment (especially as Controlled by Rainfall). A Regional Study of the Topography, Drainage, Vegetation, and Settlement; and of the Character and Origin of the Rains. By Dr. Griffith Taylor. Pp. 188. (Melbourne, 1918.)

The Physical Chemistry of the Proteins. By Prof. T. B. Robertson. Pp. xv+483. (London: Longmans, Green, and Co., 1918.) 25*s*. net.

Neue Beobachtungen über den Erreger der Maulund. Klauenseuche die Entwicklung des Schmarotzers im Blut, Speziell in den Roten. Blutkörperchen. Von Dr. Hrch Stauffacher. Pp. 62+plates. (Zurich: Polygraphisches Institut A.-G., 1918.) 8 francs.

Coal-Tar Dyes and Intermediates. By E. de Barry Barnett. (Industrial Chemistry Series.) Pp. xviii+213. (London: Baillière, Tindall, and Cox, 1919.) 10*s*. 6*d*. net.

Verses from Fen and Fell. By Thomas Thornely.

Pp. x+98. (Cambridge: At the University Press, 1919.) 4s. 6d. net.

The Nature of Being. An Essay in Ontology. By Henry H. Slesser. Pp. 224. (London: George Allen and Unwin, Ltd., 1919.) 10s. 6d. net.

Transactions of the Bose Research Institute, Calcutta. Vol i. Parts 1 and 2. Life Movements in Plants. By Sir J. C. Bose. Pp. xxvi+251+appendix xv. (Calcutta: The Bose Research Institute, 1918.)

Le Tube Coolidge. Ses Applications Scientifiques, Médicales et Industrielles. Par H. Pilon. Pp. 83. (Paris: Masson et Cie, 1919.) 4 francs net.

Les Symbiotes. Par Paul Portier. Pp. xx+315. (Paris: Masson et Cie, 1918.) 5 francs.

Immune Sera: A Concise Exposition of our Present Knowledge of Infection and Immunity. By Dr. Charles Frederick Bolduan and John Koopman. Fifth edition. Pp. viii+206. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 7s. net.

Coal Tar and Some of its Products. By Arthur R. Warnes. (Pitman's Common Commodities and Industries.) Pp. xxii+105. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 2s. 6d. net.

Home and Farm Food Preservation. By Prof. William V. Cruess. Pp. xxiv+276. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) 8s. net.

The Human Skeleton: An Interpretation. By Prof. H. E. Walter. Pp. xv+214. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) 10s. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 20.

ROYAL INSTITUTION, at 3.—Prof. C. H. Lees: Fire Cracks and the Forces Producing Them.

ROYAL SOCIETY, at 4.30.—Dr. C. Chree: Magnetic Storms of March 7-8 and August 15-16, 1918, and their Discussion.—L. C. Martin: The Transparency of Biotite to Infra-red Radiations.

LINNEAN SOCIETY, at 5.—F. Lewis: Notes on a Visit to Kunadiyaparawitta Mountain, Ceylon, with List of the Plants Observed and their Altitudinal Distribution.—Miss May Rathbone: Specimens of Plants Preserved by Formalin Vapour.—H. R. Amos: Wheat-breeding with Mr. W. O. Backhouse in Argentina.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Sir Thomas Kirke Rose: The Volatilisation of Gold.—W. S. Curteis: Cobar Stope Measurement Methods.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on G. L. Addenbrooke's Lectures on Dielectrics in Electric Fields.

CHILD-STUDY SOCIETY, at 6.—Discussion opened by Mrs. K. Truelove: Training of the School Girl in Infant Care.

CHEMICAL SOCIETY, at 8.—T. M. Lowry and H. H. Abram: The Rotatory Dispersive Power of Organic Compounds. IX. Simple Rotatory Dispersion in the Terpene Series.

FRIDAY, MARCH 21.

ROYAL INSTITUTION, at 5.30.—Prof. W. W. Watts: Fossil Landscapes.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. C. Armitage: Jigs, Tools, and Special Machines with their Relation to the Production of Standardised Parts.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8, with Royal Society of Medicine (Electrical Section).—R. S. Whipple: (1) Electrical Methods of Measuring Body Temperatures; (2) The Electro-cardiograph.

SATURDAY, MARCH 22.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

MONDAY, MARCH 24.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. W. A. Bone: Coal and its Conservation.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Capt. Alan Ogilvie: Macedonia.

TUESDAY, MARCH 25.

ROYAL INSTITUTION, at 3.—Prof. A. Keith: British Ethnology—The People of Scotland.

INSTITUTE OF METALS, at 4 and 8.—Annual General Meeting.—Capt. G. D. Bengough and Dr. O. F. Hudson: Fourth Report to the Corrosion Research Committee.—Dr. W. Rosenhain and D. Hanson: The Properties of Some Copper Alloys.—Lt.-Col. C. F. Jenkin: Metallurgical Information Required by Engineers.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Further Discussion:* J. Caldwell and H. B. Sayers: Electric Welding Developments in Great Britain and the United States of America.—W. S. Abell: Experiments on the Application of Electric Welding to Large Structures.—J. R. Smith: The Application of Electric Welding in Ship Construction and Repairs.

WEDNESDAY, MARCH 26.

INSTITUTE OF METALS, at 4.—Annual General Meeting.—D. Hanson and S. L. Archbutt: The Micrography of Aluminium and its Alloys.—Owen W. Ellis: Effect of Work on Metals and Alloys.—F. Johnson: The Influence of Cold Rolling upon the Mechanical Properties of Oxygen-free Copper.—At 8.—General Discussion on the Relation of Science to the Non-ferrous Metals Industry. Dr. W. Rosenhain: Science and Industry in Relation to Non-ferrous Metals.—W. R. Barclay: The Relationship between the Laboratory and the Workshop.—F. C. A. H. Lantsberry: The Scope of the Works Laboratory.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. A. H. Gibson: British Engineering and Hydro-Electric Development. (The Training of Engineers.)

GEOLOGICAL SOCIETY, at 5.30.

ROYAL AERONAUTICAL SOCIETY, at 8.—Lt.-Col. T. R. Cave Brown Cave: Lighter-than-Air Craft.

THURSDAY, MARCH 27.

ROYAL INSTITUTION, at 3.—Prof. C. H. Lees: Fire Cracks and the Forces Producing Them.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Dr. R. McCarrison: The Genesis of Œdema in Beriberi.—H. L. Hawkins: The Morphology and Evolution of the Ambulacrum in the Echinoidea.

CHEMICAL SOCIETY, at 4.30.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—The late H. R. Constantine: The Co-ordination of Research in Works and Laboratories.

FRIDAY, MARCH 28.

PHYSICAL SOCIETY, at 5.—Discussion on Metrology in the Industries. Introduced by Sir R. T. Glazebrook.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting), at 7.—Dr. J. F. Crowley: The Organisation of Technical Engineers.

SATURDAY, MARCH 29.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

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