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Eugenics and Society

IF the Eugenics Society fashions its attitudes and policies in accord with the ideas and ideals presented to it in the Galton Lecture for 1936 delivered on January 17 by Prof. Julian Huxley, it will surely receive many and powerful reinforcements. Eugenics is destined to become part of the religion of the future, or of whatever complex of sentiments which may then take the place of organised religion. But, before it can become a soul-compelling ideal, it must first achieve precision and efficiency as a branch of applied science. It must devise new techniques which can cope with plurality of causation and plurality of effect, and can also design and explain an experiment in which rigorous control is not possible. Eugenics is much more than human genetics, for though it certainly aims at the improvement of the human race by means of the improvement of its genetic qualities, its policies must never disregard the obvious fact that such improvement implies a knowledge not only of the type but also of its habitat and destiny. Improvement, whatever form this may take, can only be realised in a certain kind of environment, and therefore, to the eugenist, a study of the environment must accompany a study of the genetic constitution of the stock.

In all comparisons of individuals, of social classes and of ethnic groups, it is impossible to assert that any observed difference in characterisation is a reflection of some fundamental genetic dissimilarity until it has been shown that it is not due, in the whole or part, to the impress of different environmental forces. Until the environment—housing, diet, education—is equalised, we have no right to the view that certain groups or classes who differ among themselves in visible characters are genetically dissimilar, and that therefore in relation

to the conditions of the social environment some are superior and others inferior. It is the case that different ethnic groups, for example, differ in regard to the amount and to the range and type of variability of physical characters, and that these differences are, in the main, genetic. It is safe to assume, further, that these groups will be shown to differ genetically also in respect of intellectual and emotional characters, both quantitatively and qualitatively. But it is unlikely that these differences can ever account for the prejudices and antagonisms that separate the peoples.

Racial theories are nothing more or less than rationalisations of political prejudices, as shown by Prof. Huxley in his Friday evening discourse at the Royal Institution on March 27. So long as a half-caste remains an outcast, it is impossible to assess his biological or social worthiness. The social environment itself exercises a selective influence, attracting to it certain biological types and repelling others, favouring certain evolutionary trends and embarrassing others.

The eugenist must therefore consider, as a eugenist, the particular political and social structure of the community with which he deals. He must ask whether or not social success is synonymous with ultimate biological and human values, and also whether or not a competitive and individualist system, based on private capitalism and public nationalism, is in its essence of a nature eugenic or dysgenic. If the social system is not itself satisfactory, then the eugenist must aim at its transformation. Eugenists must familiarise themselves with the outlook and the concepts of sociology, with the technique and practice of social reform, for these are an indispensable part of the machinery the eugenists need if they are to realise their aims.

An Empire Development Board

FOR some years past, Sir Robert Hadfield has advocated the establishment of an Empire Development Board in order to secure a systematic and co-ordinated or a 'planned' development of the vast resources and opportunities of the British Empire. He has now brought his suggestions together in a concise pamphlet* which, although prepared for consideration by a committee of the Institution of Civil Engineers, is deserving of the widest study. Sir Robert speaks with authority as a man of science, an engineer and as an administrator; and whilst drawing most of his examples from the field of engineering, he is clear that the membership of the Board should be fully representative of Empire scientific, technological and industrial activities.

The proposals are concrete and definite: a permanent body of adequately remunerated members continually at work and continually supplied with 'new blood' on an elastic basis of retirement by rotation, with a secretariat in each country and the main Board travelling frequently to all parts of the Empire. The Board would be non-political, and its aim would be to assist in developing new and additional resources, and *not* the guiding of existing trade into Empire channels by fiscal means. Its purpose would be to develop the Empire as a whole, and not to benefit one part at the expense of another. The Board would co-operate fully with all professional institutions, trade and industrial federations, as well as with the Governments of the constituent parts of the Empire, but would not itself control or manage existing or new undertakings.

* Empire Development and Proposals for the Establishment of an Empire Development Board. By Sir Robert Hadfield. Pp. 78. (London: Chapman and Hall, Ltd., 1935.) 2s. 6d. net.

Sir Robert is under no illusions regarding the magnitude of such an undertaking. He points out, in the first place, however, that the Dominions Royal Commission (1912-17) expressed with no uncertain voice the need for such a body and unanimously recommended the creation of an Imperial Development Board. There is thus evidence both of need and of prospective co-operation. In reply to the argument that the plan is too immense to be handled effectively by any single organisation, it is urged that the magnitude of the task is simply a measure of the opportunity, and that clearly some organisation to deal with the problems is in any event better than no organisation at all. With regard to the objection that the cost would be excessive, it is argued that productive work would be accomplished at comparatively small cost and that within reasonable limits the more spent on the work the greater would be the return, whilst a small fraction of the sums spent annually on the various legislative bodies within the Empire would supply an adequate income.

The proposals put forward by Sir Robert Hadfield would seem to be especially vital at the moment. We have at home a National Government which has already indicated its appreciation of one urgent Empire problem by setting up a Dominions Migration Board. The countries of the Empire are united by a common loyalty and a real brotherhood which cannot be but strengthened by the work of a common Development Board. As one by one political ties are loosened, there is real need for a new bond.

L. D. S.

Method and the Science of Man

IF trenchant criticism of the methods employed in investigation affords any gauge of a healthy state in a given science, physical anthropology must be enjoying a peculiarly healthy activity. To recent attacks on racial classification on the basis of the measurement of physical characters may now be added criticism of both the accuracy and adequacy of bodily measurement itself. It may be remembered that Sir Arthur Keith was once

criticised for relying on the evidence of the eye in racial discrimination. It was pointed out that in so doing he relied upon an inexact observation for evidence which was afforded more exactly by measurement. It should be remembered, however, that 'racial discrimination by inspection', to be effective, must be trained; while measurement itself, experience has shown, may be a source of error, if due precaution be not taken against the

personal equation and any technical deficiencies of the observer.

Two recent studies in the methods of anthropoid palæontology and physical anthropology respectively lend support, however, to Sir Arthur's view. In a lecture on "Evolutionary Parallelism and Human Phylogeny", delivered recently before the Oxford University Anthropological Society, Prof. W. E. Le Gros Clark (*Man*, 2; 1936) stresses the implications of the principle of convergence, whereby a group, though splitting off from the main stock, might follow a course of parallel development, which would result in a close resemblance to members of the cognate stock, or stocks, while masking important differences, which the methods of anthropometry, in so far as they depend on a summation of resemblances, or craniometry, relying, more or less, on a single character, would inevitably overlook. These all-important differences are often of a non-metrical character. Such, for example, are the shape and orientation of the nasal skeleton; but they are not commonly taken into account in the biometrical treatment of the skull.

Prof. Le Gros Clark's reference to the nasal skeleton is of special interest in view of the fact that study of the nose is one of the principal sources of the data upon which Prof. V. Suk bases an attack on certain anthropometric methods, which constitutes the second of the studies to which reference is made above. In "Fallacies of Anthropological Identifications and Reconstructions" (*Pub. de la Fac. des Sci. de l'Univ. Masaryk*,

Brno, Čis 207; 1935) he shows that not only does facial expression not depend upon the osseous parts, but also that when an actual dissection is made, a very considerable discrepancy appears between anatomical points fixed through the tissues and those located on the actual bones themselves. Prof. Suk, working with cadavera, was able to fix these points with much greater accuracy than is possible in the living, yet even so he found in the difference before and after dissection an error of four, five and even six millimetres in locating the nasion; while the difference between the breadth of the external nose and that of the bony nose was sometimes so much as nineteen millimetres. One conclusion which emerges is that an index of the bony nose does not tell us anything about the external nose of the individual.

Taking into account the various points brought under consideration, Prof. Suk concludes that neither the reconstructions of early man—these he suggests are made under the influence of the Australian cast of countenance—nor the identifications of the bones of prominent historical characters by comparison of measurements with portraits, have any value. The further conclusion follows, in Prof. Suk's own words, "that that part of Anthropology, which is too much preoccupied with osteology and osteometry, loses any solid ground, when it does not take into consideration the whole body, for Man is not merely a skeleton".

The Cost of Health

Food, Health and Income:

Report on a Survey of Adequacy of Diet in relation to Income. By Sir John Boyd Orr. Pp. 72. (London: Macmillan and Co., Ltd., 1936.) 2s. 6d. net.

IN some of the recent controversial discussions concerning dietary standards applicable to human beings, attention was focused on minimum requirements. This report recently issued by Sir John Boyd Orr emphasises the need for defining the optimum diet, that is to say, one which is capable of maintaining a standard of perfect nutrition, which is "a state of well-being such that no improvement can be effected by a change in the diet". Although data do not yet exist for

defining accurately this optimum diet, recent laboratory researches and dietary surveys have made it possible to indicate the amounts of some of the important constituents of a diet which are required to ensure good nutrition in certain classes of individuals. If such standards are accepted as furnishing an indication of the adequacy of present-day diets, it is possible to use existing data relating to the food consumption of the population of Great Britain to determine how far such diets are capable of supporting a state of good nutrition.

The mean quantity of each of the main varieties of food consumed by individuals in Great Britain could be calculated, and it would be a simple matter to determine whether this mean quantity

furnished a sufficiency of the individual food constituents considered necessary for good nutrition. It was, however, clear that the income of an individual determined to a considerable extent the kind of food he bought, and it was therefore a matter of greater importance to investigate the adequacy of existing diets in relation to the amount of money available for the purchase of food.

Data were obtained from various sources which suggested that it was permissible to divide up the population of Great Britain into six groups according to their weekly expenditure on food. This expenditure ranged from 4s. or less in group I to 14s. or more in group VI. From existing dietary surveys it was possible to estimate the average amount of common kinds of food consumed by individuals belonging to the various groups, and in this way some idea was obtained of the adequacy of the diet of each group for maintaining a state of good nutrition.

The main findings which emerged from this study were that, while the consumption of bread and potatoes was practically the same in all six groups, the consumption of milk, eggs, fruit, vegetables, meat and fish rose with the income. Thus in the poorest group an average of 1.8 pints of milk and 1.5 eggs were estimated to be consumed per head per week, while in the richest group the corresponding amounts were 5.5 pints of milk and 4.5 eggs. The poorest group apparently spent 2.4d. on fruit and the richest 1s. 8d. A detailed analysis of the diets indicated that the average diet of the poorest group, which com-

prises $4\frac{1}{2}$ million people, was deficient in every food constituent examined. The diet of the second group, comprising 9 million people, was adequate in protein, fat and carbohydrate, but deficient in all the vitamins and mineral elements examined. That of the third group, also comprising 9 million people, was deficient in some of the vitamins and mineral elements, while the diets of the fourth, fifth and sixth groups approached or surpassed the standard of adequacy in regard to all the constituents examined. These results as a whole suggest that a diet adequate for the maintenance of perfect health is obtained by not more than one half of the population of Great Britain.

Investigations carried out in various parts of the world do in fact indicate that there may be a definite relation between the physiological adequacy of the diet and the physique, the incidence of disease and the death-rate. Such indications are obtained, for example, by comparisons of the physical measurements and sickness and death-rates of groups of individuals known to receive differing types of diet, or by observations of the effect on the physique and health of groups of individuals likely to be poorly nourished, when supplements of food of high nutritive value are added to their diet. If it is true that the health of a large section of the population of Great Britain is suffering as the result of faulty nutrition in the physiological sense of the term, it is difficult to escape from the conclusion that we are confronted with a problem which demands serious study by economists and politicians.

'Deutsche Mathematik'

Deutsche Mathematik

Im Auftrage der Deutschen Forschungsgemeinschaft, herausgegeben von Theodor Vahlen. Heft 1, January 1936. Pp. 112. (Leipzig: S. Hirzel, 1936.) Subscription price, 12 gold marks a year (6 issues).

THE periodical of which this is the first number appears under the general direction of Prof. T. Vahlen (*Herausgeber*), with Prof. Bieberbach as responsible editor (*verantwortliche Schriftleitung*). A short introductory statement announces that its aim is to give a living picture of the whole of the mathematical work of German comrades (*Volks-genossen*). It will therefore publish not only new results, but also informative articles for mathematicians of every kind, from student to original worker, with notes on congresses, camps, study groups and *Fachschaften*.

There are three parts, headed "Arbeit", "Belehrung", and "Forschung". In the last two are articles of a purely mathematical nature, including, in Part 3, a paper by W. Rinow on the topology and geometry in the large of spaces with a given Riemannian metric, and in Part 2 a historical account, by E. A. Weiss, of the development of Lie's theory of the "straight-line-sphere" transformation.

The "work" to which Part 1 is devoted is, of course, Party work. The first article, "Studenten, in Front!" is an exhortation, of a type now familiar, to intensive study of the problems of 'race-bound' creative work in mathematics, and is followed by accounts of work in mathematical labour-camps, and of a seminar at Heidelberg, in which the Germanic soul-structure of Kepler and Newton, as shown in their works, was contrasted with that of Einstein, whose theories were found

not to deal with assertions which can be tested experimentally or by astronomical observations. More remarkable than these works of students is an article by E. Tornier, now professor in the University of Göttingen, entitled "Mathematician or Juggler with Definitions?", which informs the reader what mathematical theories are to be regarded as genuinely significant.

"Every theory of pure mathematics has the right to live if it is really capable of answering concrete questions about genuine objects, such as the whole numbers and geometrical constructs (*Gebilde*), or if it is at least capable of being used in the building up of such theories. Otherwise, either it is an uncompleted beginning (that is, when further building up can make it capable of application), or it is a document of Jewish liberalistic obscurantism, sprung from the intellect

of rootless artistes, who by juggling with definitions referring to nothing, conjure up mathematical creativeness before themselves and their empty-headed clientèle, a clientèle which is glad slowly to learn off a few tricks, in order to shine as third-rate Rastellis before still humbler audiences."

Whether the author of this outburst had any definite branches of modern mathematics in his mind when he wrote it is difficult to say, since there are few mathematical theories, Germanic or not, which have not some application to the 'genuine objects' he mentions, if suitably interpreted. It was at any rate a slight relief to the reviewer to find that among the original papers in Part 3 there are several which deal with abstract axiomatic theories.

The whole journal, including the mathematical papers, is printed in German type. M. H. A. N.

Progressive Physics

Reports on Progress in Physics

Vol. 2. General Editor: Allan Ferguson. Pp. iv+371. (London: Physical Society, 1936.) 21s. net.

THE second volume of the Progress Reports issued by the Physical Society does not belie the promise of the first. It continues the method, initiated in the earlier volume, of a series of reports dealing with the main content of physics issued under the same heads as appear in the first volume. It is to be presumed that these heads—general physics, the quantum theory, atomic physics, sound, heat, optics, spectroscopy, X-rays, and electrical and magnetic measurements, will appear regularly in the succeeding volumes. Over and above these come the titles of special reports which will vary from year to year—reports concerned with topics which are, it may be, of specialised interest, or which chronicle some of those rapid and spectacular advances of which almost every year has its share. The special reports which appear in the present volume are of remarkable and varied interest.

A very timely contribution from Prof. H. R. Robinson deals with the charge (e) and specific charge (e/m_0) of the electron. When Birge's well-known report was published in 1929, two widely-differing values of e/m_0 held the field; direct deflection methods gave the value 1.769×10^7 , spectroscopic methods 1.761×10^7 . The value of e , on the other hand, was assumed to be known very exactly. To-day the situation is reversed; the spectroscopic and deflection values of e/m_0 are in close agreement,

whereas two competing values for e exist, which are to each other almost in the mystical ratio 136/137. Obviously a critical discussion was needed, and this has been admirably furnished by Prof. Robinson.

The methods developed and employed in geophysical prospecting are fully and critically discussed by Mr. Lancaster-Jones, and Prof. E. V. Appleton contributes a long report of absorbing interest which deals with radio-exploration of upper atmosphere ionisation. The important subject of electron tubes is handled, under the general editorship of Prof. G. I. Finch, in four sections, two of which—a general introduction, and a section on the electron-diffraction camera—are contributed by Prof. Finch himself. The other sections deal respectively with the electron microscope (Mr. H. J. H. Starks), and the high-speed cathode ray oscillograph (Messrs. Miller and Robinson).

There are two matters of outstanding interest that rise at once to mind when one turns over the pages of so comprehensive a report as this one. The first concerns the content and balance of the report, and it may as well be confessed at the outset that a report which shall satisfy all-comers in this respect is never likely to materialise. Each specialist tends to belaud his own brand of leather, and while the quantum physicist deplors the space given to the dweller in macroscopic regions of thought, the technical researcher loudly proclaims that the atomic physicist is the spoilt child of his generation. On the whole, this volume of the reports holds the balance remarkably well.

Dr. N. Feather devotes twenty-three pages to a brilliant discussion of recent advances in atomic physics, and, under Prof. G. Temple's general guidance, the forty-seven pages of the section on quantum theory are divided into four subsections dealing respectively with the quantum theory of atomic nuclei, the spectra of polyatomic molecules, the quantum theory of valency, and the theory of paramagnetism in ionic crystals.

The remaining sections contain much matter which comes under the heading of atomic physics, and this branch of the subject certainly has its fair share of the content of the book. For the rest, classical and technical physics play their part, and no more than their part. If a suggestion may be put forward for the consideration of those responsible for future reports, it is that many would welcome a little more space given to the discussion of some of those problems wherein physics touches the regions of psychology and physiology (this by no means implies that these topics have passed unrecognised in the present report).

The other matter concerns the limits of appeal of the report. Broadly speaking, there are three levels at which a report may be written—we do

not propose to discuss the difficult question of the assignment of "higher" or "lower" to any of these levels. But a report may be written to appeal to the layman at one end of the scale, and to the specialist at the other end, or it may steer a middle course, in that it may be written, in the instance of a report on physics, for the physicist who is not necessarily a specialist in the particular section which he may wish to read. The Physical Society's Reports endeavour to make the double appeal to the specialist and to the physicist who is not a specialist, and certainly a number of the sections succeed in combining these appeals; others frankly endeavour to help the specialist to keep abreast of his subject; all are thoroughly readable and are fully documented.

One need say no more concerning the externals of the volume than that it is a production of the Cambridge University Press; type, paper and binding are alike of first-rate quality, and the volume is excellent value for the money. No research worker in physics can afford to ignore it, and the volume should find a place on the shelves of every library which has a section devoted to physical science.

Chemistry of War Gases

Die Chemie der Kampfstoffe

Von Dr. Mario Sartori. Aus dem Italienischen übersetzt von Dr. Hans Klumb. Pp. viii+259. (Braunschweig: Friedr. Vieweg und Sohn, 1935.) 18 gold marks.

THIS is a well-arranged compilation of the available information about the substances which were actually used in the Great War, or which were about to be used when hostilities ceased. Some fifty substances are dealt with, and for each of them there is a brief history of its discovery and of its use in the Great War, followed by descriptions of the methods of preparation in the laboratory and of manufacture, where known. The physical and chemical properties are given, together with a brief statement of the physiological action, and in some cases methods of detection and estimation in the air. This descriptive matter occupies four-fifths of the volume.

At the end of the book there is a table giving the substances that were actually used in the War, arranged in the order of their introduction. There are thirty-one entries in this list, which also gives a considerable amount of tabulated information about them. Another table contains seventeen substances which were prepared and investigated

during the War, but did not actually come into use.

At the beginning there are three short chapters of a more general character. The first discusses some of the physical properties of a few of the more important substances: their densities, vapour pressures, volatilities, boiling points, melting points, persistence and stability. Some of these properties are, of course, closely related; the higher the vapour pressure of a substance, the lower is its boiling point, the greater its volatility and less time will it persist when scattered on the ground. The class of sternutators, which are derivatives of diphenylarsine, is, however, to be reckoned among the non-persistent substances, in spite of their very low vapour pressures, because they are used in the form of smokes, or aerosols.

The second chapter deals with the relation between chemical structure and noxious action. In many cases similar compounds are seen to produce similar effects, as in the case of the sternutators, or 'nose gases', just mentioned. Many of the lachrymators, or 'tear gases', contain the group $\text{.CH}_2\text{X}$, where X is a halogen, and some contain the ketonic group :CO , but this does not apply to all of them. The very important group of vesicants, or blister gases, consists practically of

only two substances: mustard gas, $S(CH_2CH_2Cl)_2$, and lewisite, $CHCl:CH:AsCl_2$. Their action both on the skin and the other organs is very similar, but it is difficult to see much resemblance in their constitution except that they both contain chlorine. Most of the other noxious gases also contain one or other of the halogens, but they have practically no action on the epidermis. The other constituents that go to make a substance noxious appear to be sulphur, arsenic and $.NO_2$ and $.CN$ groups, but why some substances are so much more effective than others is not always easy to understand. The property of being soluble in the body fats is probably of importance.

The third chapter discusses the classification of 'gases', but is not very helpful. In the body of the book the substances are arranged according to the toxic elements and groups that they contain, which probably is most convenient in a purely chemical work, but in practice these substances are generally classified according to their principal physiological action.

A. MARSHALL.

Die Fermente und ihre Wirkungen

Von Prof. Dr. Carl Oppenheimer. Supplement, Lief. 1. (Bd. 1: Specieller Teil: Hauptteil 7-15.) Pp. 160. Supplement. Lief. 2 (Bd. 1, Specieller Teil, Hauptteil 8). Pp. 161-320. Supplement. Lief. 3 (Bd. 1, Specieller Teil: Hauptteil 8, 9). Pp. 321-480. (Den Haag: W. Junk, 1936.) 28s. each.

PROF. C. OPPENHEIMER'S "Enzymes" has established for itself the position of a 'museum' of reference and information on this ever-growing subject. Such status is accompanied by the disadvantage that the complete work becomes too costly to possess individually and to replace by new editions even by the libraries. Yet if it is not kept up to date, especially in a subject which moves so rapidly, its utility rapidly lessens. To meet this difficulty, it is being re-issued in the form of a supplement to the special parts, which are those most useful for the scientific worker, and not to the complete work. Following the German practice, this supplement is appearing in parts, the first three of which are before us. The whole is to comprise two volumes, and is to be complete in ten parts within about two years at a cost of £8 10s. 0d. to those who subscribe in advance.

The present parts deal with the esterases, in particular the lipases of animal and vegetable origin, and the carbohydrases, covering both the enzymes which split the various glycosides and the amylases.

As before, every effort has been made to cover adequately the enormous and confusing literature of this vast subject, and there is at least evidence that more attention is being paid to the English and American publications. Any criticism in detail is obviously impossible: our reading satisfies us that the work has been carefully done, and that it is closely up to date.

Modern Surveying for Civil Engineers:

the Practice of Surveying, Estimating and Setting out Works of all Kinds, including Chapters on Modern Photographic and Aerial Surveying as applied to Engineering Enterprises. By H. F. Birchall. Pp. xi + 524 + 26 plates. (London: Chapman and Hall, Ltd., 1935.) 25s. net.

MANY books have been written on geodesy and surveying for civil engineers and surveyors, and of their authors many are engineers with Colonial experience. The volume under notice falls within the latter category, and therefore must be considered from this point of view.

The impression obtained is that the work will be extremely useful to an engineer in the Colonies who has already had some experience of the subject, and this alone would justify the brevity of treatment of the sections dealing with such matters as the calculation of closed theodolite traverses, the principles of levelling, and the methods of setting up of a level, theodolite or tacheometer. Many teachers of civil engineering would probably join with the reviewer in questioning the advisability of omitting the study of practical astronomy, while it would perhaps have been preferable if the consideration of circular curves had preceded that of transition curves, instead of following it. The standard method of finding the constants of a tacheometer in the field is not given, while Fig. 30 on p. 24 is wrongly drawn. In other respects, the work is exceedingly well illustrated, though some of the illustrations would repay full lettering and description.

The sections which deal with actual examples of large surveys of civil engineering works in the Colonies are very interesting and well set out, and should appeal to readers whose practice involves problems of such a kind.

B. H. K.

Introduction to Vertebrate Embryology:

a Textbook for Colleges and Universities. By Prof. Waldo Shumway. Third edition, revised and enlarged. Pp. xii + 390. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20s. net.

IN recasting his excellent text-book of vertebrate embryology for a third edition, Prof. Waldo Shumway has incorporated much new material, especially summarising the results of recent experimental research, but has maintained the lucidity and suggestiveness of the previous editions. In its new form, the book is an admirable introduction to cytology and genetics and a clear exposition of the new work on organisation, which has recently acquired fresh distinction by the award of the Nobel prize to Prof. Spemann.

Its value to the student is enhanced by the technical information about microscopy and the methods of histological procedure. Altogether it forms an admirable introduction to embryology and genetics which can confidently be commended both to students and teachers of this important part of anatomy.

A Text-Book of West African Agriculture : Soils and Crops. By Dr. F. R. Irvine. Pp. xiv + 348 + 32 plates. (London : Oxford University Press, 1934.) 7s. 6d. net.

FOR an English doctor of science to write an agricultural text-book for native West African students can be no easy task, and only the West African reader can say how far Dr. Irvine has succeeded in his objects. The outlook of the African native towards soil science must, for example, be different from that of the European, and require a different mode of presentation from the teacher. Dr. Irvine has, however, succeeded in compressing into seventy pages a most lucid and simply expressed account of the essential points of soil science, and although this involves some degree of over-simplification, it always affords at least as adequate an explanation of fact and is as intelligible as the more orthodox point of view.

The main part of the book is devoted to descriptions of the cultivation of almost every crop that is or might be grown in West Africa, and should be of great value not only to the students of Achimota College, but also to all who wish to know the rudiments of tropical agriculture and economic botany. Dr. Irvine is cautious in recommending the adoption of modern European methods and implements into African agriculture, confining himself to descriptions rather than to praise of the achievements of more northerly civilisations. This is an excellent feature, and shows a deep understanding of the needs of the readers for whom the book is primarily intended, and by pointing out the virtues as well as the failings of the time-honoured systems of native agriculture gives the book an added value to the English reader.

The book is well produced and fully illustrated with plates and diagrams.

Our Enemy the Termite

By T. E. Snyder. Pp. xii + 196. (Ithaca, N.Y. : Comstock Publishing Co., Inc., 1935.) 3 dollars.

THE author of this book has been associated, as an entomologist, with the U.S. Department of Agriculture since 1909. During this period he has been chiefly occupied with the investigation of termites, and other wood-destroying insects, and his original writings on these subjects are known to most entomologists. Much of the first-hand knowledge, thus acquired in an official capacity, is incorporated in a general way in this useful manual. The species of termites discussed are those native to the United States. While these 52 species represent only about 3 per cent of the world's termite fauna, the limitation is offset by the fact that most phases of termite biology are discussed. Dr. Snyder's book is, in fact, an authoritative introduction to the complexities of termite economy. The subjects of castes, reproduction, colony founding, growth, food, inquilines and other phenomena all come in for treatment.

The biological aspect of termite life is followed by chapters dealing with the relationship of these insects to man. The damage they bring about to buildings, crops and other property is well known, but relatively

few people understand the ecological principles underlying effective control. Dr. Snyder has much to say on this subject ; he is an advocate of the adoption of proper codes for building construction as a means for prevention, and explains the procedure to be adopted. The numerous clear illustrations, mostly taken from the author's published papers, add to the value of the book. While it is to be commended to the biologist, its clarity of style, and the addition of a glossary of unfamiliar terms, renders it easily understandable by the layman.

A. D. I.

Weeds

By Prof. W. C. Muenscher. (Rural Science Series.) Pp. xxii + 577. (New York : The Macmillan Co., 1935.) 25s. net.

TRADE in plant products between widely separated countries has brought with it an interchange of the weeds of cultivated land. By the spread of Western civilisation to all parts of the world, there has resulted a preponderance of European weeds among the emigrants to other temperate regions. North America is no exception. A survey of this weed flora of the northern part of the United States shows that a large proportion of the adventive weeds are from Europe. The wide range of many weeds therefore renders a weed flora of more than local interest.

The problem of weed control is twofold, for it is necessary first to identify the plant concerned before it is possible to choose the most suitable means for destruction. Both of these aspects of the problem are dealt with fully in this book. Chapters are devoted to agencies of weed dispersal, means of circumventing weeds, and weeds of special habitats. Mechanical and chemical methods of weed control are discussed in concise manner, but with sufficient detail to allow of their application by the practical farmer. Numerous references are given to modern research in this field. The bulk of the volume consists of a flora in which about five hundred weeds are described, suitable means of destruction being suggested for each. Many excellent line drawings, an artificial key to the species and a glossary should all increase the value of the work to the layman.

Electron Diffraction

By R. Beeching. (Methuen's Monographs on Physical Subjects.) Pp. viii + 108. (London : Methuen and Co., Ltd., 1936.) 3s. net.

THE increasing interest manifested in problems of surface and molecular structure is sufficient justification for the appearance of this very clear and well-balanced little monograph, quite apart from the excellent practical illustration which it gives of the principles of wave mechanics. In the scope of a hundred pages, the author has discussed electron wave properties, the early history of the experimental side of the subject, diffraction by transmission and by reflection, apparatus and technique, and the principal types of problem suited to investigation by electron diffraction. The book may be strongly recommended as a most useful review of the subject.

A. F.

The Galactic Nebulæ*

By J. H. Reynolds

THE relationship which exists between the dark galactic clouds, the luminous diffuse nebulosities and the involved or neighbouring stars is now generally recognised, but it has been only during the last twenty years or so that the real connexion between them has become evident, owing principally to the work of Slipher and Hubble. The luminous nebulosities, such as that surrounding θ Orionis and ρ Ophiuchi, are regions on the near side of obscuring clouds, illuminated by stars within effective range. The medium composing the clouds is lit up in two ways, depending on the temperature of the stars involved. Stars of B_0 type and higher temperatures excite and ionise the atoms of the cloud by intense ultraviolet radiation, the resulting characteristic radiations being principally hydrogen, oxygen (singly and doubly ionised in the metastable state), and helium. With stars of lower temperature than B_2 , the illuminated cloud gives a continuous spectrum of the same type as the stars, which we may reasonably interpret as reflected light, while nebulosities surrounding intermediate stars show a combination of both types of spectrum.

Although the great advance in nebular astronomy during the present century has been entirely due to photography, since the pioneer work of Common and Roberts in Great Britain, and Keeler in America, the blotting out of the involved stars by over-exposure has had the effect of masking the apparent luminosity relationship between the stars and the surrounding nebulosity, so that some of the galactic nebulae came to be regarded as independent formations. As an example of this I may mention Wolf's photograph of Nebula N.G.C. 7023 in Cepheus (Fig. 1). No one would think from the photograph that any star was involved in the nebula at all, although it is in fact the nebulosity surrounding the star B.D. 67° 1283. This brings me to a point which seems not to have met with the consideration it deserves, and that is the real relationship between the magnitude of the star and the surrounding nebulosity. It is evident that the apparent relationship depends for one thing on distance. If, for example, the Great Nebula in Orion were twice its actual distance the involved stars would be reduced to a quarter of their present brightness, while the apparent luminosity of the surrounding nebulosity would be still the same as at present, although reduced in size to half its angular diameter.

There is another complication introduced by the type of instrument employed. Broadly speaking, the apparent brightness of a star in the telescope depends on aperture, while the brightness of the surrounding nebulosity depends on focal ratio. By using a short focus reflector or lens we can increase



FIG. 1. Star involved in nebulosity, N.G.C. 7023.

the intensity and extent of a nebulosity; but the photographic result is apt to give a very erroneous impression of its real brightness, or rather faintness. A third modification is introduced by the three dimensional form of the nebulosity, which makes it impossible to say what is the real local distribution of intensity in an irregular cloudblike formation. It seems, therefore, impossible to measure the true ratio of intensity between any particular point of nebulosity and involved stars; but it is possible to measure with advantage the light distribution in planetary nebulae, as these are usually symmetrically shaped formations, and consist of concentric gaseous shells transparent to their own radiations.

The first to realise the true character of the dark obscuring clouds in the Galaxy was Barnard, who

* From the Presidential Address delivered to the Royal Astronomical Society on February 14.

used a 6 in. short focus lens. Their extent must be enormous, as they cover many square degrees of the sky in Orion, Cygnus and other regions in and about the Galaxy. Their edges are usually luminous, although there are some well-known exceptions to this. Thus the North America Nebula in Cygnus is really the luminous edge of an extensive dark cloud (Fig. 2). On one side of the bright edge star-counts give only 10 per cent of the number on the other, where the normal stellar background of the Galaxy is shown with little or no obscuration. The same applies to the long filaments of nebulosity N.G.C. 6960, 6992 in Cygnus, although in these cases the disparity of

by $\lambda\lambda$ 3727/9 extends much farther away from θ than $\lambda\lambda$ 5007, 4959, the radiations of doubly ionised oxygen. Hydrogen seems to be almost co-extensive with singly ionised oxygen, while helium is found mostly in the central regions. We have therefore to deal with elements of low atomic number, which form a large part of our own atmosphere. It seems curious that there is not more evidence of nitrogen in these clouds, another gas of low atomic number and very widespread in our atmosphere. The explanation seems to be that singly ionised nitrogen in the metastable state has two strong radiations at $\lambda\lambda$ 6584, 6548, but no other radiations occur within accessible range.

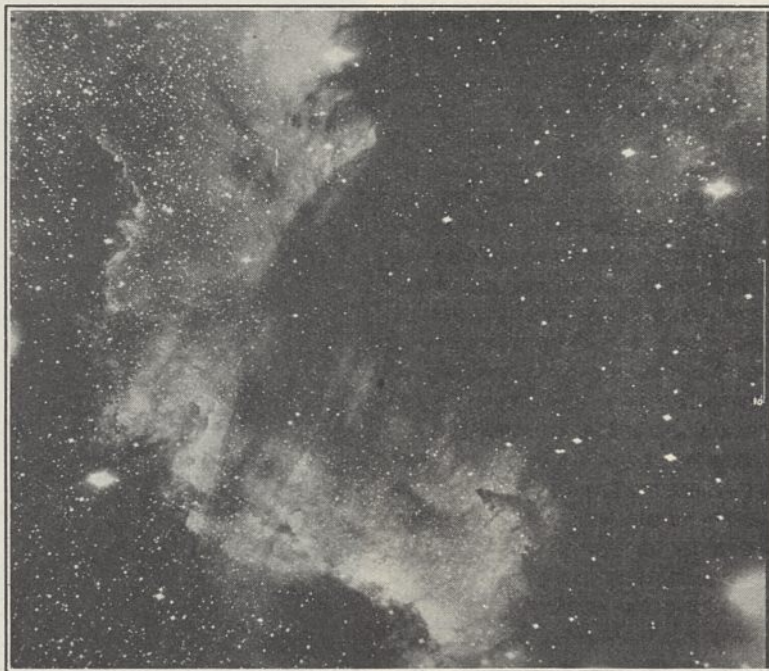


FIG. 2. North America Nebula in Cygnus, N.G.C. 7000.

star-counts on either side is nothing like so marked, owing either to a shallower depth of the absorbing medium, or a greater rarefaction, or both in some degree. There seem to be indeed all degrees of density of the absorbing medium between complete opacity at a shallow depth, such as the dark nebulosity near ζ Orionis, and a scarcely perceptible dimming of the stars by a light veil.

We come now to the important question of the composition of these clouds. In the case of the Orion Nebula and others giving a gaseous spectrum, we have quite definite evidence as to their nature. They consist of hydrogen, singly and doubly ionised oxygen in the metastable state, and helium. These radiations extend for a range of about eight light years from θ Orionis if we take the usually accepted distance of 180 parsecs. As might be expected, the singly ionised oxygen represented

Both these radiations are conspicuous in some of the planetary nebulæ, although I cannot find that they have been identified yet in the Orion Nebula.

It has often been assumed that the clouds must consist of solid particles owing to the fact that they reflect the light of neighbouring stars, and have a strong absorbing effect. But there is definite evidence that there can be no considerable amount of solid particles in the gaseous nebulæ, as such particles would tend to absorb the radiations from the gases, and give a continuous spectrum. It is now generally accepted that the characteristic radiations of the gaseous nebulosities are due to the ionisation of the gases in the cloud by the strong radiation of ultra-violet light or streams of electrons emitted by the high-temperature stars involved. When the effective distance limit of this ultra-violet radiation is passed, the atoms being no

longer ionised would naturally be present in their neutral condition. There seems to be no valid reason why these neutral atoms should not form molecules, and even enter into combination with atoms of other elements to form molecules of water vapour and, if nitrogen is present, of ammonia. Owing to the low temperature of interstellar space, such molecules could scarcely exist in a gaseous or liquid form. Is it not, therefore, possible that the 'dust' which causes the reddening of the light of stars involved in or behind the clouds, and reflects the light of stars of temperature lower than *B2*, may be particles of frozen water vapour and perhaps ammonia? In any event, all the evidence we have is that only gases of low atomic number

there was only a rough correlation between the two. The projected outline of both N.G.C. 6729 and Hubble's Variable Nebula is comet-like, and is comprised irregularly within an angle of 60° with the variable as the apex.

The illumination of the nebulosity N.G.C. 6729 is consistent with the idea that the light of the variable star is transmitted to the cloud with the velocity of light, if a distance of about 120 light years is accepted. But the most striking evidence for this is afforded by Slipher's spectrographic investigation of these two variable nebulae, for both the stars and the nebulosities gave a spectrum similar to the earlier spectrum of novae. Bright hydrogen lines are specially conspicuous, with



FIG. 3. A planetary nebula, N.G.C. 7635.

are present; but we do not know enough of the physical conditions to answer the question.

Perhaps the most extraordinary examples of the 'reflexion' nebulae are the 'variable' nebulae. Three of these are known—Hind's variable nebula in Taurus, near τ Tauri, N.G.C. 6729 in Corona Australis, and Hubble's variable nebula in Monoceros. All three are connected with variable stars and dark obscuring clouds, but it is the last two that are specially interesting.

Knox Shaw has made a detailed study of N.G.C. 6729, in the *Helwân Bulletins*. The dark cloud against which the variable nebula is projected is very dense, and the edge is not illuminated, although there are two conspicuous patches of luminous nebulosity surrounding two stars, which must be on the near side of the cloud. The form as well as the brightness of the nebulosity varied to some extent with the magnitude of the star, but

absorption on the edges of shorter wave-lengths, and bright helium also appears with many other radiations found in Nova Aurigæ at an early stage.

Although the planetaries give the same type of spectrum as the gaseous diffuse nebulosities, they are totally distinct in their origin and characteristics. There is no doubt now, I think, that they originated as new stars. The concentric, or almost concentric, shells of gas were blown out from a nova at the original outburst, and have been travelling outwards for many thousands of years in most cases, at velocities slow compared with those of the original outburst. Nova Aquilæ in 1918 was the first of these outbursts to give us the clue, and Campbell's classic work on the planetaries, of which details can be found in the *Lick Obs. Bull.*, vol. 13, gave us the corroborative evidence we wanted. It is true that Nova Persei in 1901 showed a rapidly expanding luminous shell,

but this Kapteyn interpreted at the time as the passage of light outwards in a cloud. This explanation still holds good, as the parallax of this star is so small that no other seems to account for the extremely rapid growth of the shell. In six months it had expanded to an angular distance of between 6' and 7' from the star. This first luminous ring was followed by a much smaller nebulous envelope which had expanded to about 30" in diameter by 1926. It is of irregular form, and from the curious hook-like form of its spectral lines is still expanding at a considerable rate.

The great majority of planetary nebulae are almost symmetrical about an axis, and are either elliptical or circular in outline. In some cases the gases are concentrated in the outer rim of the shell and it is not so long ago that 'ring' nebulae were differentiated from the planetaries in the catalogues, the N.G.C. for example having a different symbol for each.

We know now, of course, that the central stars which are of *O* type, and probably dwarfs, are the cause of the illumination of these enormous globes and shells of gas, by strong radiation in the extreme ultra-violet. The slitless spectrograph of the Crossley reflector at the Lick Observatory gave separate images along the spectrum, and the comparative diameters of these show much the same sequence as the diffuse gaseous nebulae. The smallest images are helium and doubly ionised oxygen, and the largest are singly ionised oxygen (both in the metastable state), and hydrogen. In a good many cases singly ionised oxygen is not represented at all.

Like the new stars, the planetaries usually are found near or in the Galaxy, and their parallaxes are small. But if novae are responsible for the planetary nebulae, how is it that we do not find them on the sites of well-known outbursts in the past?

Tycho Brahe's great nova of 1572, which equalled Venus in brightness, was situated in Cassiopeia in declination 61° and about one and a half degrees from α , according to his observations, which were taken with great care. After allowing for precession, we can determine the locality of the outburst to-day, but although a search has been made, there is no trace of a planetary nebula within 8° of it. Tycho Brahe's nova was not the first in this region, for two others were reported in old chronicles in the region between Cassiopeia and Cepheus. One occurred in A.D. 945 and another in A.D. 1264. There is, however, a very unusual type of planetary in R.A. $23^h 16^m$, Dec. $+60^\circ 39'$ (Fig. 3), lying about 8° away from the site of Tycho's nova, and it may be that this is the result of one of the earlier outbursts. It differs from all other planetaries in the fact that the bright illumination of the clearly defined outline over about 80° of arc is due,

not to a central star, but to an eighth magnitude star probably outside the shell altogether. The contour of the rest of the disk, which is only visible in part, is about 3' in diameter, which at a distance of 200 light years would represent 0.3 of a light year in diameter.

It would seem that if the radiation from the central star falls below a certain temperature, and no longer extends into the ultra-violet, the whole nebular shell disappears, so far as visibility is concerned. This is only what we might have expected, but we are still left with the difficulty of explaining its continued existence at all as a shell of gas, if the spheroidal form is the result of a balance between gravitation and radiation pressure, the basis of most of the theoretical work on the subject. It is possible of course that it is no longer entirely gaseous, as there is some evidence of obscuration. This unique object at any rate shows us that there may be invisible as well as visible planetaries.

The researches of Keeler, Campbell, Moore, Wright and Curtis at the Lick Observatory on the planetaries were undoubtedly the most complete ever undertaken at a single observatory. Besides the direct photography with the 36-in. Crossley reflector, and the work with the slitless spectrograph, a spectrograph with a slit and high dispersion attached to the 36-in. refractor revealed the fact that some of the planetaries were still in motion radially, and also in slow rotation.

With the slit placed across the major axis when the outline was elliptical, the lines at $\lambda 5007$ and 4959 were found to be either doubled or widened in the middle, and the ends of lines were slightly twisted in some cases. This doubling or broadening of the lines is naturally interpreted to-day as a measure of expansion or contraction, although Campbell did not agree with this view, but the twisting and inclination of the lines he explained himself as a rotation effect.

The most striking feature of the *O* type nuclear stars is their great and increasing intensity towards the ultra-violet end of the spectrum. The maximum radiation seems to be actually beyond the atmospheric limit of $\lambda 2800$, while the visual range is unusually faint. This explains why the central stars were missed in the days of visual observation, and why they come out so readily in photographs. Instead of colour excess, such as we find in the stars involved in the clouds, we find a large colour deficiency. It is difficult to give a reason for this faintness of the visual spectrum. It can scarcely be actual and we are led to think that there must be some physical effect in the mechanism of excitation of the gaseous shell which weakens the transmission of the longer wave-lengths but allows the ultra-violet to pass without loss of energy.

The Mean Annual Loss of Life during Earthquakes

By Dr. Charles Davison

IT is always difficult to make an accurate estimate of the number of lives lost during a great earthquake, and impossible in such disasters as those of Lisbon in 1755 and Messina in 1908. For Lisbon alone, the estimates vary between 30,000 and 70,000; but the bodies were removed from the city in masses without being counted. In the Messina earthquake, the first estimates gave 150,000 as the number of persons killed. A later report reduces the figure to 82,000, but, as it includes more than 32,000 "presumed killed", the real number may be about 50,000. In the great Japanese earthquake of 1923, there is the same uncertainty. According to the official estimates, 99,331 persons are known to have lost their lives, but there were also 43,476 reported as missing. In all cases in which the figures differ widely, the mean of the greatest and least is taken in the estimate that follows.

In an attempt to determine the average annual loss of life from earthquakes, it is necessary to include the earthquakes that occurred during a considerable interval. If this were not done, the effect of a small number of losses so great as that of the Japanese earthquake of 1923 might unduly distort the average. In that here given, the earthquakes of the two centuries 1735-1934 are taken, with the exception of the Calcutta earthquake of 1737, for which the report of 300,000 persons killed seems doubtful. The well-known Milne scale of intensity for destructive earthquakes is used, though earthquakes of the lowest degree are omitted, as they contribute but slightly to the loss of life.

During the two centuries mentioned, the total

number of deaths in 135 earthquakes of the third degree of intensity in the whole world was 1,044,606, and in 61 of the second degree 2,125, leading to averages of 7,738 and 35 per earthquake. In the last century (1800-99) covered by Milne's catalogue of destructive earthquakes, there were 360 and 510 earthquakes of the two intensities. At the above rates, the total number of deaths per century would be 2,785,680 and 17,850, giving 28,035 as the average loss per year.

The average annual rates obtained in the same way for certain important earthquake districts may be given. They are as follows: 13,862 in China, 7,980 in Colombia and Ecuador, 2,240 in Japan, 1,006 in Italy, 991 in Central America, 715 in India, 586 in Persia, 550 in Asia Minor, 99 in Greece, 35 in the Philippines, 29 in Formosa, and 6 in the United States. In addition to the above regions, there is a number of others, such as Spain, Portugal, Venezuela, Algeria, etc., in which the numbers of earthquakes with known losses of life are too small to give satisfactory results separately. Grouping them together as a single district, the corresponding average number of lives lost per year is 2,380. The sum of all the above numbers is 30,479.

Thus, remembering the uncertainty of some of the estimates on which we have to depend, it would seem that the average number of lives lost every year in the earthquakes of the whole world is about 28,000-30,000. Of the two figures, the smaller is probably the more accurate, because the larger the region, the less will be the disturbing effect of the most destructive earthquakes.

Obituary

Vice-Admiral H. B. T. Somerville, C.M.G.

THE tragic death on March 24 of Vice-Admiral H. B. T. Somerville has removed from the world one who was imbued with the spirit of service and who, throughout his whole life, set an example of steadfast endeavour in all the duties which he was called upon to perform.

Boyle Somerville was blessed with good health, a strong sense of humour, a good voice, all the charming

characteristics of the best type of Irishman, and won the friendship of all who knew him. Of his earliest years in the Navy the writer has no personal knowledge, but his work as a surveyor remains, and it was a source of great satisfaction to him to know that his labours in so many parts of the world would continue to be of use and benefit to his fellow-seamen. To give something useful to the world, something which should endure for all time, is perhaps a normal

hope of all pioneers, and an insight of the untiring efforts and application necessary to the accomplishment of a modern detailed survey is given in his book "The Chart Makers" which, humorous though it is in many places, shows how arduous is the task of the surveyor and how painstaking his investigations.

In 1889, Somerville was appointed to the Surveying Ship *Dart* and served in her and in the *Penguin* in Australasian waters until 1896; after a short period of service in the Hydrographic Department, Admiralty, he joined the *Egeria*, and in that ship he proceeded to British Columbia, carrying out surveying work in the Straits of Magellan *en route*. During the latter part of the commission he became first lieutenant, and was in 1900 appointed first lieutenant of the *Triton* in home waters. He became commander in 1901 and was next appointed to take charge of special tidal observations in the Channel Islands. In 1903, he was ordered to undertake special surveys in the Persian Gulf, for which he received the appreciation of the Lords of the Admiralty. In the early part of 1904 he was selected to take command of the *Sealark* to carry out surveys in the Mediterranean and East Indies; it was during his time in the *Sealark* that he was instructed to collaborate with the Percy Sladen Research Expedition, in the work of which he was already so interested. Returning home to England at the end of 1907, he was placed in charge of the West Coast of England Survey, and in 1912 took command of the *Research* in home waters, in which ship he was serving on the outbreak of war in 1914.

During the War, Somerville, who had been promoted to captain in 1908, was in command of H.M. Ships *Victorian*, *Amphitrite*, *King Alfred* and *Devonshire* in the 10th Cruiser Squadron. He was promoted to Rear-Admiral in 1919 and to Vice-Admiral (Retired) in 1925.

His last work in the Hydrographic Department was the compilation of "Ocean Passages of the World", and he served as chairman of a Tidal Committee in 1923.

Admiral Somerville was interested in a great variety of subjects, and whilst in the Pacific Islands collaborated with the late Commander S. C. Weigall, R.N., in compiling vocabularies of dialects of some of the Polynesian islands; he also turned his mind to the improvement of sounding appliances, and the Somerville gear, which was a great advance on older methods of sounding, is still used in the surveying service. The last years of his life were devoted to literary work chiefly connected with the South Seas, where so much of his early life was spent. In 1934, he published "Commodore Anson's Voyage into the South Seas and Round the World", in which he used his knowledge of those waters to rewrite Walter's classic, embodying at the same time the results of his researches in the Admiralty records of the period. At the time of his death he was engaged on a similar modernised version of William Mariner's "Account of the Natives of the Tonga Islands", and had already collected a considerable amount of unpublished material not known to Dr. Martin, who published the original book in 1817.

Mr. C. A. W. Monckton

WE regret to record the death, which took place on March 1 in London at the age of sixty-three years, of Mr. C. A. W. Monckton, explorer and formerly administrative official in Papua.

Charles Arthur Whitmore Monckton was born in New Zealand in 1872 and went to New Guinea in 1895, when Sir William MacGregor was Lieutenant-Governor. In 1898 he entered the public service as resident magistrate at Samarai. The administration of the country under British rule was then in its earliest stages of organisation, and Monckton's duties were largely the pursuit of raiding parties, who constantly attacked the white miners within his jurisdiction, which covered the north-eastern area of the island, not previously administered, and of which he was the first resident magistrate. In 1903 he was also given the Northern Division, which was in a state of disorder.

In 1906, when in pursuit of previously unvisited tribes, some of whose members had raided a miners' camp and murdered some of its occupants, Monckton made the first ascent of Mount Albert Edward (13,320 ft.) under the fire of hostile bowmen, and mapped the country from it. A more strenuous expedition of the same year to the Wasia River in search of gold and to ascertain how far the river lay in British territory encountered terrible hardships and ended in disaster, for which Monckton was criticised by the authorities. In September 1906, New Guinea had come under the Australian Commonwealth; and Monckton, with characteristic impetuosity, resigned and retired to England, where he lived for the remainder of his life.

A pioneer in administration, Monckton was one of the first to recognise that the qualities which lead a native to transgress the white code by adherence to tribal custom, such as raiding and head-hunting, might be turned into useful channels. He invariably recruited his very efficient police from such criminals. He published three books in which a great gift of humour was used to advantage in displaying a keen appreciation of native character, while at the same time recording data of no little value relating to tribes at that time unknown. His first book, "Some Experiences of a New Guinea Resident Magistrate", appeared in 1920 and was received with acclamation by the critics. It was followed by "Last Days in New Guinea", published in 1922, and "New Guinea Recollections" in 1934.

WE regret to announce the following deaths:

Mr. James Whitehead, K.C., fellow of the Imperial College of Science and Technology, who was a leading authority on Patent law, especially in its applications to technology, on April 3, aged fifty-eight years.

Dr. W. A. Parr, president of the British Astronomical Association in 1932-34, on April 2.

Prof. J. Stoklasa, director of the State Institute of Research in Plant Products, Prague, on April 4, aged seventy-six years.

News and Views

Sir Robert Mond: Award of Messel Medal

THE Society of Chemical Industry has awarded its Messel Medal this year to Sir Robert Mond. This medal is awarded to those who have attained eminence in applied chemistry, and is given in alternate years. Sir Robert Mond has for many years been associated with prominent concerns in the chemical industry. He is a director of the International Nickel Co., the South Staffordshire Mond Gas Co., and the Mond Staffordshire Refinery Company, Ltd., and his directorships in the past have included those of the Mond Nickel Co., and Brunner Mond and Co. Sir Robert was born in Lancashire. He is the son of the great industrial chemist Dr. Ludwig Mond, and the award of the medal will be felt by many chemists to be not only an acknowledgment of Sir Robert Mond's own services to chemical industry in Great Britain, but also a reminder of the important part taken by the Mond family in the progress of industrial chemistry in Great Britain. Dr. Ludwig Mond, Sir Robert's father, was prominent in the early organisation of the Society of Chemical Industry, having been one of its first secretaries in 1881 and its president in 1888. Sir Robert was educated at Cheltenham, Cambridge, Zurich and Edinburgh, and worked for some time with Sir William Thomson, later Lord Kelvin. He was largely responsible for the planning and equipment of the Davy Faraday Laboratory at the Royal Institution. Sir Robert is also well known for his interest in Egyptology; and he is also chairman of the Norman Lockyer Observatory Corporation. He was knighted in 1931.

Exhibitions of Chinese Art

THE exhibition as a whole of the Eumorfopoulos Collection of objects of Chinese and Far Eastern art acquired for the nation, announced to take place in the Victoria and Albert Museum, South Kensington, will be declared open by the Chinese Ambassador on April 17. Not only will some of the pieces now be seen by the public for the first time; but also it is the last occasion on which it will be shown as a single collection. When this exhibition closes at the end of the coming summer, the exhibits will be divided between the Victoria and Albert and the British Museums, and certain of them will be allocated on loan to other museums. This exhibition will supplement the exhibition of Chinese art at the Royal Academy in several directions. The art of the Han and T'ang dynasties, for example, will be much more fully represented; and there will be an extensive series of the pottery burial figures of the Wei dynasty (A.D. 386-535). The Eumorfopoulos collection also affords opportunity for comparison, as it includes example of art from areas which did not come within the scope of the exhibition at Burlington House, such as the art of Korea, little known and not otherwise

well represented in Great Britain, and the art of the nomadic tribes of southern Siberia. A charge for admission of 1s. will be devoted to the fund for the purchase of the collection, of which at present only one half has been raised. An exhibition of Chinese art is also being held in the City Art Gallery, Manchester. It was opened by the Chinese Ambassador on April 3 and will be on view for a period of six weeks. It consists of some of the exhibits lent to the exhibition at Burlington House by British collectors, together with specimens from collections in Lancashire and Cheshire.

American Indians and the Land

EQUALLY with other citizens of the United States, the American Indian is benefiting under the 'New Deal'. An appropriation has been made to purchase for his benefit some of the land in Oklahoma now in the possession of the whites, which formerly belonged to Indian tribesmen. The prospects of the Indians have now much improved under the legislation promoted by the Hon. John Collier, Commissioner for Indian Affairs since 1932. He was largely responsible for the passing of the Wheeler-Howard Act in 1933, under the provisions of which an attempt is being made to promote the prosperity of the Indian on lines in accord with the tradition of tribal culture, and to revert, so far as is now possible, to the system of group tenure of land, which was broken up in the mistaken efforts of a previous generation to develop the Indian standard of life by individual grants of land. The provisions of the new legislation and its relation to existing conditions are summarised by Dr. Wilton Marion Krogman of the Western Reserve University, Cleveland, Ohio (*Z. Rassenkunde*, 3, 1).

LAND may no longer be held in severalty by the Indian, but only through the tribe or group under the guardianship of the Federal Government, on a tenure which may vary in form. The sum of 2,000,000 dollars, together with such further sums as may accrue, has been set aside for land purchase, while a credit sum of 10,000,000 dollars has been set up, which is available for any Indian through a tribal corporation. The Indians, it is to be noted, are to be encouraged to retain their tribal culture—though not in the "back to the blanket" sense—and administration is to adapt itself to local variations in cultural pattern. It is estimated that between 1887, when they were settled on the reserve, and 1932, the Indians lost through alienation 90,000,000 acres of their grant of land. Of the remaining 47,000,000 acres one half is desert; and there are now 150,000 Indians who have no land. The popular conception that the Indian is a degenerate and disappearing race is entirely erroneous. In certain selected areas between 1905 and 1934, the Indian population rose from 61,146 to 78,139.

Horse Mummification in Ancient Egypt

MUMMIFICATION of sacred animals is a familiar practice in the annals of Ancient Egypt, especially in the later periods. A discovery of what is thought to be the earliest known example of the mummification of a horse has recently been made on the hill of Sheikh Abdel Kurneh, on the west bank of the Nile at Thebes, by an expedition of the Metropolitan Museum of New York under the field direction of Mr. Winlock. The expedition is carrying on Mr. Winlock's excavation interrupted in 1927, when he discovered the tomb of Sen-Mut, the architect of the famous temple of Queen Hat-shepsut at Deir el-Bahari. The work of the present season, it is stated in a dispatch from Cairo in *The Times* of April 6, has brought to light the intact tombs of Ra'mose and Hatnufer, the father and mother of Sen-Mut. In clearing the bottom of the ravine preparatory to opening the rock chamber, in which the burials were found, the body of a horse was uncovered in the limestone clif. It had been mummified and wrapped and enclosed in an enormous coffin. It is of the xviiith dynasty and, therefore, probably the oldest horse burial found in Egypt up to the present. The rock chamber was crowded with funerary material, including jars and baskets containing linen, food, and in one instance a silver bowl and two small pitchers for mixing wine. Two jars are dated the seventh year of Tuthmosis III, while some of the linen and jar sealings bear titles of Hat-shepsut when she declared herself King of Egypt. On one side of the chamber were uninscribed rectangular coffins and on the other anthropoid coffins bearing inscriptions indicating that they contained the bodies of Ra'mose and Hatnufer. Neither had an official title.

Messrs. Taylor, Taylor and Hobson, Ltd.

THE fiftieth anniversary of the foundation of the firm of Messrs. Taylor, Taylor and Hobson, Ltd., manufacturing opticians and engineers, was celebrated on Monday, April 6, by a dinner given by the directors to all employees and a few guests. The brothers Mr. Thomas Smithies Taylor and Mr. William Taylor, F.R.S., were the founders of the business in 1886. The first lenses produced by the firm were known as Rapid Rectilinear lenses. These were followed by single achromatic 'View' lenses and wide angle lenses. Mr. William Taylor at this time devoted a great deal of attention to establishing the manufacture of lenses and lens parts on an interchangeable basis, and providing means of cutting screw threads accurately. The abruptly started thread was devised and patented, and he started the practice of measuring screw threads trigonometrically with a micrometer, and with little cylinders, or wires, put between the threads, and of measuring threading tools and the amount by which they were shortened from a theoretically perfect point, by means of a notched bar. The methods were gradually developed and led to the manufacture of the engraving machine which is now well-known as the 'Taylor-Hobson Engraver'. Mr. W. Taylor has served on many standardisation committees and was responsible for establishing the principle that in gauging screw

threads, the 'go' gauge must include all the elements and the 'no-go' gauges deal with them separately, except that pitch and effective diameter must be gauged concurrently. The election of Mr. W. Taylor as a fellow of the Royal Society in 1934 was a mark of recognition by British men of science of his pioneer work in the application of mechanical engineering to the manufacture of optical instruments, and the improvements of photographic lenses.

The Aberdeenshire Dee

RIVER FLOW RECORDS, the private organisation directed by Capt. W. N. McClean, has just issued in brochure form (Parliament Mansions, London, S.W.1. 10s. 6d.) a complete account with diagrams of the observations and readings taken for the year 1935 in connexion with the survey of the River Dee (Aberdeenshire), comprising records of water-level, flow and rainfall. The diagrams, in four sheets, exhibit in coloured outline the monthly water-levels at Cairnton Gauge Post in 3-hourly averages, and the aggregate rainfall and run-off over a catchment area approximately of 528 square miles. The value of these monthly diagrams has been enhanced since their publication for 1934 by the inclusion of the maximum and minimum temperatures and wind at Balmoral and by the incidence of rainfall from the automatic rain gauge. Thus the occurrence of snow and the effect of temperature in increasing or diminishing the flow become clear in winter and spring months. The effect of wind is not obvious, and it appears likely that certain changes in water-level, which, locally, are attributed to strong down-stream winds, may be due to temperature.

ONE aim of the records is the comparison of rainfall with run-off. Daily rainfall observations were taken from ten gauges widely distributed over the area, and acknowledgments are made of the assistance rendered by the Meteorological Office at Edinburgh, the British Rainfall Organization, the Royal Meteorological Society and voluntary observers. The mean annual rainfall on the area of 528 square miles given by the British Rainfall Organization is 42 in.; the year 1935 provided 42.7 in. and 1934, 48.4 in., deduced from daily observations at the ten gauges mentioned above, combined with the mean distribution of rainfall on the area. Assessed at the end of September in each year, when the ground saturation is generally low and therefore negligible, the residual loss was 8.34 in. in 1933; 11.48 in. in 1934 and 7.36 in. in 1935. The operations of River Flow Records are extremely valuable as an aid to a national inland water survey, and the report suggests the formation of a committee of river interests, under the independent patronage of the county, to carry the Dee survey to fruition, but "the final picture would be incomplete" without the central supervision and financial support of the Government.

Protection of Wild Life in Africa

THE Convention for the Protection of the Fauna and Flora of Africa, signed on behalf of nine Governments in London on November 8, 1933, became

effective on January 14, 1936. The ratified articles have therefore come into force in all the African territories of Great Britain, Belgium, Egypt, the Anglo-Egyptian Sudan and the Union of South Africa (Science Service, Washington, D.C.). As a result, gorilla, okapi, white rhinoceros, pigmy hippopotamus and eighteen other rare wild animals, together with the unique plant of the Kalahari Desert, *Welwitschia*, are now absolutely protected. Protection almost as complete is afforded to a series of animals in List A, which may not be killed for ordinary purposes at all, either by natives or whites, but may be taken in strictly limited numbers, with Government permission, for important scientific purposes. There are included such African elephants as possess tusks less than ten pounds in weight. If the tusks be heavier than ten pounds, the elephants fall into Class B, where they are partnered by black rhinoceros, the two species of giraffe, the wild ostrich and several kinds of egrets and hornbills. Class B animals may be hunted only by special licence, whereby the area, time and extent of the hunting is strictly limited and defined.

British Empire Naturalists' Association

At the annual general meeting of the British Empire Naturalists' Association to take place in the Artworkers' Guild Hall, London, on April 29, under the chairmanship of Mr. Richard Morse, the lecturer will be Mr. D. Seth-Smith, curator of birds at the London Zoological Gardens. The Council of the B.E.N.A. has recently drawn up a resolution protesting against the choice by the Air Ministry of a section of the Northumberland coast near the Farnes, frequented by many uncommon birds and including the only English breeding station of the eider duck and the only East England breeding station of the grey seal, for a future bombing station. A new local branch for Shropshire has recently been formed by the Association, and has already begun activities. It has been decided to hold the annual B.E.N.A. all-night ramble and dawn bird song record in Surrey on the night of Saturday-Sunday, May 23-24, the organisation of this being carried out by Mr. W. J. Finnigan, who has cared for the previous all-night meetings. The B.E.N.A. herbarium, for long at Bexhill, has now been transferred to the South London Botanical Institute, 323 Norwood Road, London, S.E.24, where it may be inspected daily from 2 until 9 p.m. except on Thursdays, Sundays and days of outings of the Institute.

Electric Developments in British Ships

DURING the last three years, the shipowning and shipbuilding industries have been seriously depressed. It is satisfactory therefore to learn from a paper by Colonel A. P. Pyne (*J. Inst. Elec. Eng.*, February) that steady progress has been made in the applications of electricity in British ships. The popularity of short cruises in large luxury liners has favoured development. The problem of ventilation has attracted attention. It is now recognised that the stirring up of air by means of fans, or even the delivery of

warmed or cooled air to given points by means of ducts, does not suffice. Air conditioning now takes into consideration the problems of the draughtless delivery of purified air and the extraction of vitiated air in the proper proportions. The incoming air must have the right temperature and the correct humidity to suit the climatic conditions of the moment. The air conditioning plant now changes the supply to warmed or cooled air automatically as required. The electric heating of public rooms and cabins is becoming universal. The heaters adopted are generally of the convector type, made more cheerful by luminous effects. The depression of the industry has prevented electric marine propulsion from making much progress. Two large motorships, the *Stirling Castle* and the *Athlone Castle*, each having a tonnage of 25,500 and auxiliary generators of 3,500 kilowatts for lighting and power, are at present being built. The *Queen Mary*, having a tonnage of 73,000, has auxiliary generators of 9,100 kilowatts capacity. The steam turbo-electric *Normandie* built in France last year has a tonnage of 75,000 and auxiliary generators for lighting and power of 13,200 kilowatts.

New Telephoto Systems in the United States

THERE are various methods now in use in different countries for transmitting photographs, printed matter and line drawings by means of telegraph or telephone wires or by radio. In certain respects the circuits must meet more stringent requirements than those used by speech or music. The sending apparatus scans the picture in closely spaced lines and converts the light and dark portions into electric currents proportional in strength to the light and shade of the picture. The transmission along the line causes a weakening of the current, but this is got over by amplification at the receiver. In a circuit for telephotography the successive portions of the signal are spread out side by side so that all are seen by the eye at the same time. In telephoning, the ear hears them one after the other and any slight blurring is scarcely noticed. Any little irregularity in the time sequence of the signals is at once seen in the telephotograph and remains as a permanent record. In the *Bell Laboratories Record* of February, P. Mertz describes how this defect can be remedied by equalising the 'time delay' of the signals (which is done in the new Western Electric telephotograph system). For good pictures this time delay of the various rays in the transmission band must not exceed the two-thousandth part of a second. Photographs are given showing the great improvement produced by using this device on the transmission line. It is also shown how 'random noise', telegraph interference, high-frequency noise and 'echo' distort the photograph. The first of the new telephoto systems to be installed connects Miami, Washington, New York, Boston, Chicago, San Francisco, etc., and includes 7,400 miles of main circuit. In a single connexion between sender and receiver, there may be as much as 3,500 miles of cable and 2,500 miles of open wire.

Outstanding Problems in Photometry

DR. J. W. T. WALSH gave a thoughtful address on "Outstanding Problems in Photometry" to the Illuminating Engineering Society on February 4. He pointed out that the advent of the gaseous discharge lamp has made the problem of heterochromatic photometry a very urgent one. It is well known that if two surfaces are judged to be equally bright by a number of observers with normal colour vision when the brightness is one candle per square foot, they certainly do not necessarily appear equally bright when the energy they emit is halved (Purkinje effect). Another class of photometric measurements which presents new and difficult problems is the photometry of projection apparatus, such as motor-car headlights, signal lights and similar devices. For such apparatus the conception of candle-power often becomes meaningless. The different optical elements produce beams for which the effective light centres are at such widely separated positions that there is no point that can be approximately regarded as the effective light centre of the whole. Dr. Walsh suggests two methods of attack. The first is to abandon candle-power measurements altogether and give a figure or figures for the illumination produced at a specified distance from the face of the projector. The other is to make measurements of candle-power at very great distances from the projector. In the case of a railway signal, this distance may be half a mile. This calls for the use of a telephotometer. A sensitive instrument of this type will probably in the future become part of the regular equipment of any photometric laboratory which has to deal with projection apparatus. In addition, problems arise in deciding what type of measurement is most appropriate in particular cases.

Solar Research at the Kodaikanal Observatory

THE presidential address to the Section of Mathematics and Physics at the twenty-third Indian Science Congress was delivered by Dr. T. Royds, director of the Kodaikanal Solar Physics Observatory, who took as his subject "Some Solar Problems" (Calcutta: Asiatic Society of Bengal). Dr. Royds explained that he was dealing with topics which were the subject of present research at Kodaikanal. The first of these was the relation between the dark markings, seen on spectroheliograms, and the prominences. The motion of the dark markings near the limb demonstrates that they are situated at such a height above the photosphere that they would project 31" above the limb, whereas the average height of prominences is known to be 36". So far as Kodaikanal observations go, the dark markings and prominences appear to be different aspects of the same thing, that is, a narrow line of flame extending above the sun's surface, having a width of 7,000 miles, a height of 14,000 miles, and an enormous length amounting sometimes to 400,000 miles. Dr. Royds went on to deal with the problem of the support of the chromosphere: it has recently been found at Kodaikanal as the result of observations of the infra-red lines near 7770 Å. that oxygen is a normal constituent of the chromosphere. This fact

adds to the difficulties in the path of the theory that selective radiation pressure supports the chromosphere. Dr. Royds concluded his address by giving an account of the theory of the intensities of Fraunhofer lines and of recent measurements which have been carried out at Kodaikanal.

Garden Allotments

UNTIL the beginning of this century, allotments were chiefly to be found in rural districts; but at the present time, largely owing to the stimulus given to the movement during the Great War, nearly four times the number are situated in urban, as compared with rural, areas. Advice on their management is frequently required, particularly by residents in towns and cities, and the publication by the Ministry of Agriculture of an illustrated bulletin (No. 90. "Allotments". London: H.M. Stationery Office, 1s.) should prove of immense practical value to all holding or contemplating holding an allotment. The scope of the bulletin is wide, and only an indication of its range can be given here. Questions of soils and their treatment, manures and manuring, with a special section on lime, are dealt with in some detail. Full directions follow for the cultivation of all the ordinary market garden crops, such as potatoes, the cabbage group, peas, beans and root vegetables and to a lesser extent fruit and flowers. Advice is also given on simple methods for purposes of protection and forcing. Only a small section is devoted to pests and diseases, as the reader is referred to the more detailed publications on the subject already issued by the Ministry. At the end of the bulletin a summary of work appropriate for each month of the year will be found, together with useful hints for those intending to exhibit their vegetables at shows. Further, the business side of allotment holding is not overlooked, and a part of the bulletin is devoted to questions of rules for allotment associations, tenancy agreements, choice, planning and layout of sites and the methods by which an individual can, where practicable, acquire an allotment.

National Institute of Agricultural Botany

THE National Institute of Agricultural Botany has just published its sixteenth report, which records the services provided in 1935 by the Crop Improvement Branch and the Official Seed Testing Station at Cambridge and the Potato Testing Station at Ormskirk. A small quantity of the new variety of wheat 'Holdfast' was marketed during 1935. This wheat was bred from a cross between 'Yeoman' and 'White Fife', has a white chaff and white grain and shows a marked resistance to 'lodging'. It is particularly well fitted for growing on good land in high condition. The number of samples tested by the Official Seed Testing Station was 30,502, the highest on record. The work of the Potato Testing Station was seriously hampered by the abnormal weather conditions, but the usual tests of new varieties for susceptibility to wart disease were carried out, together with a number of yield and quality trials. A Lord Derby Gold Medal was awarded to 'Gladstone', a new potato produced

by Messrs. McGill and Smith Ltd. The Potato Synonym Committee has also published its findings from the trial plots laid down in 1935, and the list of varieties with their synonyms may be obtained on application. Those interested in farming and wishing to keep in touch with the current work of the Institute, one of the chief objects of which is to supply unbiased information as to germination, variety and productive value of seed, are recommended to join the fellowship of the Institute, particulars of which can be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

Soil Sterilisation

A THIRD and enlarged edition of Bulletin No. 22, "Practical Soil Sterilisation", has been issued by the Ministry of Agriculture. As in former editions, the volume deals with the practical aspects of sterilising soil by means of heat and chemicals, both on a large scale in glasshouses and in small quantities for market garden and propagation work. The process of sterilising soil by steam is now widely practised, and the recent development of a new device, the 'Hoddesdon' pipe system, which overcomes many of the disadvantages of the older methods, called for a revised issue of the bulletin. The new system is composed of pipes laid in position separately and joined prior to turning on the steam, thus enabling a more efficient distribution of the heat than was possible with the tray, grid or spike methods, where small areas tended to remain untouched. In addition, the cost, namely, £160 per acre, compares favourably with other methods, and the labour is less arduous, so that from all points of view the new system can be recommended to the commercial grower with every confidence. All practical details are supplied in the bulletin, which may be obtained from H.M. Stationery Office or any bookseller, (1s. net).

Oxidation-Reduction Potentials

FOLLOWING on hydrogen ion concentration, the subject of oxidation-reduction potentials has opened up a new field of investigation into the character of the media in which organisms flourish. Dr. L. F. Hewitt, in his "Oxidation-Reduction Potentials in Bacteriology and Biochemistry" (L.C.C., third edition, 1935), gives a very clear presentation of the theory as well as an account of the methods of measurement. The mechanisms underlying the action of respiratory pigments as well as the characteristics of certain bacterial culture media have been very profitably examined by this technique. A good deal of information has been derived from following the oxidation-reduction potential of the medium during the actual growth of the bacteria, and the findings have been supported by other methods of investigation. As a test method for defining the optimum conditions for growth, its further possibilities may be substantial. This little book will prove of great service to bacteriologists and biologists generally.

Osborn Library at New York

IN 1908, in the American Museum of Natural History, Prof. Henry Fairfield Osborn (see NATURE of November 16, 1935) established the Osborn Library of Vertebrate Palaeontology, presenting his personal library as a nucleus. To this the Museum added such volumes as it already possessed, its file of palaeontological periodicals which it has kept up to date, and continued purchasing such new volumes as its funds made possible. As in any departmental library, however, the separata are the greatest needs of the worker, Prof. Osborn continued to turn over to the Osborn Library files of those papers which he received from his colleagues. Dr. Barnum Brown, curator of fossil reptiles in the Museum, asks that those who exchanged papers with Prof. Osborn during his life should continue to keep the Osborn Library on their lists, while others are invited to send copies of their papers. It will be at once a tribute to Prof. Osborn's memory and a service to fellow-workers since the Osborn Library is open to all.

Congress of Economic Entomology

THE annual meeting of the Deutsche Gesellschaft für Angewandte Entomologie will be held in Frankfurt-on-Main on May 13-16, when three major problems in economic entomology will be discussed, namely, the control of bedbugs, mosquitoes and pests of stored products. Leaders of discussions on these problems will be Mr. A. W. McKenny Hughes, of the British Museum (Natural History) and secretary of the Medical Research Council Bedbug Committee, Prof. E. Martini, of the Institute of Maritime and Tropical Diseases, Hamburg, and Mr. E. Bernfuss, technical manager of the Städtliche Lagerhaus of Vienna. It is felt that all three problems are of international importance and urgently require attention, and it is hoped that medical officers and others concerned in public health, professional entomologists, warehouse managers, manufacturing chemists interested in insecticides, and chemical engineers interested in fumigation equipment will attend the meeting. Full particulars of the meeting can be obtained from Dr. W. Rasch, Hermann Göring Ufer 3, Frankfurt (Main) 1.

Conference of Overseas Industrial Medical Officers

THE Annual Conference for Medical Officers in Industry Overseas will be held on July 16 at the London School of Hygiene and Tropical Medicine, in order that medical officers in industry on leave from the tropics may be able to meet their colleagues and discuss their problems. The main subject for discussion will be the prevention of disease, for example, the control of malaria and epidemic diseases in the tropics; water supplies; sewage and refuse disposal; housing; the keeping of records; and hygiene generally. Further information can be obtained from the Organising Secretary, Ross Institute of Tropical Hygiene, London School of Hygiene and Tropical Medicine, Keppel Street (Gower Street), London, W.C.1.

Institution of Mining and Metallurgy : Awards

To mark the occasion of the jubilee of the Witwatersrand gold mining industry, two awards of the Gold Medal of the Institution of Mining and Metallurgy have been made, as follows: to Sir Lionel Phillips, "in recognition of his distinguished contribution to the development of the industry extending over many years; and of his public work in many capacities"; to Dr. James G. Lawn, "in recognition of his distinguished services to the mining profession and industry". The Consolidated Gold Fields of South Africa, Ltd., Gold Medal and premium of forty guineas have been awarded by the Institution to Dr. Munro S. Fisher, for his researches on the origin of alluvial gold.

Announcements

At the general meeting of the Linnean Society of London held on April 2, it was announced that His Majesty the King has been graciously pleased to continue the royal patronage of the Society. The reigning Sovereign has been the patron of the Society since it received its first charter in 1802.

DR. EZER GRIFFITHS, principal assistant in the Physics Department of the National Physical Laboratory, has been elected president of the British Association of Refrigeration for the session 1936-37.

At a meeting of the Geological Society on March 25, it was announced that the grant of the proceeds of the Daniel Pidgeon Fund for 1936 has been made to Dr. S. R. Nockolds, who proposes making a petrological study of the Garabal Hill-Glen Fyne complex, Argyll.

PROF. G. T. MORGAN, director of chemical research in the Department of Scientific and Industrial Research, will deliver the Hofmann Memorial Lecture at the Imperial College of Science and Technology on May 4, at 5.30.

MR. RICHARD K. LAW, M.P. has been appointed a member of the Medical Research Council by the Committee of Privy Council, to fill the vacancy caused by the retirement of Mr. W. S. Morrison, M.P., on becoming Financial Secretary to the Treasury.

THE Challenger Society for the Promotion of the Study of Oceanography will probably be making further grants in aid of research during the year 1936-37. The general committee is prepared to consider applications for small grants in aid of research in marine biology at a recognised laboratory during the current year. Applications, accompanied by details of the proposed research, should reach the honorary secretary, Mr. J. R. Norman, British Museum (Natural History), S.W.7, before the middle of May.

AN extended general meeting of the British Psychological Society will be held at the University of Leeds, on April 17-20. Several papers will be read and discussed, and a symposium on "Colour

Constancy" will be held with papers by Prof. David Katz, Dr. R. H. Thouless and T. M. Martin. Further information can be obtained from Dr. Ll. Wynn Jones, 7 Bideford Avenue, Leeds, 8.

THE annual malaria control course for laymen, including engineers and planters, will be held on June 22-26, at the Ross Institute of Tropical Hygiene (London School of Hygiene and Tropical Medicine), Keppel Street (Gower Street), London, W.C.1, under the direction of Sir Malcolm Watson. The course is free. Further information can be obtained from the organising secretary at the Institute.

IN view of the increasing number of the tropical agricultural problems with which the Colonial Office has now to deal, the Secretary of State for the Colonies has decided to appoint an assistant agricultural adviser in addition to his present agricultural adviser, Mr. F. A. Stockdale. Dr. H. A. Tempany, now director of agriculture in the Straits Settlements and adviser on agriculture, Malay States, has been selected for this post, and it is expected that he will take up his duties during the summer.

A VIOLENT earthquake was recorded at Kew Observatory early on April 1. The first impulse arrived at 2 hr. 23 min. 49 sec. G.M.T. The bearing of the epicentre, which was about 7,400 miles away, indicates that the shock occurred near the Philippine Islands, about lat. 6° N., long. 126° E.

DR. RUDOLF STUMMEN-TRAUMFELS, professor of zoology at Graz, has been awarded the Linné Medal by the Swedish Academy of Sciences.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A scientific officer for research on internal combustion engines at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (April 21).

Scientific officers, junior scientific officers and assistants (Grades II and III) for radio research in the Directorate of Scientific Research of the Air Ministry, The Secretary [S.2 (d)], Air Ministry, Kingsway, London, W.C.2 (April 22).

An assistant in the Department of Folk Culture and Industries, National Museum of Wales, Cardiff—The Director (April 30).

A Sorby research fellow of the Royal Society—The Assistant Secretary, Royal Society, Burlington House, London, S.W.1 (May 1).

A lecturer in mathematics and the method of teaching arithmetic in the Furzedown Training College (May 9), and a lecturer in physics and mathematics in the Avery Hill Training College (May 18)—The Education Officer, County Hall, S.E.1.

A demonstrator and assistant lecturer in chemistry in the Royal Holloway College, Englefield Green, Surrey—The Principal (May 16).

A lecturer (woman) in geography and mathematics in St. Hild's College, Durham—The Principal (June 6).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot 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.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 622.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

New Data on Isotopes

ISOTOPIC WEIGHTS BY THE DOUBLET METHOD

CONTINUING work with my new mass-spectrograph¹, I have made measurements of several more doublets. That of N, CH₂ was easy to obtain with a mixture of nitrogen and methane, and gave very consistent results. The vapour of pure heavy water did not, at first, give as strong a line at 20, OD₂, as was hoped, but as 19, ODH, was good, CF₄ was introduced and the doublet F, ODH measured. Later the intensity of OD₂ was improved and enabled a comparison with ²⁰Ne to be made. The latter line was then coupled with doubly charged ⁴⁰A, giving a very close doublet. By the use of BF₃ with a suitable quantity of neon, the fairly wide doublet ¹⁰B, ²⁰Ne++ was photographed. The spectra also showed the expected doublet at 29 due to ²⁸Si and ¹⁰BF. This gave the first accurate measurement of the mass of the former. The following are the results:

Doublet	Number of doublets measured	Difference in packing fraction	Difference of mass
N, CH ₂	17	8.8, ± 0.05	0.01245
F, HDO	10	9.6, ± 0.15	0.01833
Ne, D ₂ O	14	15.4, ± 0.2	0.03083
A++ , Ne	11	5.4, ± 0.15	0.01088
Ne++ , ¹⁰ B	14	16.8, ± 0.15	0.01684
²⁸ Si, ¹⁰ BF	7	11.8, ± 0.2	0.0342

On a plate obtained when ethane was present in the discharge, two spectra gave good measurable doublets at 27. It is quite certain that the heavier member is due to C₂H₃, and highly probable that the lighter is ²⁷Al derived from the cathode. If this is so, it provides the first measurement of the mass of this simple element. What was assumed to be the doublet ²⁸Si, CO was also measured, but the conditions were not favourable to accuracy. The following are the packing fractions and isotopic weights deduced. Those of ²⁷Al and ²⁸Si are only provisional.

Symbol	Packing fraction	Isotopic weight
¹⁰ B	16.1	10.0161 ± 0.0003
¹⁴ N	5.28	14.0073 ± 0.0005
¹⁹ F	2.36	19.0045 ± 0.0006
²⁰ Ne	- 0.70	19.9986 ± 0.0006
²⁷ Al	- 3.3	26.9909
²⁸ Si	- 5.0	27.9860
²⁸ Si	- 4.7	28.9864 ± 0.0008
⁴⁰ A	- 6.15	39.9754 ± 0.0014

SOME DOUBTFUL ISOTOPES

Owing to the rapid advance in research on disintegration and the theory of nuclear structure, the existence or non-existence of rare isotopes has acquired an entirely unexpected importance and calls for a short review of the present situation.

The possible presence of lines due to compounds, particularly hydrides, has been a bugbear of mass-spectrum analysis from the start. When S 33, 34 and Ne 21 were found to be true isotopes, caution

was somewhat relaxed, with regrettable results in the case of Zn and Ge. So long as ample resolution and intensity are both available, negative results are absolutely conclusive, and the spectra obtained by Bainbridge for these elements showed that many of the lines recorded by me were really hydrides. I corrected the values of abundance for this result in my book², and it is of interest to note that the correction brought the atomic weight of Ge into good accord with the chemical value recently confirmed by Honigschmid³.

From the work of Dempster⁴ and Bainbridge and Jordan⁵ it is clear that similar corrections must be made for Cd 115, Sn 121 and Pb 209, though in the last case I find it difficult to explain line 224 on my spectra, which seemed to confirm the presence of ²⁰⁹PbCH₃. The following are the revised figures for percentage abundance, all the rarer isotopes of lead being regarded as doubtful.

Cd mass numbers	106	108	110	111	112	113	114	116		
Abundance	1.5	1.0	15.6	15.2	22.0	14.7	24.0	6.0		
Sn mass numbers	112	114	115	116	117	118	119	120	122	124
Abundance	1.1	0.8	0.4	15.5	9.1	22.5	9.8	28.5	5.5	6.8
Pb mass numbers	204	206	207	208						
Abundance	1.5	28.3	20.1	50.1						

The parabola analysis of Ni and Fe by de Gier and Zeeman⁶ is, except for Ni 61, in excellent agreement with my own. Their results for Fe 58 and Ni 64, present on my plates, but of doubtful origin, makes it highly probable that these are true isotopes. The evidence as to Ni 61, where unfortunately the resolving power of the parabola apparatus is pushed to its limit, I regard as conflicting. The line 61 on my plates cannot possibly be due to a hydride of Ni and if, as is suggested, it is C₂H, there is the further difficulty in explaining my confirmatory line 89 ⁶¹NiCO. The matter will best be settled by the production with an instrument of ample resolving power, such as Dempster's, of a spectrum so strong that components considerably weaker than Ni 64 could be detected.

With regard to the remarkable mass-spectrum obtained by Dempster⁴ with a mixture of rare earths, it appears to me probable that the lines 148, 150 are due to isotopes of Nd not recorded by the feebler beams I was able to get with anode rays. If this is so, the discrepancy between the physical and chemical atomic weight of that element may disappear.

F. W. ASTON.

Cavendish Laboratory,
Cambridge.
March 30.

¹ NATURE, 137, 357 (February 29, 1936).

² "Mass-spectra and Isotopes", (Arnold, London, 1933).

³ Z. anorg. Chem., 225, 81 (1935).

⁴ Proc. Amer. Phil. Soc., 75, 735 (1935).

⁵ St. Louis meeting, Amer. Phys. Soc., Phys. Rev., 49, 416 (1936).

⁶ Proc. K. Akad. Wet. Amsterdam, 38, 810, 959 (1935).

Absorption of Slow Neutrons

THE absorption of slow neutrons is believed to take place in two ways: a general absorption of very slow neutrons (thermal energies) together with a highly specific absorption (rhodium, indium, silver, gold)¹ of faster neutrons. Further to investigate this phenomenon, experiments have been carried out on the absorption of neutrons with the apparatus shown in Fig. 1.

The radon beryllium source was placed in a block of lead at the bottom of a paraffin wax tube². The top of the paraffin block was covered with a layer of boric acid 1½ cm. deep to absorb slow neutrons emerging from its surface. In these circumstances, the neutrons which emerge from the mouth of the tube are those which have been slowed down by repeated collisions with the paraffin wax. To detect the neutrons an ionisation chamber ½ cm. deep filled with boron trifluoride was used. Such a chamber has several advantages over a chamber lined with boron, since the kicks produced are twice as great and of uniform size, and so they are more readily distinguished from the background produced by the

is completely surrounded by paraffin wax it is not very sensitive to the slowest neutrons, since a great many of these are reflected at the first paraffin surface.

One or more absorbing sheets were placed immediately over the mouth of the tube. The following results were obtained. The statistical error is about two per cent.

With the chamber surrounded by paraffin wax

Absorber	None	B	B	B/Cd	Cd	Cd/In	Cd/Ag	Cd/Au
Weight in mgm./cm. ² .	—	288	399	288/159	159	159/73	159/220	159/116
Number of neutrons recorded.	100	58	53½	58	68	66	68	68

With the chamber open at the bottom

Absorber	None	B	B/Cd	Cd	Cd/In	Cd/Ag	Cd/Au	In	Ag	Ag	Au
Weight in mgm./cm. ² .	—	220	220/159	159	159/73	159/200	159/116	73	220	126	116
Number of neutrons recorded.	100	17	13	23	20½	23	23	84½	91½	95	99

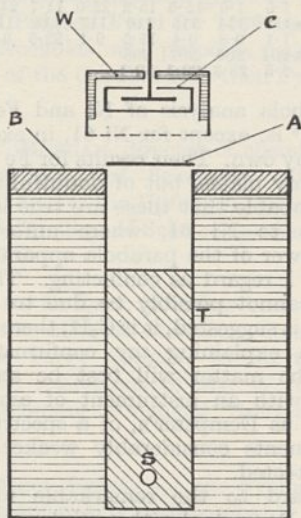


FIG. 1. A, absorber; B, layer of boric acid; C, ionisation chamber; S, source; T, paraffin tube; W, layer of paraffin wax.

γ-rays emitted by the radon source. The chamber was in a shallow cylindrical box of paraffin wax 2 cm. thick; the bottom of the box could be closed with a circular sheet of wax 2 cm. thick. Such a chamber will detect neutrons over a very wide velocity range, since neutrons which are not captured on their first passage through the gas may be scattered back by the top paraffin sheet. Such a neutron will have been considerably slowed down, and is therefore likely to be detected. When the chamber

From these results one can estimate the width and position of the neutron absorption bands in terms of the absorption of boron. For convenience of expression, it is useful to assume that the reaction cross-section of boron is inversely proportional to the velocity of the reacting neutron. There are reasons for believing that this theory may be true³, and even if it is not, absorption in boron will remain for some time a convenient practical method of isolating neutrons in a definite velocity range. With this notation the results obtained may be summarised as follows:

The absorption band of cadmium occurs in the energy range⁴ 0–1½ e.v. and the results are consistent with a very narrow absorption band (0–0.1 e.v.). The absorption band of indium occurs in the same range and partly overlaps that of cadmium. No effect due to the specific absorption of gold or silver could be found, and it is therefore probably not in the range investigated.

This method of measurement is being extended to other elements and other velocities.

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Clarendon Laboratory,
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March 5.

¹ Amaldi and Fermi, *Ric. Scient.*, **6**, 2, 9 (1935); Szilard, *NATURE*, **136**, 950 (1935); Frisch, Hevesy and McKay, *NATURE*, **137**, 149 (1936).

² Hopwood and Chalmers, *NATURE*, **135**, 341 (1935).

³ Bohr, *NATURE*, **137**, 344 (1936).

⁴ Frisch and Placzek, *NATURE*, **137**, 357 (1936).

Conservation of Energy and Momentum in Atomic Processes

ACCORDING to recent experiments by R. Shankland¹, the conservation principles are not obeyed in individual processes of interaction between matter and radiation. The general theoretical implications of the new results have been considered by Dirac², who concludes that they only require us to forgo quantum electrodynamics (in which radiation is represented in terms of light-quanta rather than in

terms of electromagnetic waves). In this note I wish to direct attention to one or two points which may be of interest in connexion with the new results and the Uncertainty Principle.

Let us consider the γ -ray microscope for locating an electron. Let the electron be illuminated by radiation the total intensity of which is such that the average energy of the radiation scattered by the electron is a fraction p of $h\nu$. The fraction of such experiments in which an electron recoils is then p , and the fraction in which a scintillation is observed in the focal plane of the lens is also of the order of p . On the theory of strict conservation, the recoils and scintillations happen in the same experiments (coincidences), so that the location of the electron is inevitably accompanied by a disturbance of its momentum. This, however, is not so if the new results of Shankland are correct (assuming with Dirac that they mean that there is no coincidence in time between the 'scattering' by, and the recoil of, an electron), and in an experiment in which a scintillation is observed the probability that the electron has recoiled is no more than in an experiment in which a scintillation is not observed—it is equal to p in both cases. It would thus appear that by making p small we could in those experiments in which a scintillation is observed deduce the position of the electron, and at the same time be sure that its momentum has not been disturbed. The new results would thus run counter to Heisenberg's Uncertainty Principle.

The smallness of p is essential to the above argument. To be fairly sure of a result in a given experiment p must, of course, be of the order of unity. Under such conditions the electron is fairly certain to recoil, and we again have uncertainty in momentum—in fact, a greater uncertainty than in Heisenberg's γ -ray microscope because we have no information about the direction of recoil.

As the results of earlier work are not in accordance with those obtained by Shankland, it is desirable that further information be obtained regarding the conservation of energy and momentum in individual quantum processes. With this object in view I have experiments in progress on the emission of radiation by single atoms. In these experiments Wilson-cloud observations are made on the absorption of the fluorescent radiation from argon atoms, in order to see if this radiation is only emitted by those atoms which have not suffered internal conversion, as would be the case if there is strict conservation.

Note added in proof.—Regarding the argument in the second paragraph the following supposition is involved: If it is certain that a scattered radiation field has originated within a certain volume δv , and nowhere else, then there must have been a scattering particle in that volume at the time concerned.

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March 6.

¹ R. Shankland, *Phys. Rev.*, **48**, 8 (1936).

² P. A. M. Dirac, *NATURE*, **137**, 298 (1936).

Apparatus for the Investigation of the Ionosphere

In a previous communication¹ a semi-automatic method was described by which curves showing the equivalent height of the reflecting regions of the ionosphere as a function of the frequency of the exploring radio waves could be plotted. In order to increase the flexibility of the method, a new system of electrical linkage between the tuning systems at the transmitter and at the receiver has been developed whereby the receiving installation automatically follows the changes of the sender frequency, so that the two stations maintain synchronism without attention.

The high-frequency circuits of the receiver which must be kept in tune with the frequency of the exploring waves are tuned by a single control. The receiver, which is of the superheterodyne type, has an intermediate amplifier tuned to 110 kc. per sec. The signal from the transmitter and part of the out-

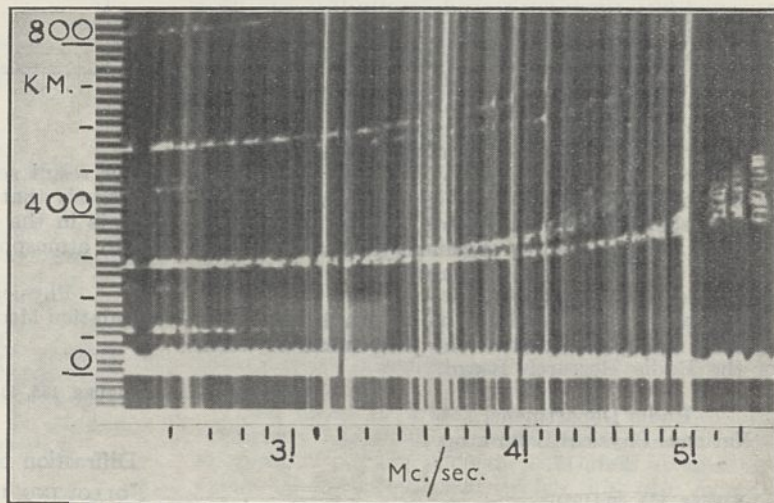


FIG. 1. Curves showing the relation between the equivalent height of the reflecting regions of the ionosphere and the frequency on which the exploring radio waves are emitted.

put from the high-frequency oscillator of the receiver are coupled to a valve V_1 used as a first detector. The signal frequency after V_1 will therefore be the difference between the frequency transmitted and the frequency to which the high-frequency oscillator at the receiver is tuned. This new frequency passes through the primary winding of a transformer to two other valves V_2 and V_3 , which are also used as detectors. The secondary of this transformer has two windings, one of which is tuned to resonate at 100 kc. per sec. and is associated with V_2 , and the other is tuned to resonate at a frequency of 120 kc. per sec. and is associated with V_3 . The output from V_2 and V_3 passes through a differential relay. When the transmitter and receiver are in tune, the difference in the current flowing through the two windings of the relay will be zero. Immediately the tuning of the receiver varies with respect to the transmitter, the amplitude of the signal impressed on the grid of V_3 or V_2 will be increased according as the frequency to which the receiver is tuned increases or decreases with respect to the tuning of the receiver. The change in anode current caused by this signal operates the relay, which is used to control a shaded pole reversible a.c. motor. This motor is coupled to the tuning control of the receiver, which is thereby caused to

rotate until the high-frequency oscillator is again tuned to 110 kc. per sec. below the frequency of the transmitted signal (that is, when the difference in current through the relay windings is again zero).

Fig. 1 shows a curve of the type referred to above. The frequency on which the exploring waves are sent out is increased continuously from 2.7 to 5.2 mc. per sec. The broad white trace near the bottom of the picture is due to the ground pulse. At the lower frequencies reflection has taken place both from the *E* and *F* regions. Magneto-ionic splitting and the critical frequency for the ordinary ray from region *F* are also shown. The appearance of a saw tooth effect on the upper edge of the ground pulse trace shows the 'hunting' of the receiver tuning. The light vertical lines shown in the picture are due to interfering stations.

One of the difficulties in applying this system is the small amount of energy available for control purposes. The duration of the emission, which is repeated fifty times per second, is only 10^{-4} sec. The energy is therefore less than 1/200 of that of a continuous emission of the same power. It is essential that the energy from the wanted transmitter should be great in comparison with that from all others.

This may be achieved in two ways: (1) by causing the energy to be passed from transmitter to synchronising system by means of a transmission line; (2) by arranging that the valve V_1 in the synchronising system is only sensitive for the duration of the wanted emission. The second arrangement makes it possible to link a receiver with a transmitter even in the absence of a ground ray.

This work was carried out at the Radio Research Station, Slough, as part of the programme of work of the Radio Research Board.

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Feb. 17.

¹ NATURE, 133, 66 (1934).

Geomagnetic Effect on Cosmic Radiation in the Stratosphere

As shown in a previous note¹, the geomagnetic effect on cosmic radiation seems to begin at the same latitude (about 50°) independently of the altitude. We concluded, therefore, that it would be interesting to compare the latitude effect of all our ionisation measurements, made during the two last ascents of the *F.N.R.S.* (1932-34), without taking the altitude into account.

For this purpose, we have plotted against the geomagnetic latitude λ , the ratio between the ionisation J_λ measured at λ degrees, and the ionisation J_{50° measured at 50° at the same altitude (Fig. 1).

Each point in Fig. 1 being the mean value of a series of measurements, the rectangles give the probable error calculated from the dispersion of individual measurements. The measurements include those already used in our previous note and also those made with the high-pressure ionisation chamber. All the measurements were performed at altitudes corresponding to pressures of the atmosphere between 70 mm. and 180 mm. Hg.

It can be seen that the magnetic effect is practically the same at all altitudes, the dispersion of experimental points being less than the probable error. The

critical geomagnetic latitude is about 49°, the same as at sea-level. For λ less than 49°, the decreasing rate is of the order of 7 per cent per degree.

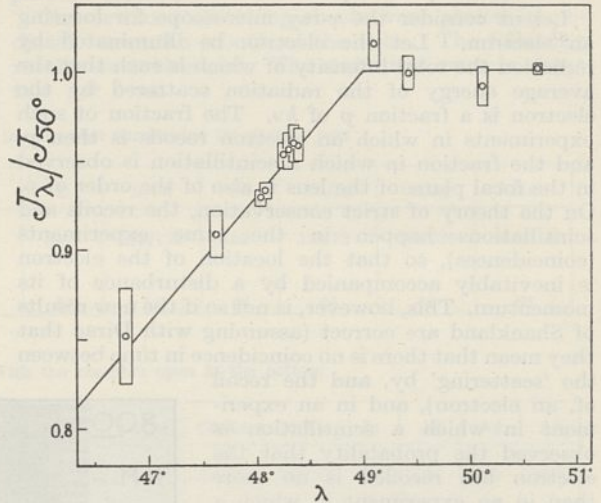


FIG. 1.

This result seems to be in contradiction with the hypothesis that the lack of magnetically soft components in the cosmic radiation at sea-level is only due to atmospheric absorption.

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March 3.

¹ NATURE, 135, 313 (1935).

Diffraction of X-Rays by Bence-Jones Protein

FOLLOWING the discovery by Bernal and Crowfoot¹ of the sharp diffraction spectra obtained from single pepsin crystals, Wyckoff and Corey² showed that with suitable technique certain other micro-crystalline proteins (for example, oxyhaemoglobin) give diagrams with spacings between 10 Å. and 40 Å.

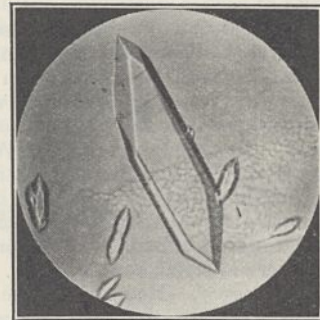


FIG. 1. Crystal of Bence-Jones protein. \times about 225.

We had at our disposal a sample of crystallised Bence-Jones protein obtained by precipitating three times with ammonium sulphate, dialysing against distilled water and concentrating in the cold; the crystals spontaneously precipitated from the aqueous solution were dissolved in a little sodium chloride or urea solution and reprecipitated by dialysis, etc. The largest single crystals were 150 μ long and 15-60 μ .

wide. They were described by Dr. Seiffert as slender, occasionally compressed, hexagonal pillars with a rhombohedron (Fig. 1). A more detailed description will appear elsewhere. The instability of the crystalline structure is very marked, and the crystals are best kept in the mother liquor in a refrigerator.

The suspension was sent from Berlin to Geneva and kept at 5° C. Prior to exposure, the specimen was placed in a thin glass tube (*Markeröhrchen*) and this was sealed with wax at both ends. This was necessary because otherwise evaporation takes place during the exposure and the lattice is destroyed. As in the case of the crystalline substances described by Bernal and Wyckoff, water of crystallisation is necessary for the production of an interference pattern by this protein. Exposures were made with copper $K\alpha$ -radiation, 15 m.a., 35 kv., at distances up to 77 mm. The temperature was always below 12° C.; duration of exposure 10–40 hours; pin-hole collimator 0.7 mm., 80 mm. long. The lines are nevertheless relatively weak.

Number	Spacing (A.)	Intensity
1	41	very strong
2	28	medium
3	25	weak
4	14.8	weak
5	11.1	medium
6	10.1	medium
7	4.8	medium (diffuse)
8	3.4	strong (diffuse)
9	2.2	weak (diffuse)

The spacings and intensities are similar to those obtained by Wyckoff and Corey for oxyhaemoglobin. From the great separation of the planes, it follows that the unit cell is large and accordingly should contain at least one 'chemical' molecule of protein. The molecular weight of Bence-Jones protein as determined by Svedberg is about 34,000.

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Feb. 3.

¹ NATURE, 133, 794 (1934).

² Science, 81, 365 (1935).

Positive Platinum Sols

A DETAILED investigation on the adsorptive properties and the capacity of platinum electrodes, made by A. Frumkin and A. Šlygin¹, has led to the conclusion that there may exist, besides the negative platinum sol with oxides on the surface of the particles, which has been described by Pennycuik, two further varieties of platinum sols. One of them should be a negative sol, with its surface coated with a film of adsorbed hydrogen, the outer part of the double layer consisting of cations. The other should be a positive sol with a double layer, the outer part of which is formed by anions. According to the results obtained with platinum electrodes, it was expected that positive sols would be obtained by a careful oxidation of negative H₂-platinum sols. These positive sols must themselves be transformed by further oxidation into the usual negative sols. These conclusions were announced by A. Frumkin at the discussion on "Colloidal Electrolytes" held by the Faraday Society in September 1934²; it remained uncertain, however, whether the stability of positive platinum sols, which is determined mainly by an electrical double layer, is such that it would be possible to prepare them.

We had prepared and investigated³ negative H₂-platinum sols, and we have now succeeded in preparing positive platinum sols by a very slow and careful oxidation of negative H₂-platinum sols. The experimental procedure was based on a control of the degree of oxidation of the platinum surface by measurement of the conductance of the sol. On adding a small amount of hydrochloric acid to a H₂-platinum sol, there is a rise of conductance of the sol, corresponding to the amount of acid added, as no acid is adsorbed. During the bubbling of oxygen highly diluted with nitrogen through the sol, there is a continuous change of conductance, due to adsorption of acid, followed by its partial desorption when the surface begins to be covered with an oxide film. Each point of the curve corresponds to a definite state of the surface. Stopping the further oxidation at a definite point by saturating the sol with pure nitrogen, and transferring the sol to an apparatus for cataphoretic measurements in an atmosphere of pure nitrogen, we have been able to measure the cataphoretic velocity of sols corresponding to different degrees of oxidation, made all from the same initial batch of H₂-platinum sol. The following data are typical of the results obtained:

Cataphoretic mobility (μ /sec. per v./cm.).	Initial H ₂ -Pt-sol During progressive oxidation			
	- 2.4	+ 1.7	+ 3.3	- 2 - 2.3

The negative charge of the last portions of sol corresponds to the state of the surface when acid is partly desorbed, which is accounted for by the formation of an oxide film.

The same effects can be obtained with sulphuric acid instead of hydrochloric, but the sol is much more unstable. It is not yet possible to say whether these positive platinum sols can exist for a considerable length of time.

These results show that the particles of a platinum sol behave like small platinum gas electrodes. The existence of positive platinum sols clears up to some extent the contradiction which hitherto existed between data on the sign of the charge of metallic surfaces as deduced from electrokinetic measurements and from electrode potentials.

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Feb. 10.

¹ Sov. Phys., 4, 239 (1933); C.R. Acad. Sci. U.R.S.S., 2, 176 (1934); Acta Phys. Chim. U.R.S.S., 3, 791 (1935).

² Trans. Farad. Soc., 31, 69 (1935).

³ Acta Phys. Chim. U.R.S.S., 3, 79 (1935).

The Hydroxyl Bond in *n*-Aliphatic Alcohols

ROBERTSON¹, in an interesting note to NATURE, recently pointed out the probable existence of the Bernal-Megaw 'hydroxyl bond'² in resorcinol. Further evidence of the existence of such a bond is to be found in a previous paper by E. Ott and the author³ on the X-ray study of the *n*-aliphatic alcohols. It was found that in the α -modification ($\gamma = 90^\circ$) the distance between hydroxyl groups projected on the *c*-axis is 1.46 Å. If a close packing of the hydroxyl heads is assumed, the centres of the OH groups are then found to be separated by a distance of 3.13 Å. The value of $a_0 = 4.76$ Å. given by Bernal⁴ is used in this calculation. The distance 3.13 Å. is less than

the ordinary approach between aliphatic chains, and compares favourably with the examples given by Bernal and Megaw in their discussion of the 'hydroxyl bond'.

As a conclusion drawn from this calculation, one is forced to question the space group determination of Bernal⁴. He has suggested the space group C_{3m}^- for the α -modification of $C_{12}H_{20}OH$. The two molecules per unit cell are then placed in the equivalent positions $00u$ and $00\bar{u}$. This puts the two molecules on a single triad axis, and does not allow for close packing of the hydroxyl groups. Assuming the tetrahedral angle for the carbon-oxygen bond, then on the basis of this space group determination and the projected OH—OH distance of 1.46 Å., the distance between hydroxyl centres is calculated as 2.09 Å. This distance is much too small to be reasonable for the 'hydroxyl bond'. Perhaps the intensity data of Bernal could be interpreted to give a different space group which would allow for a close packing of the hydroxyl heads.

The calculation of the projected OH—OH distance made by E. Ott and the author is to be seriously considered, because it is based upon 001 reflections from the α -modifications of six members in the series of n -aliphatic alcohols $C_{13}H_{27}OH$ to $C_{18}H_{37}OH$, all of which agree.

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Jan. 29.

¹ NATURE, 136, 755 (1935).

² Proc. Roy. Soc., A, 151, 384 (1935).

³ J. Chem. Phys., 2, 239 (1934).

⁴ Z. Krist., 83, 153 (1932).

Effect of Ascorbic Acid and Indolyl Acetic Acid on Regeneration of Willow Branches and Germination

IN the middle of 1935 we began an investigation into the effect of vitamin C on plants, and the general growth response since claimed by Synnöve v. Hausen¹ was obtained by us with tomato and castor oil plants.

β -Indolyl acetic acid was synthesised after the method of R. Majima and T. Hoshino², and the related indole derivatives β -indolyl propionic acid, β -indolyl methyl malonic acid (which yields β -indolyl propionic acid by loss of carbon dioxide) and β -ethyl indole were synthesised in a manner which precluded any possible contamination with β -indolyl acetic acid. Epinastic curvatures were obtained on a large range of plants with β -indolyl propionic acid, which however gave no positive result with the oat test, so that Thimann and Koepfli³ were mistaken in attributing positive results to persistent traces of the lower homologue.

A selected range of willow branches, 12 inches long, was placed in vaseline-sealed glass containers with the morphologically lower ends in 200 c.c. of Pfeffer's⁴ inorganic nutrient solution containing the compounds mentioned. At a concentration of 1 in 100,000, the order in which both roots and shoots appeared was the following: (1) ascorbic acid, (2) β -indolyl acetic acid, (3) β -indolyl propionic acid, (4) control. With a concentration of 1 in 500,000, the result was: (1) ascorbic acid, (2) control, etc. Evidently the stimulatory action of the ascorbic acid persists even in very low concentration in spite of probable oxidation. With a high concentration of 1 in 2,500, regeneration is retarded considerably by

the ascorbic acid, and almost entirely prevented by the indole derivatives.

Oats, mustard and cress seeds were germinated under sterile conditions in 10 c.c. of Pfeffer solution containing the compounds. At a concentration of 1 in 10,000, both germination and subsequent growth occurred in the following order: (1) ascorbic acid, (2) control, (3) β -indolyl propionic acid, (4) β -indolyl acetic acid. When applied after germination, and following upon a certain amount of root development, the β -indolyl acetic acid took third place. Abnormal length of coleoptiles and hypocotyls occurred with the indole compounds in the case of prostrate seedlings. The indole derivatives at this concentration apparently retard germination and growth, and even at lower concentrations (1/100,000) the result is the same, though ascorbic acid still acts in stimulatory fashion. With higher concentration (1/1,000) the ascorbic acid also showed a retarding effect, while the others were practically lethal.

The effect of the ascorbic acid agrees with the recently published result of Havas⁵, and points to the familiar hyper-effect of the vitamins; but the retarding effect of the indole derivatives seems in main part due to the prevention of root growth, which occurred very strikingly in these cases. In high concentration the roots grown in β -indolyl acetic and β -indolyl propionic acids were short and cone-shaped with swollen bases, F. A. F. C. Went's⁶ suggestion of transverse growth in the root caused by the auxins seeming to be verified. The abnormal length of the stems of prostrate seedlings was probably due to direct contact with the growth compounds.

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University of Melbourne.

Feb. 17.

¹ Synnöve v. Hausen, NATURE, 136, 516 (1935).

² R. Majima and T. Hoshino, Ber., 58, 2043 (1925).

³ K. V. Thimann and J. B. Koepfli, NATURE, 135, 101 (1935).

⁴ Pfeffer; see Knudson, Bot. Gaz., 73, 1-25 (1922).

⁵ L. Havas, NATURE, 136, 435 (1935).

⁶ F. A. F. C. Went, Biol. Rev., 10, 2 (1935).

Ascorbic Acid as a Precursor of Serum Complement

PARTICULARLY in septicæmic conditions affecting man, the importance of "alexine" (Bordet) or "complement" (Ehrlich) in immune processes, although (so far) inexactly defined in scope, is becoming very generally recognised^{1,2}. Frequent attempts to analyse and define this substance, generally by chemical means, have resulted in the recognition of at least four components or "end" and "middle-pieces"^{3,4}.

I have recently obtained evidence (to be published in detail elsewhere, pending the permission of the Anglo-Iranian Oil Co., Ltd.) that the "complement" complex, as it exists in the circulating blood of the guinea pig, following coagulation and separation of serum, and in the form demonstrable by a standardised hæmolytic system, disappears or suffers reduction in titre, when ascorbic acid is withdrawn, completely or partially, from the food of the experimental animal; and the concentration of "complement" (obtained in the same manner) can be restored to normal, or slightly supernormal, level by the consumption of a diet rich in vitamin C.

These effects can be produced in seven days or less, too soon for qualitative malnutrition to affect the animal's physical well-being; indeed it remains in perfect health, being supplied with everything necessary for healthy functioning, except, during a few days only, ascorbic acid. It follows that reduction or disappearance of "complement" from the circulating blood must be one of the earliest signs (in guinea pigs, and perhaps in man) of a state of affairs which, if prolonged for twenty to forty days (in the cavy) or four to eight months (in man) will result in scurvy.

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Feb. 8.

- ¹ Cadham, F., "Septicaemia: a Method of Treatment", *Amer. J. Med. Sci.*, 188, 542 (1934).
² Whitby, L. E. H., and Britton, C. J. C., "Disorders of the Blood", 45 (J. and A. Churchill, London, 1935).
³ Gordon, J., and Wormald, A., "The Action of Ultra-Violet Rays on Complement", *Biochem. J.*, 22 (4), 909 (1928).
⁴ Gordon, J., and Thompson, F. C., "The Relationship between the Complement and Opsonin of Normal Serum", *Brit. J. Exp. Path.*, 16 (1), 101 (1935).

A Satisfactory Substitute for the Osmium Tetroxide Golgi Apparatus Methods

OSMIUM tetroxide at 18s. a gram is the most expensive substance used in biological research. It is principally used in the Kolatchew and Weigl methods for the Golgi apparatus, and in the F. W. A. and Champy methods for mitochondria. The nearest cheap substitutes for Weigl and Kolatchew methods are the formalin-silver methods of Cajal and Da Fano. The trouble with these latter methods is that there is usually distortion and often incrustation of the Golgi bodies, banana-shaped elements, for example, often becoming beads, or spheres, and different from what can be seen *intra vitam*. The general fixation is often very poor.

I have been astonished at the beauty of silver nitrate formalin preparations made according to F. Aoyama's modification of Cajal's method¹. This method is as follows: Fix small pieces of tissue in cadmium chloride 1 part, formol neutral 15 parts, distilled water 85 parts, for three to four hours. Rinse quickly in two changes of distilled water, and transfer to 1.5 per cent solution of silver nitrate for 10 to 15 hours at 22° C. Rinse quickly in two changes of distilled water, preferably in a darkened room, and transfer for 5 to 10 hours to the reducing solution (hydroquinone 1 part, neutral formol 15 parts, distilled water 85 parts, 0.1 to 0.15 parts of sodium sulphite, sufficient to produce yellowish tinge). Wash thoroughly in tap water ($\frac{1}{2}$ to $\frac{3}{4}$ of an hour), upgrade, imbed and section. Counterstain in carmine or hæmatoxylin and eosin. Cold-blooded animals may need longer impregnation and fixation.

This method has been tried in this laboratory on the following material: rat pancreas and dorsal root ganglion, *Helix* ovotestis and cerebral ganglion, midgut of mealworm. In every case the preparations were superior to those got by Da Fano's method, and very nearly approached the best Weigl preparations for morphology of Golgi bodies. The non-cellular elements of tissues were bright yellow, and quite different from the Cajal or Da Fano effect. The rat and snail preparations were perfect enough for the most precise research on cell inclusions. In

only a few cases did mitochondria impregnate, and the method is probably more specific than Weigl, and much more specific than Da Fano.

The preparations were made by Mr. R. Brown and Miss M. Daniels. The formalin used was un-neutralised, but from a fresh supply; the silvering was done in a Hearson incubator at the proper temperature.

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Feb. 24.

²*Z. wiss. Mikr.*, (1930).

Induction of Mammary Ducts

THE mammary gland of the pig has normally two primary ducts which open separately on the surface of the nipple. Embryologically, the two ducts proliferate from the base of a cone-shaped depression of the stratum germinativum known as the mammary pocket or mammary bud. A similar depression or epithelial ingrowth, variable in depth, surrounds the nipple at its juncture with the body wall. Among several foetal glands sectioned, a few cases of aberrant ducts, similar histologically to the primary ducts, were noticed to have sprouted from the same relative position to the apex of the epithelial ingrowth at the base of the nipple as the primary ducts do to the apex of the mammary pocket (Fig. 1).

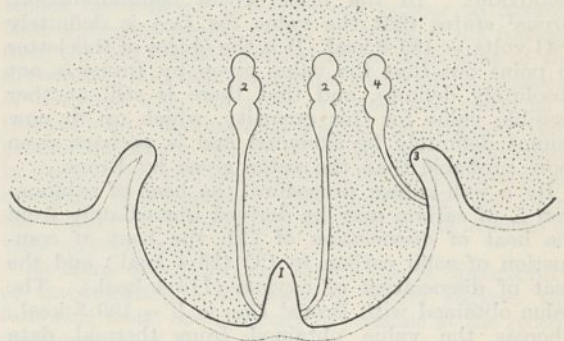


FIG. 1. Diagrammatic section through the nipple of a foetal pig. (1) Mammary pocket; (2) primary ducts; (3) epithelial ingrowth; (4) aberrant duct.

These aberrant ducts would appear to furnish evidence that an inducing stimulus is responsible for the development of the primary ducts, similar in principle to Spemann's demonstration¹ of the underlying mesoderm providing an inducing stimulus for neural plate development in Urodela. Recently, Waddington² suggested that some, if not all, inductions are due to the diffusion of active chemical substances into the reacting tissues. It would appear reasonable therefore to infer that an active substance is present in the nipple which stimulates duct development in specific locations relative to apices of epithelial ingrowths. Furthermore, that the stimulus is specific for particular groups of animals. Thus in the horse, in common with the pig, there are normally two primary ducts which develop respectively from the anterior and posterior walls of the mammary pocket; ruminants have only one duct, which proliferates from the apex of the mammary pocket, and in man there are several primary ducts.

Phylogenetically, Darwin considered the mammary glands to have developed in response to an intimate relationship existing between mother and offspring as occurs in the lower mammals. Histologically, they have been regarded as both modified sweat and sebaceous glands. Bresslau³ regards the increased secretory activity of skin glands on particular spots of the abdomen in the lower mammals as due to the presence of highly vascular gland areas. He considers the gland areas to be phylogenetically older than the Mammalia, since they are found on the ventral surface of some birds—the so-called brooding spots. In the higher mammals the mammary glands from their inception are specialised structures the ducts of which, as previously mentioned, appear to owe their inception to an inducing substance; the occasional absence of this substance may be the cause of the blind teats sometimes found.

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Ottawa.
Feb. 6.

¹ *Arch. Entw. Mech. Org.*, **100**, 599.

² *J. Exp. Biol.*, **13**, 86.

³ "The Mammary Apparatus of the Mammalia" (Methuen).

Dissociation Energies of CO and CN, and Heat of Sublimation of Carbon

THERE has recently been in this journal some discussion on the heat of dissociation of carbon monoxide¹. In the most recent communication, Brons¹ states that the value for D_{CO} is definitely 8.41 volts = 193.9 kcal. It is the object of this letter to point out that the value given by Brons is not absolutely definite, and that there is still another possible value for this quantity, which up to now cannot definitely be excluded and is perhaps even more probable than the value given by Brons.

By a well-known procedure, the heat of sublimation L of carbon may be derived immediately from the heat of dissociation of CO, the heat of combustion of solid carbon to CO (26.4 kcal.) and the heat of dissociation of oxygen (116.4 kcal.). The value obtained with Brons' D_{CO} is $L = 109.3$ kcal., whereas the value obtained from thermal data (vapour pressure curve of carbon) is $L = 143$ kcal. This discrepancy, as was pointed out to me some time ago by Prof. P. Harteck, seems to be rather too large, and one is tempted to look for a loophole in the proof given by Brons.

Actually the value given by Brons is obtained from a new predissociation limit, 9.66 volts above the ground state of CO. The difference in energy of this limit from the limit found at 11.05 volts is just equal to the difference in energy of the ¹S and ¹D states in the carbon atom. The agreement is in fact rather close. However, as I have already pointed out on several occasions², the actual dissociation limit may lie more or less *below* the predissociation limit, except in the cases where a breaking off of the rotational fine structure is observed for at least *two* successive vibrational levels. The latter is the case for the 11.05 volts limit in CO, and this limit is therefore a real dissociation limit; whereas for the new predissociation limit the breaking off has been observed for only *one* vibrational level, and therefore the value 9.66 is up to now only an upper limit to the corresponding dissociation limit, which in fact may be appreciably lower. Therefore the products

of dissociation at the upper dissociation limit (11.05 volts) need not necessarily be C(¹S) + O(³P), as concluded by Brons, but may also be C(³P) + O(¹D), assuming that the above-mentioned agreement is a chance coincidence. On this assumption, it follows that the *heat of dissociation of CO* is

$$D_{CO} = 73,760 \text{ cm.}^{-1} = 9.093 \text{ volts} = 209.7 \text{ kcal.}$$

The lower point of predissociation newly found by Brons would then correspond to a dissociation into normal atoms (C(³P) + O(³P)) with 0.57 volts of excess kinetic energy. The comparatively large amount of excess kinetic energy is not unusual; for example, the predissociation of CO found by Schmid and Gerö³ 0.48 volts above the 11.05 limit definitely leads to the same dissociation products as the 11.05 limit itself, that is, the atoms in this case have an excess kinetic energy of 0.48 volts. (This follows from the fact that the difference of the two predissociation limits, 0.48 volts, is definitely smaller than any plausible energy difference of the separated atoms.)

Our conclusion is therefore that, besides the value $D_{CO} = 8.41$ volts = 193.9 kcal. given by Brons, the value $D_{CO} = 9.093$ volts = 209.7 kcal. is also compatible with the predissociation data of CO now available. The latter value has the advantage that it does not lead to so low a value for the heat of sublimation of carbon. The value yielded is now $L = 125.1$ kcal. instead of 109.3 kcal. (Incidentally, it may be remarked that the value of L obtained from D_{CO} is the heat of sublimation into normal atoms, not into molecules or a mixture of both, as the thermal value 143 kcal. (cf. above) probably is.) Furthermore, the *heat of dissociation of the CN molecule* into normal atoms obtained from the heat of sublimation of carbon, the heats of combustion of (CN)₂⁴ and of carbon, the dissociation energy of N₂ and that of (CN)₂ into two CN⁵ turns out to be 5.45 volts = 125.5 kcal. on the assumption of Brons. This is also improbably low, whereas the value $D_{CO} = 9.093$ volts leads to $D_{CN} = 6.17$ volts = 142.4 kcal., which seems more probable.

		Brons	Herzberg
D_{CO}	kcal. volts	193.9 8.41	209.7 9.093
L	kcal.	109.3	125.1
D_{CN}	kcal. volts	124.6 5.40	142.4 6.17

The two alternative sets of values are compared in the table above. A final decision between the two may only be obtained if more data on the predissociation of CO or CN, or on the heat of sublimation of carbon, are available. It may, however, be stressed that the accuracy of each set is rather high.

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Jan. 3.

¹ P. Goldfinger and W. Lasareff; B. Rosen, *NATURE*, **135**, 1077 (1935); H. Lessheim and R. Samuel, *NATURE*, **136**, 606 (1935); F. Brons, *NATURE*, **136**, 796 (1935).

² G. Herzberg, *Ann. Physik*, **15**, 677 (1932); G. Herzberg and H. Sponer, *Z. phys. Chem.*, **B**, **28**, 1 (1934); G. Büttenbender and G. Herzberg, *Ann. Physik*, **21**, 577 (1935).

³ R. Schmid and L. Gerö, *Z. Phys.*, **96**, 546 (1935).

⁴ J. McMorris and R. M. Badger, *J. Amer. Chem. Soc.*, **55**, 1952 (1933).

⁵ G. B. Kistiakowsky and H. Gershinowitz, *J. Chem. Phys.*, **1**, 432 (1933).

Axial Rotation of Globular Star Clusters

THE axial rotation of globular star clusters has not yet been measured, so far as we know, from the differences of radial velocities at their opposite edges, but indirect evidence of their rotation is the observed ellipticity. The oblateness e of a rotating body depends on the ratio φ of the centrifugal force to the gravity at the star's surface; that is:

$$e = C\varphi, \text{ where } \varphi = \omega^2 r/g,$$

and as has been proved by Clairaut¹,

$$\frac{1}{2}\varphi < e < \frac{4}{3}\varphi;$$

$\frac{1}{2}$ and $\frac{4}{3}$ being the limiting cases for the homogeneous and the centrally condensed stars. The constant C as a function of the density distribution, that is, as a function of the polytrope class, was studied by H. N. Russell² and recently very exhaustively by S. Chandrasekhar³.

The general outcome of theoretical investigations is in favour of the conclusion that the globular clusters are built on the model of a polytrope 4 or 5. The constant C changes only slightly within this interval, being 0.501 for $n = 4$ and 0.500 for $n = 5$. In consequence, the value $\frac{1}{2}$ can be accepted for the model of a globular cluster.

In this connexion, the observed ellipticities of the globular clusters are of interest. Generally, the observed value of the ellipticity is not the true one but depends on the orientation of the axis of rotation in space. For the sake of simplicity, we assume that the observed ellipticities are the true ellipticities, and as a mean value was adopted from Shapley's Catalogue of Globular Clusters, the error is insignificant. Ellipticities have been observed in many clusters⁴, and in some of them ellipticity shows throughout the cluster from centre to edge. The absolute dimensions of the clusters are approximately known but only scant information on their masses is available. We have adopted for the masses of the clusters 10^5 - $10^7 \odot$, and the angular velocities were computed for the different values. Referring to our first equations, it may be noted that

$$\omega^2 = 2\gamma \frac{Me}{r^3},$$

where γ is the gravitational constant, M the mass and r the radius of the cluster. According to Shapley's determinations, the mean value of the oblateness was assumed to be 0.123, and for the mean diameter of a globular cluster $r = 1.078 \times 10^{20}$ cm. was used. The rotational velocity was calculated as a function of the mass, and the results are as follows:

Mass	Period in years
$\odot = 1$	
$1 \times 10^5 \odot$	3.877×10^8
2×10^5	2.743×10^8
5×10^5	1.735×10^8
1×10^6	1.227×10^8
5×10^6	5.487×10^7
1×10^7	3.877×10^7

It follows that the mean period of rotation of a typical globular star cluster is approximately 10^8 years. This value was deduced on the assumption that the globular clusters are rotating as rigid bodies, which cannot be said to be exactly true, because stars at different distances from the centre of the cluster evidently will have different rotational velocities. The problem is somewhat complicated by

the presence of stars in different stages of evolution, but there is a possibility of determining (by star counts) the oblateness and therefore the different rotational velocities for different spectral classes. Such counts have been made by E. Freundlich and V. Heiskanen⁵ for $M 13$. They find that the oblateness increases along the $B-M$ sequence. This interesting result interpreted from the present point of view means that the ratios of angular velocities for cluster stars of different spectral classes are:

$$B : A : F : (G-K-M) = 1.00 : 1.40 : 1.48 : 1.70;$$

that is, the stars of the $G-K-M$ types (giants) rotate twice as rapidly as stars of the B type. It would be of great interest to know how far the above results are in agreement with the conditions in our local star cluster.

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¹ Tisserand, "Mécanique céleste", 2, p. 204.
² Mon. Not. Roy. Ast. Soc., 83, 641.
³ Mon. Not. Roy. Ast. Soc., 93, Nos. 5, 6, 7
⁴ Shapley, "Star Clusters", chap. vi.
⁵ Z. Phys., 14, 226.

Fire-Walking

MANY of those taking part in the discussion on recent fire-walking performances appear to assume that a normal person would be burnt if his passage over the hot surface were identical with that of the fire-walker, and that a beginner can walk on charcoal or boulders with the same evenness and speed as a trained man. Having thus begged the question, they proceed to offer a variety of explanations, discordant in themselves, and ranging from thickened skin to an extrusion of ectoplasm; thus illustrating once more the futility of propounding theories in the absence of vital experimental data.

As some observers may have a future opportunity of investigating a fire-walk, I would suggest the following tests, based on my experience at the recent performance of Kuda Bux:

(1) Fasten a small thermocouple to any part of the performer's foot which comes into contact with the hot charcoal or stone and connect it to a suitable indicator. The temperature attained by his skin may then be read at the moment he leaves the fire, and if the indicator were watched during the transit it could be noticed whether the same part of the foot was used at each contact. The duration of the contacts and the interval between each should be measured by a stopwatch.

(2) Measure the temperature of the hot surface by pressing on it a thermocouple constructed for this purpose, and connected to a second coil on the indicator which will enable this temperature to be read. Laboratory tests could then be made by raising a surface to this temperature and noting the effect on the skin of a normal subject when applied to the surface for the same periods, and with the same intervals, as those observed in the case of the fire-walker.

(3) Strike the surface of the fire with the palm of the hand, making the same number of contacts as either of the performer's feet and with the same intervals between. If the observer feels that he is

getting burnt he can desist, but I was able to do this immediately after Kuda Bux had left the fire with my hand quite dry without sustaining any injury.

Walking on the fire should be attempted only by those who are certain that they can make the passage with the same speed as a trained fire-walker, as stumbling or hesitation may cause burning. Previous practice on cold charcoal or stone would be necessary, as for half-second contacts the rate of travel is about $3\frac{1}{2}$ miles per hour for a stride of 30 inches.

A small, portable outfit would serve to carry out the foregoing tests, and any good firm of instrument makers would supply the special thermocouples

needed, connected to wires insulated with enamel to protect them against the heat of the fire.

If it should prove that the skin of a normal person would be burnt when heated in exactly the same manner as that of the fire-walker, explanations not purely physical will deserve serious attention. Until then they must be regarded as mere speculations.

In conclusion, may I point out to those who still regard the feat of Kuda Bux as supernormal, that my hand had the same experience on the fire as either of his feet, and as I was not under any 'psychic' influence the plain inference is that neither of us attained a temperature high enough to cause burning.

CHAS. R. DARLING.

Points from Foregoing Letters

THE isotopic weight and 'packing fraction' of several atomic species have been determined by Dr. F. W. Aston with his new mass-spectrograph by comparison of doublets (atoms and groups of atoms having nearly the same mass/charge ratio). Dr. Aston gives revised figures for the relative abundance of various isotopes of cadmium, tin and lead. The existence of Fe 58 and Ni 64 is supported by the experiments of Gier and Zeeman, but evidence as to Ni 61 is still conflicting.

The absorption of slow neutrons by several elements has been measured by C. H. Collie with a more sensitive arrangement. Assuming that the reaction cross-section of boron is inversely proportional to the velocity of the reacting neutrons, the author deduces that the absorption bands of cadmium and indium for neutrons, which partly overlap, occur in the range 0-1.5 electron volts.

If the conservation principles are not obeyed in individual processes between matter and radiation (Shankland) and if there is no coincidence in time between the scattering by an electron and its recoil (Dirac), then, Dr. E. J. Williams concludes, the position and momentum of an electron could be ascertained in certain cases, and Heisenberg's uncertainty principle would be invalid. Dr. Williams has undertaken experiments on the emission of radiation by single atoms to test the conservation principle.

A system of electrical linkage between the tuning systems at the transmitter and the receiver of radio waves used in the investigation of the electrical layers of the upper atmosphere is described by R. Naismith. The new arrangement enables the two stations to maintain synchronism without continuous attention.

By re-plotting previously obtained measurements on the influence of the earth's magnetic field on cosmic radiation, so as to show the effect of latitude (without taking the height into consideration), M. G. Cosyns comes to conclusions which seem to contradict the view that atmospheric absorption alone is responsible for the absence of magnetically soft components in the cosmic radiation at sea-level.

The X-ray diffraction pattern of crystals of protein prepared by the Bence-Jones method is described by A. Magnus-Levy, K. H. Meyer and W. Lotmar. The particle weight of this protein is, according to Svedberg, about 34,000.

The preparation of positive platinum sols by regulated oxidation of negatively charged sols is described

by Nathalie Bach and N. Balaschowa. The behaviour of the ultra-microscopic platinum particles is analogous to that of platinum gas electrodes.

The effect of various concentrations of ascorbic acid (vitamin C) and of β -indolyl acetic acid and β -indolyl propionic acid upon the regeneration of willow shoots and the germination of oats, mustard and cress seeds is described by Dr. W. Davies, G. A. Atkins and P. C. B. Hudson. According to concentration, ascorbic acid may either stimulate or retard growth. The indole derivatives seem to inhibit the root growth in germinating oats, mustard and cress at all concentrations, although in dilute solution they stimulate regeneration in the willow.

In the absence of vitamin C, the blood of experimental animals, according to Dr. Frank Marsh, lacks its "complement" (a heat-sensitive substance resembling a ferment, found in the serum, which helps in the destruction of cells in blood). Dr. Marsh considers that this indicates a condition which eventually (four to eight months in man) leads to scurvy, and consequently the test might help in early diagnosis of that disease.

The presence in a few mammary glands of foetal pigs of additional or aberrant ducts which had proliferated from epithelial ingrowths situated at the base of the nipple are considered by Dr. Alan Deakin as furnishing evidence of the presence of an inducing substance within the nipple, which is responsible for the development of mammary ducts generally.

Prof. G. Herzberg contends that the value derived by Brons from spectrographic data for the heat of dissociation of carbon monoxide (193.3 kcal.) is not necessarily the true one; a value of 209.7 kcal. is also compatible with the available data. This higher value gives a correspondingly higher value to the heat of sublimation of carbon (125.1 kcal.), which is more in keeping with that obtained from thermal data (143 kcal.).

An attempt is made by Z. Kopal and Dr. H. Slouka to determine the axial rotation of globular star clusters using a well-known theorem of Clairaut and the results of theoretical investigations by S. Chandrasekhar. The mean rotational velocity of a typical globular star cluster is found to be approximately 10^8 years. Using star counts by E. Freundlich and V. Heiskanen in M 13, it is concluded that stars of the G, K, M classes rotate twice as rapidly as the B stars.

Research Items

Stone Age Cultures in Uganda

IN *Man* of March, Mr. T. P. O'Brien, leader of the African Prehistoric Research Expedition, reviews the Stone Age cultures of Uganda on the evidence of the sites throughout the country examined by the expedition. *Kafuan and Oldowan*. The Kafuan pebble culture is the oldest recognisable in Africa, ante-dating Oldowan I. It occurs mostly in gravels deposited by Pluvial I rivers. The implements are mostly small, showing a rough reduction of the edge to produce chopping and cutting tools. The Oldowan type implement is a rough chopper. Oldowan pebble tools are few. *Uganda 'Cromerian'*. A crude large-flake culture found in talus deposits, belonging to a dry period preceding Pluvial II. *Chellean*. A few water-rolled proto- or early Chellean tools are found in the gravels of the top terrace of the Kagera. True Chellean does not occur widely. *Acheulean*. On present evidence appears after a gap. The lowest stratigraphically dated is in Horizon *M*, which marks a climatic break in Pluvial II. The majority of the implements are of large flakes adaptable to the 'wood technique', though only a small proportion actually show real wood technique. It is comparable to Leakey's Stage I-II at Oldoway. Higher up in the same beds and again associated with a climatic break is a later phase of Acheulean, there being no, or little, evidence of intervening stages. In this, the *N* Horizon, there is evidence of deterioration or regression in style. In the *O* Horizon, Upper Acheulean occurs in plenty and well made. The most remarkable feature of this horizon is the appearance of an entirely new culture, previously known from the French and Belgian Congo—the *Tumbian*, of which the characteristic tools are oval or long *bifaces*, which later develop into beautiful *feuilles-de-laurier*. The *tranchet* is common. This culture occurs with the advanced Acheulean, but the relation is not yet clear. *Levalloisian*. First appears between *M* and *N*, and afterwards carries on until it develops finally into Still Bay. *Upper Palaeolithic*. The Aurignacian does not occur in Uganda, surprisingly, probably owing to lack of suitable stone.

Metabolism during Mild Exercise

MUCH attention has been devoted, during recent years, to the effects of hard exercise on metabolism. F. C. Courtice and C. G. Douglas (*Proc. Roy. Soc., B*, 119, 382) have studied the effects of the milder exercise of walking ten miles at 4.5 m.p.h. This amount of exercise was insufficient to increase the blood lactic acid, and the conclusion is reached, after discussion, that the respiratory quotient gives a trustworthy indication, under these conditions, of the nature of the foods metabolised. During the exercise the respiratory quotient (*R.Q.*) rose owing to increased carbohydrate metabolism. After the exercise the *R.Q.* fell, and acidosis and ketosis developed, owing to increased metabolism of fat. If the subject had consumed much carbohydrate on the day before the exercise, there was no evidence of increased fat metabolism after the exercise. The consumption of carbohydrate just before the exercise did not have this effect (see also NATURE, 136, 1001; 1935).

Fertilisation in *Acacia Baileyana*

DR. I. V. NEWMAN has published two further papers which complete his investigations on the life-history of *Acacia Baileyana* (*Proc. Linn. Soc. N.S.W.*, 59, parts 3-6). The carpel is found to arise as a single folded foliar structure with ovules inserted along the margins. The integuments are only formed after fertilisation, and the megaspore is possibly smaller than the microspore. The anther is regarded as containing eight sporangia, each with a one-celled archesporium which develops into a 16-celled pollinium. This condition should make it possible to determine definitely whether the split in the chromosomes is suppressed in the last premeiotic telophase. The pollen grains germinate in the anther, cutting off a generative cell which becomes spindle-shaped, has a definite membrane, and cytoplasm less dense than that of the grain. The pollen was grown successfully on 1 per cent agar with 20 per cent sugar solution. As the legume contains only 12 ovules, a pollinium on the stigma furnishes an excess of pollen tubes and two frequently enter the same embryo sac. Evidence was obtained that the extra male nuclei fuse with the polar nuclei, producing endosperm with occasionally as many as $7n$ or $8n$ chromosomes. The mature sac becomes filled with starch grains, and after fertilisation the endosperm nucleus divides to form about 64 free nuclei before wall-formation begins around the embryo.

Hemimerus, a Parasite of the Giant Rat

MESSRS. JAMES A. G. and John W. H. Rehn have recently published an article revising the species of *Hemimerus* (*Proc. Acad. Nat. Sci. Philadelphia*, 87, 457-508; 1935). This genus is allied to the earwigs, but is wingless and eyeless, with the hind body terminating in thread-like cerci, instead of forceps. So far as is known, the species of *Hemimerus* only occur as ectoparasites on terrestrial giant rats of the genus *Cricetomys*. The hosts, as well as the parasites, are limited in distribution to tropical Africa. The most important fundamental studies of these curious insects have been made by Dr. Heymons who, in 1905, showed that the offspring are produced viviparously, a peculiar kind of placenta enabling them to undergo their development on nutriment provided by their female parent. The adaptations of *Hemimerus* are those of a true parasite which lives externally on its host. The food appears to consist of epidermal products and of a fungus which possibly grows on the skin of the host. Messrs. Rehn have examined 343 specimens of the insect from various parts of Africa, and find that their distribution ranges from Portuguese Guinea, across the continent to Mozambique and the north-eastern Transvaal. The northern and southern range cannot be accurately defined at present, owing to paucity of material or records, from areas where it and its host undoubtedly occur. The authors redescribe the three species already known, and recognise five other species previously unrecorded. The paper is accompanied by a full bibliography of the genus and forty-seven figures illustrating diagnostic characters.

Control of Antirrhinum Rust

THE fungus *Puccinia antirrhini*, causing a rust disease of snapdragon plants, has established itself firmly in England during the last two years. This fact renders any experiments upon its control of more than passing interest. Mr. D. E. Green has conducted an extensive series of such experiments, using nine types of spray fluid, and three fungicidal dusts (*J. Roy. Hort. Soc.*, 61, Pt. 2, 64-76, February 1936). Copper-containing sprays were found to be effective, and of these, Burgundy mixture was the most suitable. Control was not absolute, however, and as it was considered that at least six sprayings were necessary, this method is likely to daunt even the *Antirrhinum* enthusiast. Mr. Green is, however, trying another method, namely, the raising of rust-resistant snapdragons, and the results of these trials will be awaited with great interest. They give high promise already.

Tulip Fire Disease

TULIP fire caused by *Botrytis tulipæ* is the most serious disease that attacks the tulip crop, and a descriptive account of it, with control measures, is given by A. Beaumont and others (*Ann. App. Biol.*, 23, p. 57). The blooms on attacked plants are rendered quite unmarketable, but though the direct loss on account of diseased bulbs is small, the indirect loss is by no means negligible where the flowers are 'topped', as a substantial increase in size is made during the period subsequent to 'topping'. No varieties are known which are completely resistant; but the degree of susceptibility varies; Baronne de la Tochnaye, for example, seems to be the most resistant tulip in the Devon-Cornwall district. A close correlation exists between meteorological conditions and the incidence of tulip fire, rainfall and humidity being the most important factors as they are the conditions necessary for germination and infection. Three types of symptom occur, fire, spot and rot. Fire is a primary infection and appears as grey lesions on leaves, flowers and capsules, whereas spot arises secondarily from spores derived from fire lesions. Rot is less common, and attacks the bulb only, although the resulting plant is sickly and generally fails to flower. Control measures are bound up with proper cultivation. Bulbs should be lifted every year and planted, preferably deeply, in fresh soil. Late planting and wide spacing are advocated, while careful roguing and destruction of diseased plants with avoidance of mechanical injury are also of the first importance. Various methods of chemical control have been tried, but the results have not yet met with much success. Further experiments in this direction are in progress.

Timber Seasoning

THE fourth number of the *Forest Products Research Records*, published under the auspices of the Department of Scientific and Industrial Research, deals with "Timber Seasoning", by R. G. Bateson. The importance of this investigation is that it deals with both air seasoning, the old common method, and kiln seasoning. Of particular interest from the practical householder's point of view is the statement that it is not possible to dry timber out of doors in Great Britain sufficiently for use in artificially heated buildings. "Under the most favourable circumstances," says the author, "the moisture control might conceivably be reduced to about 12 per cent in the height of summer but 18 per cent represents a

far more usual figure; whereas a moisture control of 9-12 per cent is required for interior wood work in centrally heated buildings". In the experience of the present writer, old air-seasoned Scots pine panelling dating from about the middle of the eighteenth century cracked badly when central heating was introduced into the house, whilst oak panelling stood up much better—but both examples prove the contention of the author. In this connexion, the author points out that certain 'refractory' hardwoods which take months to season in the kiln, can be kiln seasoned in a week or two if air seasoned for a year or two previously. This would appear to show that there is yet something to learn about air seasoning in the case of some species of, and probably the finer, timbers.

Magnesium Metasomatism

AN important paper by N. Sundius on "The Origin of Late Magmatic Solutions containing Magnesia, Iron and Silica" appears in *Årsbok*, 29, No. 7, of the Sveriges Geologiska Undersökning. The sulphide ores of Fennoscandia are often associated with quartz-rich rocks containing magnesium-, iron- and aluminium-bearing minerals such as micas, cordierite, amphiboles and garnet. Almost invariably the presence of these minerals has been ascribed to metasomatic changes due to the introduction, often through great distances, of oxides from some external source of supply. Locally, the metasomatic rocks have been sufficiently mobilised to act as intrusions towards their own country rocks. A peculiar feature of the scarn and ore occurrences in which magnesium metasomatism is manifested is the scarcity of evidences of volatile substances of the kinds usually regarded as pneumatolytic carriers. Sundius discusses a number of examples and concludes that a supply of outside agents is not always necessary, but that magmatic differentiation products corresponding to the minerals in question may be concentrated from a magma as residual solutions and may crystallise *in situ* or be squeezed out into the adjoining country rocks. Water at high temperature is regarded as the chief cause for the production of such late-magmatic solutions. The latter are supposed to contain hydroxyl-bearing compounds, probably silicates, and possibly aluminates and ferrites. Metasomatic activity on the part of the water-rich magma solutions is favoured by the diminished stability of earlier-formed feldspars in their presence. The author admits that vaporisation of metallic compounds from the magma may have played a prominent part in some cases, though, he adds, no examples have as yet been clearly revealed. The problem is far from being solved and Sundius himself warns petrologists that "a rigorous application of the theory here developed is not advisable".

The Southern Alaska Range

S. R. CAPPS has recently described an area of some 23,000 square miles which was still largely unexplored when the surveys reported were begun in 1926. (*U.S. Geol. Surv.*, Bull. 862). The parts of the Range now described reach heights up to 12,000 feet and include a labyrinth of rugged mountain crests and valley glaciers. One of the highest mountains of the region is Mount Spurr, a volcano which still shows signs of mild activity. Other volcanoes lie to the east, forming part of the great line of vents that stretches along the Alaska Peninsula and the Aleutian

Islands. The oldest rocks of the region are gneisses, mica-schists, crystalline limestones and quartzites, known to be pre-Triassic and thought to be Palaeozoic in age; they may, however, be Pre-Cambrian. Less highly metamorphosed Mesozoic sediments follow, cut by gigantic intrusions of a general granitic character. The age of the Mesozoic sediments in the Alaska Range has proved difficult to determine, as the rocks consist of a monotonous alternation of argillaceous rocks and graywackes which are almost devoid of fossils. Just why these particular Jurassic and Cretaceous seas should have been so inhospitable to life is a baffling problem, for near by, in the Pacific littoral belt of the Alaska Peninsula, a prolific fauna flourished during those periods. Near the shores of Cook Inlet there are extensive deposits of Tertiary lignitic coal, but at present more accessible supplies are available for the local market. Lodes carrying promising amounts of gold and silver have been discovered near the borders of granitic intrusions, but lack of transport facilities has so far retarded development.

Organic Liquids in Diffusion Pumps

K. C. D. HICKMAN (*J. Franklin Inst.*, February) has studied the behaviour of organic liquids used to provide the vapour stream in diffusion pumps, and he has been able to clear up some of the inconsistencies in reports of their behaviour. The liquids—the Burch vacuum oils and such esters as dibutyl phthalate—always contain traces of relatively volatile substances, and in the operation of the pump these substances collect in the high vacuum region, spoiling the vacuum there. They then redissolve in the condensate and are not eliminated by the backing pump. The author constructed a two-stage pump in which interconnexions ensured that the more volatile constituents were transferred to the rough pump, while the high-vacuum pump operated with the best fraction of the vapour. The pump gave a much better vacuum under these conditions than in the case where the interconnexions were changed to reverse the direction of fractionation. A further development was the construction of a fractionation pump in which successive fractions of the pumping liquid were used in successive vacuum stages. A practical form of this pump is to be described in a future paper.

Potassium Isotopes in Minerals and Plants

THE question of the variation in the isotope ratio of potassium in plants has received conflicting answers, the balance of evidence being that there is no isotope effect. The element has three isotopes, 39, 40 and 41. The abundance ratio K^{39}/K^{41} has been determined, with somewhat varying results. A. K. Brewer (*J. Amer. Chem. Soc.*, 58, 365; 1936), using the mass-spectrograph, with a constant velocity source permitting the entire primary ion beam to be focused on the entrance slit, and a Dempster type analysing chamber, finds the ratio $K^{39}/K^{41} = 14.27 \pm 0.04$ for Vesuvius lava. Most other minerals examined show only small differences, the abundance ratio being in general near 14.25. A low value (14.11 ± 0.03) was obtained for Hawaiian basalt and a high value (14.6 ± 0.05) for wyomingite (a lava). The results obtained with 32 plant ashes show distinct variations in the isotope ratio, the K^{41} content differing between plants by as much as 15 per cent. Kelp shows the most pronounced deviation

(12.63 ± 0.20) from the general average. It is interesting to note that plants have likewise been shown to exhibit a selectivity in the case of heavy hydrogen. The factors contributing to the abundance ratio variations appear to be the variety of plant, age, soil and section of plant. In a second paper (*ibid.*, p. 370) the same author reports that the abundance ratio for Pacific water is 14.20, no appreciable variations being observed between samples from different localities or at points down to 2,500 m. in depth. The value for the atomic weight is calculated as 39.094, in close agreement with the value accepted by the Committee on Atomic Weights.

Effect of Weather on 132-kilovolt Line Insulators

THE experience gained during the last few years in the running of the Grid in Great Britain under all kinds of weather conditions has shown that the behaviour of the 'chains of insulators' needs close study. In industrial areas, or where the atmosphere is polluted, flashovers occur, although the lines are adequately insulated according to the usual standards and the insulators are regularly cleaned. In a paper read to the Institution of Electrical Engineers on February 19 by J. S. Forrest, an investigation with the object of finding out which kind of insulator is most suitable for use under foggy conditions is described. The investigation was carried out at the Croydon transforming station of the Central Electricity Board. It was found that in fog or with dirty insulators under humid conditions, the leakage current is very unsteady, and continuous 'surging' often takes place. These current surges are due to surface discharges on the insulators and are usually self-extinguishing, but a severe surge may develop into a complete flashover. The experiments have led to a testing technique to determine which of the available types of insulators is most suitable in neighbourhoods subject to fogs. It is found that the frequency and magnitude of the current surges give a criterion by which the performance of insulators can be judged. It is unnecessary and therefore uneconomical to clean tension insulators as often as suspension insulators. It is probable that the better performance of the tension chains is due to the more efficient cleaning by rain and to the less tendency for leakage-current surges to develop into complete flashovers.

Radial Velocities of 100 Extra-Galactic Nebulae

THE discovery of the enormous velocities of recession of some of the spiral nebulae, together with the distance-velocity relation and its resulting hypothesis of an expanding universe, has led to a more intensive study of the radial velocities of these objects. The 100-in. reflector at Mount Wilson has already been used for determining the radial velocities of many nebulae, and now a further list of 100 velocities has been published by Humason (*Astrophys. J.*, 83, 10) in which the range in distance of the observed objects has been greatly increased. This list includes values for nebulae in clusters or groups as well as for 56 isolated nebulae; and the velocities found, with six exceptions, are all of recession, ranging from 50 km./sec. to 42,000 km./sec. When correlated with distance, these results indicate that the velocity-distance law is still sensibly linear up to the distance of 70 million parsecs (the estimated distance of the clusters in Boötes and Ursa Major).

Conference on the Teaching of General Science

A SUB-COMMITTEE of the Science Masters' Association, acting in collaboration with the University of London Institute of Education, recently organised a one-day conference on the teaching of 'general science'. The problems discussed have caused much controversy during the past few years. The panel of investigators on the School Certificate examinations recommended the adoption in schools of courses covering the main principles of elementary physics, chemistry and biology instead of more specialised courses covering only one, or part of one, of these subjects. At the annual meeting of the Science Masters' Association in 1934 this recommendation was endorsed. The movement is supported by those who consider that some study of biology should be part of the education of every child, as well as by those who wish school science to be less formal and less academic than it often is. It is opposed by those who fear superficiality of treatment and who feel that they can train children's minds more satisfactorily by using a more restricted medium. The large attendance at the conference, and the keen discussions which ensued, illustrated the general desire to thrash out the issues involved and to pool experience and knowledge.

Sir William Bragg took the chair at the first of the five meetings and initiated a discussion on "The Aims of General Science". The educated man, he said, should be aware of the main lines of development of human thought and, to-day, this involves an appreciation of the scientific attitude. It is important, too, that an intellectual atmosphere be fostered which is unfavourable to a misapplication of the fruits of research, due to lack of knowledge. Dr. Titley (King's College) amplified these remarks, and considered in detail aims which have been widely accepted. In particular, he gave a careful résumé of present views regarding the mind-sharpening value of scientific studies. He pointed out that exercising the mind within a narrow and specialised range might give it great power, but only in a very restricted field. The keen discussion which followed these stimulating addresses revealed fair unanimity of views. Clearly, it was found difficult to distinguish between the general aims of science teaching and the aims of general science, but this is an argument in favour of the latter. The teaching of 'Heat, Light and Sound', for example, would certainly not allow the attainment of the aims admitted.

Prof. E. N. da C. Andrade took the chair at the second meeting, the subject being "The Content of the Course". He admitted that wider syllabuses might lead to some superficiality of treatment, but could see no particular harm in this. Even the building up of 'balanced' courses, he thought, was really unessential. A scientific attitude and a love of science could best be fostered by a teacher who cast his net wide, but was not afraid to follow up his own pet hobbies. Prof. H. E. Armstrong should have followed Prof. Andrade but was unfortunately compelled to be absent for health reasons. He sent, however, a stimulating and provocative message. Mr. C. L. Bryant (Harrow) then gave details of the minimum syllabus in general science which has been

drawn up by the special sub-committee of the Science Masters' Association. The proposals were well received, though it was felt that a more optimistic attitude regarding time-table allowance would have been desirable. Many of the best schools give twice as much time to science as is contemplated by the sub-committee.

At the first afternoon meeting, held under the chairmanship of Mr. H. T. Tizard, problems of unification and correlation were considered. Mr. W. G. Greaves (Ledbury Grammar School) criticised the use of the topic method of teaching, in which topics such as air, water, measuring instruments, etc., are studied and no attempt is made to keep the subjects separated. He considered this to be useless as a method of unification, admirable though it might be as a teaching device.

Mr. J. A. Lauwerys (Institute of Education) discussed the point as to whether there was sufficient unity in the various branches of school science to make it a single subject. He put more faith in the integrating powers of the intellectual digestion of the adolescent mind than in those of various syllabuses or methods. Topics would certainly be useful in the first two years of study, but there was no reason to avoid 'subjects' at a later stage when logical interconnexions could be demonstrated and understood. The hints and comments made by speakers who took part in the subsequent discussion will probably be useful to those who are attempting to make their subject more interesting and valuable to the average pupil.

Sir Philip Hartog then took the chair for a discussion on examinations. He had been struck during the discussions, he said, by the importance attached to examination requirements. It appeared that examinations held the educational system in a stranglehold. He suggested that teachers should be clear as to the aims of their tests: they should know, for example, whether they were testing progress or utilisable skills. He recommended them to study the new-type questions, which the Americans have done much to develop.

The subsequent discussion, initiated by Mr. S. V. Brown (hon. secretary of the S.M.A.) and Mr. F. W. Turner (Morley Grammar School), showed that most teachers deplore the restrictive influence of examinations on their work. Though ready to admit that external examinations are not valueless, they would like to see fundamental alterations and improvements.

The three addresses to the last meeting—on "The Teacher of General Science"—admirably summarised the previous arguments. The chairman, Prof. H. R. Hamley (Institute of Education), Mr. W. H. Jenkinson (Sheffield) and Mr. L. G. Smith (Marylebone Grammar School) developed various aspects of this topic. The discussion which followed revealed unanimous agreement with their views. To make school science a valuable and useful part of a liberal education the right teachers must be provided by the universities. They must be enthusiasts who should know not only their own subject but also the role which it plays in the greater whole of which it is a part. Clearly

a wide and generous training in science would do more to provide such people than the narrow and intensively specialised courses favoured by some universities.

It is possible that the conference did not reach conclusions as explicit and as concrete as some might

have wished. Nevertheless, the addresses and discussions were highly appreciated and were found stimulating and helpful. Wide agreement with the ideals of more generalised science teaching was shown, though it was evident that quite a number of teachers are not yet convinced of its benefits.

Food and the Family Budget

THAT the social and economic aspects of national nutrition are evoking great public interest was shown by the crowded audience at the joint meeting of the Engineers' Study Group on Economics (E.S.G.) and the Association of Scientific Workers, held on March 31 at the house of the Royal Society of Arts, London. In a short introductory speech, Sir Richard Gregory urged the importance of investigating the causes why commodities that can now be produced in abundance, thanks to science, are not available in sufficient quantities to raise the standard of living of the people. He then called upon Dr. E. H. Tripp to present and explain the Group's report on "The Design of a Family Budget, with special reference to Food".*

The main finding of the report is that the statistical average family of 3.72 persons requires annually, for adequate living, goods and services now costing about £317, a sum equivalent to a weekly expenditure of about 63s. per wage-earner. About 82 per cent of 'families' are now earning less than this amount.

The chief items in the prescribed 'family' budget are (per annum): food, £99; rent and rates, £55, the type of house envisaged being one containing a living-room, three bedrooms, kitchen and bathroom, costing £600-£800 inclusive of land; clothing, £28; fuel and light, divided between gas, electricity and but little raw coal, £21; smoking, liquor, and sweetmeats, £28 (present national average £35). Provision is made for an annual holiday, £10, and for travelling, £20 (present national average £22).

Of especial importance in the prescribed dietary are the health foods, fresh dairy produce, eggs, meat, vegetables and fruit. The cost works out to 10s. a head per week, as compared with 9s., the current national average; and the conclusion is that a large section of the population has not the purchasing power needed to obtain the foods required for full health and working capacity.

In opening the discussion, Sir John Orr welcomed the fact that scientific workers have now begun to apply their knowledge and methods to social and economic problems, which cannot well be studied in water-tight compartments. The report of the E.S.G., he said, embodies an excellent study, and it is very remarkable that by approaching the subject from a totally different point of view and by different methods, the Group has reached a conclusion very close to that at which he and his colleagues arrived. Food requires a special place for itself. Whereas expenditure on items like entertainment, sport, and reading may vary from nothing to £1,000 a year, that on food varies much less from class to class—not more than from 4s. to 14s. a head per week between the poorest and the wealthiest. Appetite is limited, and although one might pay £1 for a dinner

in London, one could not eat more than 10s. worth of food, at retail prices. Also, the State has assumed a special liability for food by undertaking to treat and cure diseases due to an inadequate diet. Very few people starve nowadays, but many lack a diet sufficient to maintain good health. To provide an adequate diet for all people below the income-level of £317 per annum would involve, at retail prices, an increase in the national expenditure of about 5-6 per cent; but a cheaper method, and one more likely to be adopted, would be to cheapen the protective foodstuffs so that all could buy them; and that would reduce the increased expenditure to 1-2 per cent. More study and more criticism are needed to evoke concrete propositions; and once the bulk of the people is convinced, great improvement would follow.

Sir Daniel Hall said that if we increased the amount of home-grown food from the present figure of less than 40 per cent to more than 50 per cent of our total supplies, agricultural conditions would have to be revolutionised. We should certainly grow all the protective foodstuffs we can, and our land is specially suited to grow them. He disapproved the policy of subsidising wheat and sugar because they are needed in war-time; they are concentrated foods that are obtainable from our colonies, and occupy relatively little space in a ship's hold. As our farmers are now being assisted to the extent of more than £40,000,000 per annum, they could reasonably be expected to grow what is best for the country.

Mr. G. D. H. Cole agreed with the main points of the report, but regretted that the cost of education was not discussed. The food budget was certainly no more than is desirable, and it would probably be necessary to provide a larger total income. Urgently needed now are more data on expenditure at the £6-£10 a week income-level, and a new complete inquiry into working-class budgets.

Mr. A. E. Feavearyear commented on the cost of the improved housing prescribed in the E.S.G. budget. There are now some 10½ million houses in the United Kingdom, worth £4,000-£5,000 million at present prices. Assuming a house to last a hundred years, the annual cost of replacement would not amount to £50,000,000. He advocated a fairly rapid replacement of all houses below the E.S.G. standard—not less than 3 millions—but that would cost at least £1,500,000,000, or more than the entire net annual savings of the nation for five years.

Lady (Rhys) Williams described a study of infant and maternal mortality as affected by nutrition, carried out in the Rhondda Valley under the National Birthday Trust Fund. Necessitous mothers were given vitamin-bearing foods and 1 pint of milk a day for at least three months, with the result that the maternal death-rate fell from 11.29 in 1934 to 3.9 in 1935.

* Obtainable from A. H. Hayes, Hazlitt House, Southampton Buildings, Chancery Lane, W.C.2. Price 6d. (by post 7d.).

Mr. G. P. Crowden referred to the work of the British Medical Association and said that further efforts are needed to strengthen the link between laboratory and kitchen. He suggested the establishment of a central bureau to give information on matters relating to family nutrition, and that purveyors of foodstuffs might assist purchasing and distribution by offering attractive terms to housewives for weekly supplies of items in the dietary scales recommended.

Dr. G. C. M'Gonigle thought the E.S.G. report a notable contribution to family economics. He has analysed many budgets of the lowly paid and unemployed, and has found that the relatively low standard of the B.M.A. minimum dietary cannot be achieved under a family income of 55-65s. a week. High rent is a great obstacle. Contrary to popular belief, he found that the average working-class woman has a sound empirical knowledge of practical dietetics, and to the limit of her purse buys wisely and well.

Micro-Ray Communication

IN engineering, the progress of the evolution of inventions seldom proceeds along a straight line, each step leading directly and logically to its successor. The evolution often proceeds in a looped path, new inventions apparently returning to an earlier stage of development before making a new start in another direction. This is illustrated in a paper read by W. L. McPherson and E. H. Ullrich to the Institution of Electrical Engineers on January 30.

In describing the recent commercialisation of micro-ray transmissions for radio communication, the authors point out that it was with micro-rays that Hertz in 1887 performed the classic experiments which are generally admitted to have led to the wireless communication of to-day. Hertz succeeded in generating by means of a spark transmitter wave-lengths of 30 cm., and in proving conclusively that the radiation due to such circuits followed the optical laws of reflection, refraction and propagation. He thus verified Clerk Maxwell's work done twenty-two years previously. Hertz's investigations read almost like an experimental and theoretical study of light. They include the measurements of the angles of incidence and reflection from plane sheets of metal, reflection from curved metallic mirrors of definite focal length, refraction through prisms of pitch and studies in transparency and opacity. Owing to lack of sensitivity on the receiving side, Hertz's experiments bore no immediate fruit although scientific workers were greatly interested in them.

The invention of the large aerial and of tuning, and the success of medium and long wave operation, led to practically total neglect of micro-ray technique until 1919, when Barkhausen and Kurz discovered a new type of oscillatory circuit which generated wave-lengths down to about 43 cm. The first large-scale demonstration of modern micro-ray working was made between St. Margaret's Bay, near Dover, and Escalles, near Calais, a distance of 22.1 miles. The wave-length used was only 18 cm. and so the waves radiated like light waves, permitting the use of reflecting mirrors. In January 1934 a micro-ray link for commercial service was opened between the aerodromes of Lypne in England and St. Inglevert in France, covering a distance of thirty-five miles. It provides a duplex service on radio-telephony, teleprinter or Morse telegraphy as required. The wave-length is 17.4 cm., which is the shortest of any station in the world.

Experiments have shown that atmospherics of the ordinary type are never heard on the St. Margaret's circuit, although a few sharp clicks are sometimes noticed the origin of which has not yet been traced.

Thunderstorms occurring even in sight of the receiving station cause no interference. The ignition systems of aircraft or motor-boats also have no effect. It was found that the strength of the received signals did not remain constant. On three occasions the signal was uncommercial in telegraphy for periods of about two minutes. When a 600 cm. wave-length was used, no variation of the received signal was ever detected.

Diagrams are given of the working signal current operating the teleprinter at Lypne and of the state of the tides at the same times. Although the effect of the tides may be masked in many instances by other fading causes, the records suggest that they are a factor in causing fading. In nine cases out of ten, the turn of the tide, during a week's record, was accompanied by a marked change in the slope of the signal current curve. This supports the hypothesis that there exists interference due to the indirect ray reflected at the sea surface.

The authors conclude that the primary condition for good micro-ray working is a thoroughly well-mixed and homogeneous atmosphere. In the summer, currents of hot air probably create 'pockets' of very different refractive power from the rest of the atmosphere, so that the direction of transmission may be violently changed and unusual attenuation introduced. In summer, the passage of a cloud across the sun's rays gives a temperature 'kick' the magnitude of which is different when above land than when above the sea, owing to the difference in reradiation in the two cases. The path of the St. Margaret's-Escalles link is at first sight simpler, as it is nearly all above the sea; but at the faces of the cliffs near the stations strong currents of hot air often arise, and this would introduce a compound lens effect in the path of the transmission rays.

The results obtained by the practical working of the two 'links' described in the paper may be summarised as follows. The most stable micro-ray conditions coincide with very stable atmospheric conditions, as judged by thermometer and barometer. A high wind is almost invariably accompanied with good micro-ray transmission. The settling of a heavy bank of fog has been accompanied by very severe and rapid changes in the reception, followed by stability when the fog bank has ceased to move. Radio waves, six metres in length, are much more stable than micro-waves over optical paths across the Straits of Dover. It is much more difficult to tap micro-wave communications than those which use longer wave-lengths. Hence when secrecy is necessary, as in military operations, they are more desirable.

Molasses, Nitrogen Fixation and Land Reclamation

IN his presidential address to the United Provinces Academy of Sciences, India, on December 19, 1935, Prof. N. R. Dhar gave a general account of the work carried out by himself and his collaborators on nitrogen transformations in soil. Prof. Dhar leads the school of thought which believes that nitrification in soils and nitrogen fixation from the atmosphere are, especially in the tropics, photochemical at least as much as bacterial actions. Prof. Dhar has produced strong evidence in support of his theories, and the question appears now to have reached the stage at which the protagonists of bacterial and photochemical nitrification respectively are unwilling to admit any evidence which might shatter their beliefs.

Meanwhile, other soil workers will be wise to keep an open mind on the matter, for the philosophical implications of recognising that light plays a part in soils analogous to photosynthesis in the vegetable kingdom are at least as important as the practical possibilities of utilising that knowledge for the enrichment of the soil. Given sufficient facts, their practical application does not necessarily depend on their correct interpretation. The practical facts of Prof. Dhar's researches are that Indian soils are generally deficient in nitrogen, that more than half a million tons of molasses from the sugar industry are annually wasted in India, and that the application of molasses to the soil can double and may treble the soil nitrogen content, with a consequent large increase in crop yield.

Molasses contains about 70 per cent of carbohydrates and small quantities of nitrogen, phosphorus, potash, etc., these quantities, however, being much too small to account for the observed manurial effect. According to Prof. Dhar, the energy set free in the oxidation of the sugars in molasses is utilised, either bacterially or photochemically, in promoting nitrogen fixation and nitrification. Whatever the nature of the process, Dhar has produced indisputable evidence of increases in available soil nitrogen and crop yields following the application of molasses. Under temperate conditions, the converse result would be expected, as it is well known that the addition of carbohydrate-rich material to soil tends to reduce

the amount of nitrogen available to plants, the nitrogen becoming fixed as microbial protoplasm or as humus. An essential difference, however, between temperate and tropical soil requirements is that, whereas in temperate regions the limiting factor to crop growth is often the slowness, in the tropics it is the rapidity with which soil nitrogen is made available to plants, soluble nitrates being formed and leached from the soil before they can be absorbed by the crop. The general effect of molasses on the soil should be the same everywhere, but only in the tropics will its 'braking' effect on the mobilisation of soil nitrogen be a positive advantage to the cultivator, and only in the tropics will its stimulation of atmospheric nitrogen fixation, whether bacterial or photochemical, be appreciable, since temperate regions lack the heat necessary for bacterial and the light for photochemical stimulation.

For these reasons, the potentialities of carbohydrate manuring—of which molasses manuring is an example—have perhaps been overlooked by agriculturists. If Prof. Dhar can substantiate his claims, he may effect a revolution in agriculture in India, where the supply of the ordinary organic manures is far below the demand. Prof. Dhar suggests that a most valuable use can be made of molasses in reclaiming alkaline land. The acids produced in the decomposition of molasses neutralise the alkalis, and at the same time and contrary to experience when land is reclaimed with gypsum or sulphur, soil nitrogen is increased. A period of about four years is usually necessary to reclaim alkali land with gypsum, whereas with molasses applied at a rate of 30–40 tons per acre, good crops can be grown within six months. It is not stated whether such reclamations have been found permanent—in view of the oxidisability of the neutralising acids, this is open to doubt—but the method obviously merits further study. There are four million acres of infertile alkali land in India, and irrigation practices are increasing the area. The economic reclamation of these lands is one of the country's greatest agricultural problems, to the solution of which Prof. Dhar's work is pointing the way.

The Prehistoric Society

WITH the publication of its *Proceedings** for 1935, the Prehistoric Society, formerly known as the Prehistoric Society of East Anglia, completes the first year of its existence under the new style and organisation. The change will necessarily bring some broadening of outlook; but those who have followed with close attention the work of the Society under its old style, especially in recent years, are well aware that the change is one in form rather than substance. From the time of its first formation in 1908 the

Prehistoric Society of East Anglia, though strong in its local membership, reaped the advantage of its geographical position. It had the strategic advantage that many of its local discoveries and local problems were of more than local interest; they were also of the first importance in the discussion of some of the most significant of the questions relating to the antiquity of man and prehistoric archaeology at large. A glance through the later volumes of the *Proceedings* will show that the proportion of attention given to these larger questions and the tendency to view local evidence in the light of its bearing on the broader issues had steadily increased, until the Society, so

* *Proceedings of the Prehistoric Society for 1935* (*Proceedings of the Prehistoric Society of East Anglia, 1908–1935*). Edited by Dr. Grahame Clark. Pp. 166+15 plates. (Cambridge: University Museum of Archaeology and Ethnology.) £1.

far as its proceedings were concerned, had earned the right to be regarded as a national rather than a local body. That fact is recognised in the change of title. On the other hand, the strength gained from local interest will be preserved by an organisation of local groups under honorary secretaries, which will focus interest in specific local areas.

Thanks very largely to the activities of Mr. J. Reid Moir, the Prehistoric Society has never feared the difficulties which beset the pioneer in archaeological investigation; and if we may judge by the contents of the first volume of its *Proceedings*, the same policy will commend itself to the Society in its revised form. It will offer a free field for open discussion. This at least is the inference to be drawn from the tone of the first presidential address by Prof. V. Gordon Childe on "Changing Methods and Aims in Archaeology". Pointing out that the remarkable strides in discovery of prehistoric archaeology during the last ten years call for a complete reconsideration of the position in prehistoric studies, he focuses a variety of 'discontents' expressed in various quarters, and boldly accepts their implication of the necessity for certain fundamental changes of nomenclature, point of view and method. For example, while he holds that chronology is the essential of prehistory, as it is of history, the old chronological classification of 'ages'—stone, bronze, iron—can no longer be regarded as bearing any precise significance, owing to the wide distribution in time as well as in space to which it is now recognised these terms are applicable as cultural designations. On the other hand, as he himself has already suggested, the various 'ages' do express phases in economic development, which have their place in a temporal relation, thus becoming even more significant when viewed in the light of Prof. Childe's reference to the present aim of archaeology, which centres not so much on the intrinsic interest of the objects recovered as in the reconstruction of the culture of which they are an indication.

Prof. Childe dismisses in like vein the familiar chronological classification in a sequence of cultures based on the archaeological finds of France, which no longer applies in the world-wide view of prehistoric problems which must now be taken. But in dealing with this and other concepts hitherto generally accepted, his criticism—a constructive criticism be it said—is that the implication of the emphasis now laid on culture must be accepted to the full. It is no longer the period, but the culture which is the object of investigation. The chronological problem is to be solved through the relation in space and time of the various distinguishable cultures *inter se*.

Of the varied communications which follow the presidential address a bare mention of a few must suffice. Mr. G. A. Holleyman and Dr. E. Cecil Curwen describe their investigation of bronze age lynchet settlements on Plumpton Plain, Sussex. This produced some interesting pottery which is described by Mr. C. F. C. Hawkes. The pottery confirms and emphasises the distinction in date between site *A*, which belongs to the earlier Late Bronze Age from about 1000 B.C., and site *B*, which cannot be dated before 750 B.C. and covers the transition to the Early Iron Age centring approximately on 500 B.C. Mr. Henry Bury provides a welcome discussion of the Farnham terraces and their sequence and Dr. Grahame Clark furnishes an equally opportune survey of the prehistory of the Isle of Man.

The recent discussion, at the Norwich meeting of the British Association, of the antiquity of man in

East Anglia, gives a special interest to papers by Mr. Reid Moir on the Darmsden flint implements and a description of three Combe Capelle hand-axes from Norfolk; and a similar interest in a different context is attached, in view of recent discoveries in the county of Lincoln, to three papers dealing with long barrows—a description of the Therfield Heath Long Barrow, Royston, by Mr. C. W. Phillips, a discussion of a possible pedigree of long barrows and chambered cairns by Mr. W. J. Hemp, which is both suggestive and to some degree provocative, and a note on the relative chronology of English long barrows by Mr. Stuart Piggott. Mrs. Jaquetta Hawkes adds to her previous contributions to consideration of the place of origin of the Windmill Hill culture and advances her views a stage further.

A valuable feature of the miscellaneous items which complete the volume is a survey of results in the field in Great Britain and Ireland during 1935. Mention must also be made of a valuable résumé of recent work in Russia by Prof. Gordon Childe.

Educational Topics and Events

CAMBRIDGE.—The following have been approved for the degree of Sc.D.: W. N. Bailey, of Trinity College, C. G. Darwin, Master of Christ's College, J. O. Irwin, of Christ's College.

At King's College, Dr. D. Purdie has been elected into a fellowship. Dr. Purdie was placed in the first class of the Natural Sciences Tripos, Part II, in 1932, and was elected to a Charles Kingsley Bye-Fellowship at Magdalene College in 1934.

EDINBURGH.—Prof. W. H. McMillan, professor of mining in University College, Nottingham, has been appointed to the James A. Hood chair of mining in the Heriot-Watt College.

LONDON.—Prof. A. K. Henry has been appointed as from March 1 to the University readership in surgery tenable at the British Postgraduate Medical School. Since 1925 he has been professor of clinical surgery in the Medical School, Cairo, and director of the Surgical Unit, Kasr el Aini Hospital, Cairo.

LOUGHBOROUGH COLLEGE has been noted for many years as the sponsor of a combined theoretical and practical training system, essentially its own, which should constitute a good preparation for the administrative side of engineering. It has now extended this to include aeronautical engineering, and offers a course that should appeal to a type of man not very largely catered for at the present. The combined lectures, workshop, and aerodrome practice, constitute a four-year course leading to the College diploma and the Air Ministry's ground engineer's licences. A fifth year qualifies for an honours diploma, and covers the syllabus of the examinations of the Royal Aeronautical Society. The instruction comprises lectures and laboratory work, sandwiched with work in the production engineering workshops, on alternate weeks. The training is general during the first two years, but in the third and fourth year the practical work is entirely aeronautical, including aircraft rigging, maintenance, sheet metal work, engine repairs and testing. Flying instruction is also

given during that period. The fifth year covers the more advanced side of aircraft and engine design, or alternatively advanced flying up to the standard required for a pilot's *B* licence. The teaching is carried out by the college engineering staff, with the addition of three special aeronautical instructors.

THE education of Negroes formed the subject of a national conference held in Washington under the auspices of the United States Federal Office of Education in May 1934. A preliminary report has now been published, as Bulletin No. 6 of 1935 of the Federal Office, under the title "Fundamentals in the Education of Negroes". The title, suggesting, as it does, differentiation between the principles of education applicable to Negroes and those applicable to whites, is rather misleading. The purpose of the conference was to determine what are the fundamental requirements for raising the standard, both quantitative and qualitative, of education of Negroes up to the level of the education of whites. One of the conclusions reached is that the southern States are not able to provide public education for all children on an equal basis with the other sections of the country, and another is that glaring inequalities exist in the expenditures of school funds for the benefit of Negroes and whites respectively. Eleven southern States spent, in 1930, 35½ dollars per pupil in all schools but only 12½ dollars per pupil in Negro schools; moreover, 64 per cent of the Negro schools were one-teacher schools. Associated, both as cause and as result, with the inadequate provision of schooling for Negro children, is the fact that more than half of all American Negroes live in the open country or in villages.

IN "Science and the New Humanism", a series of articles contributed to the Workers' Educational Association's monthly, the *Highway*, Prof. L. Hogben, of the London School of Economics, outlines a field of study which he commends to the Adult Education Movement as one that offers an opportunity for work of the utmost national importance. The "Retreat from Reason", so ominously apparent among the younger generation in this as in other countries, he attributes to a dualism in educational politics, a cleavage between the education of scientific workers and technicians on one hand and of leaders and administrators on the other. This dualism, again, is a result of failure to adjust educational policies to the changes wrought in the structure of society by the enormous advances in the applied sciences. It is urgently necessary to devise methods of education which will give the community representatives who can co-operate intelligently with technical experts in constructive social enterprise at present suffering from paralysis as a result of educational dualism. In the first of his articles, Prof. Hogben exposes some of the faults of method that stultify current unscientific social 'science' doctrine. He quotes passages from the new humanistic studies making a fetish of mere logic, reducing their work to the level of a game of chess. Much, also, is sacrificed, he shows, to the idol of purity, so that a social inquiry which tends to the conclusion that something has to be done is said to be "tendencious", as if researches of a worker in natural science should be deemed worthless if there were grounds for suspecting the researcher of *wanting* to get a particular result, or an investigator is looked askance at for poaching on the preserves of investigators wearing a different subject label.

Science News a Century Ago

Lambeth Literary and Scientific Institution

ON April 12, 1836, a series of weekly lectures began at the Lambeth Literary and Scientific Institution, Wellington Terrace, Waterloo Bridge Road. The first and fourth of the lectures, by W. M. Higgins, were on electricity; in the second, third and sixth Dr. Lardner dealt with the principles and structure of the steam engine and its application to railroad and to navigation, while the fifth of the series was on the eye, the theory of vision and optical illusion, and was given by W. C. Dendy.

Petroleum and Titanium at Coalbrookdale

IN a paper on the physical features, geological structure and organic remains of the Coalbrookdale district, read to the Geological Society on April 13, 1836, Prestwich said that the petroleum or tar spring, for which Coalbrookdale has been so long celebrated, issues from a thick bed of sandstone, in the upper part of the coal measures: it yielded formerly more than a hogshead a day, but produces now only a few gallons a week. Another spring had been discovered, and petroleum is frequently found to some extent in working the coal. Titanium has been produced in considerable abundance in the iron furnaces. It often occurs in crystals of great beauty, but principally in amorphous masses. On examining some portions of hearth stones belonging to a furnace which had been at work for nine or ten years he discovered lumps of titanium as large as a marble cemented by a small quantity of iron.

Death of James Horsburgh

ON April 14, 1836, the eminent British seaman and hydrographer James Horsburgh died at the age of seventy-three years. Horsburgh was born at Elie in Fifeshire on September 23, 1762, of poor parentage. He learned elementary mathematics at school, and at fifteen years of age became an apprentice in a collier brig employed in the North Sea. In 1780 the vessel in which he was serving was captured by a French frigate, and Horsburgh was for a time a prisoner at Dunkirk. Regaining his liberty, he sailed for the East, and while first mate of an East Indiaman turned his attention to hydrography, teaching himself to draw and engrave. His voyages took him to China, Batavia and New Guinea, and some of his sailing directions and charts were published by the East India Company. Returning to England in 1796, his reputation gained for him the friendship of Banks, Maskelyne and Cavendish, but after a short stay at home he sailed again for the East, continuing his scientific observations. Back in England in 1806, he was admitted a fellow of the Royal Society, and in 1809 was appointed hydrographer to the East India Company in succession to Alexander Dalrymple. Few men contributed more to the safety of navigation in Eastern waters than Horsburgh.

On the Temperatures of Hot Springs

AT a meeting of the Royal Society held on April 14, 1836, Prof. J. D. Forbes concluded the reading of his paper "On the Temperatures and Geological Relations of Certain Hot Springs; particularly those of the Pyrenees; and on the Verification of Thermometers". He expressed his regret that notwithstanding the great interest of the subject, information on

the thermal phenomena was very deficient. After describing his own observations made in the Pyrenees in July and August 1835, in the last section of his paper he extended his inquiries to the hot springs met with in other parts of Europe; and in particular, those of the baths of Mont d'Or and of Bourboule, in France; of Baden-Baden, in Germany; of Loèche or Leuk, in the Vallais; of Pfeffers, in the canton of St. Gall, in Switzerland; and the baths of Nero, near Naples. Tables of observations were given with comparative columns derived from unpublished observations of Arago and Anglada.

Geology of Scotland

ACCORDING to the *Edinburgh Philosophical Journal*, at a meeting of the Wernerian Society held on April 16, 1836, "A notice was read on the dolomisation of the marble limestones, showing their magnesian character. The author also stated his views in regard to the geognostical relation of the Plutonian rocks of Skye, which he referred to the porphyry and trap formations. . . . The blunders in observation, and the wholesale appropriation to himself of the geology of Scotland (in despite of all the published and unpublished accounts of Scottish, English and German geologists) by Dr. MacCulloch, were noticed; and it was remarked by several members, that a better spirit was now generally abroad, and that few were disposed to follow in the path of the author of the Hebrides".

Societies and Academies

PARIS

Academy of Sciences, March 2 (*C.R.*, 202, 705-784). The president announced the deaths of Charles Nicolle and Ivan Pavlov. ERNEST ESCLANGON: The formulæ of Lorentz, and the principle of relativity. LUCIEN CUÉNOT: The coaptation of the anterior feet and of the head in *Phasma*. EDOUARD CHATON and Mlle. SIMONE BRACHON: The cinetome of *Opalina ranarum*, its genetic continuity and its importance with regard to the evolution of the ciliary apparatus. JOS. KAUCKY: The problem of iterations in a case of dependent probabilities. EDGAR BATICLE: The problem of encounters. ALEXANDRE OSTROWSKI: The conservation of the angles in the conformal transformation of a domain in the neighbourhood of a boundary point. GEORGES HARTMANN: Certain properties of a Grassmanian. CHARLES CHARTIER and JEAN LABAT: The application of stereoscopic chronophotography to the kinematic study of gaseous outflow. HENRI LEMONDE: The interpretation of diffusion and viscosity curves in binary mixtures. PIERRE VERNOTE: The general laws of natural convection. Conditions for the appearance of the first regime. D. MILOSSAVLJEVITCH: The use of the electronic tube as a detector utilising the curvature of the grid characteristic. ALEXANDRE DAUVILLIER: A photomagnetron and its application to the measurement of twilight illuminations. P. CARRÉ: A practical rule leading to the interpretation of certain reactions of organic chemistry from the electronic point of view. L. NÉEL: The theory of volume anomalies of ferromagnetic substances. HENRI TRICHÉ: The spectrographic study of the modifications undergone by the surface of the light alloys. Application to duralumin. CONSTANT CORIN: The infra-red absorption spectra of the chlorine deriva-

tives of methane. JEAN ROULLEAU: The influence of temperature on the photo-electric effect of cuprous oxide-metal contact. The anomalies presented by the temperature coefficient of the photopotential are only apparent, and it is possible to define a temperature coefficient with constant contact resistance which depends only on the temperature and not on the cell studied. MAURICE CURIE: The theories of phosphorescence. The theory of Muto, based on the existence of a metastable state of the foreign atom, can be applied in the simplest cases, but other experimental facts have to be taken into account. RAYMOND LAUTIÉ: The molecular volume of normal liquids. ALBERT MICHEL-LÉVY and HENRI MURAOUR: The influence of the pressure of the surrounding gas on the luminosities accompanying the detonation of explosives. Increase of pressure of the surrounding gas considerably diminishes the intensity of the luminous phenomena, when lead hydrazoate is the explosive. Three photographs are reproduced illustrating the effect of changing pressures. NÉDA MARINESCO: The law of blackening of photographic plates by ultra-sounds. The blackening by ultra-sounds follows a law analogous with that of Hurter and Driffield. The results show that the photochemical action of light and that of ultra-sounds are identical. MARCEL GODCHOT, Mlle. GERMAINE CAUQUIL and RAYMOND CALAS: The deuterhydrates of krypton and xenon. Forcrand showed that krypton and xenon can form hydrates with water containing approximately 6H₂O. The hydrates formed with heavy water are found to have the same composition. PAUL BRASSEUR: The study of the anhydrous ferric phosphates with X-rays. Four varieties of ferric metaphosphate give the same X-ray diagram. Ferric pyrophosphate gave a different diagram, but no diagram characteristic of Millot's pyrophosphate could be obtained. PIERRE SÛE: The dehydration of some sodium niobates. EDOUARD RENCKER and MARC BASSIÈRE: The allotropic varieties of lead oxide. Lead oxide exists in two states (α and β) characterised by their Debye and Sherrer diagrams. The thermal transformation of the α -oxide into the β -oxide takes place suddenly at 530° C. MORICE LETORT: A new polymer of acetaldehyde. The polymer recently described by Travers was noticed by the author in 1933, while preparing some highly purified acetaldehyde. Its properties agree with those given by Travers. One reaction in addition is given; the polymer reacts violently with fuming nitric acid and some nitrobenzene is produced. MARTIN BATTEGAY and PIERRE BOEHLER: The salts of α - and β -anthracenyl-diazonium. PIERRE COMTE: The lower Devonian of Léon (Spain). ROBERT LAFFITTE: The Jurassic and Berriasian in Aurès (Algeria). ANDRÉ EICHORN and ROBERT FRANQUET: Chromosome enumeration and the study of somatic mitosis in *Asclepias cornuti*. SERGE TCHAKHOTINE: The effects of localised irradiation of the nucleus of Infusoria by ultra-violet micropuncture. ERNEST KAHANE and Mlle. JEANNE LÉVY: The diastatic hydrolysis of acetylcholine by serum.

AMSTERDAM

Royal Academy of Sciences (*Proc.*, 39, No. 2, February 1936). F. K. TH. VAN IJERSON: Cavitation and surface tension. Studies to determine the cause of the erosion by cavitation of the pumps used in draining the Zuider Zee. W. H. KEESOM and P. H. VAN LAER: Relaxation phenomena in the transition

from the supraconductive to the non-supraconductive state. There is a relaxation time of 10-40 sec. when the threshold curve is crossed by raising the temperature in the presence of a magnetic field. W. H. KEESOM and K. W. TACONIS: Crystal structure of solid oxygen. Confirmation of Vegard's results. J. G. VAN DER CORPUT: Distribution functions (5). E. COHEN and J. J. A. BLEKKINGH, jun.: Influence of the degree of dispersion on physico-chemical constants (6). An effect of the degree of dispersion on the solubility of salicylic acid is observed. F. M. JAEGER and J. A. VAN DIJK: Complex salts of dipyrityl with bivalent and trivalent cobalt. A. A. NILJAND: Mean light curves of long-period variables, 26.V18=*RZ* Persei. This star has a complicated light curve with a main period of 354 days. P. H. VAN CITTERT: Some remarks on the resolving power of the microscope measured with Grayson's rulings. Influence of the kind of illumination on the resolving power. L. HULTHEN: The antiferromagnetic exchange problem at low temperatures. Calculation of the entropy and susceptibility. P. J. HARINGHUIZEN and D. A. WAS: Research on thin layers of tin and other metals (2). The corrosion of metals by technical insulating oils. Results for tin, lead and copper. W. HUREWICZ: Contributions to the topology of deformations (4). Aspherical spaces. J. F. KOKSMA: Metrical considerations in the theory of diophantine approximations. J. BEINTEMA: Crystal structure of magnesium and nickel antimonate. The formulae of both of these compounds is shown to be $\{M(H_2O)_6\}\{Sb(OH)_3\}_2$. IDA LUYTEN: Vegetative cultivation of species of *Hippeastrum* (2). M. H. VAN RAALTE: Influence of glucose on auxin production by the root tip of *Vicia Faba*. S. DE BOER and H. H. J. HOLT-KAMP: Effect of medicines on auricular fibrillation (1). Experimental researches on the influence of hydroquinine, hydroquinidine, quinine and hydroquinidine-free quinidine on auricular fibrillation of cats. B. VAN DER EYKEN: Denture and teeth development in the irisforelle (*Salmo irideus*) (3). Upper jaw. P. B. VAN WEEL: The periodicity in the metabolism of the recuperating pancreas of the white mouse. ELISABETH A. RIETMEYER and F. J. NIEUWENHUYZEN: The action of guanidine derivatives on motility. C. D. VERLIP and E. F. DRION: Frequency distribution of growth in homogeneous material (1). Experiments on *Kalanchoë verticillata* considered in relation to statistical theories of Pearson, Kapteyn and others.

CRACOW

Polish Academy of Science and Letters, February 5. W. SIERPINSKI: A universal function of two real variables. S. RUZIEWICZ: Remark on universal functions of two real variables. L. JANSONS: The Zeeman effect of the forbidden lines of the helium spectrum. T. BANACHIEWICZ: A new minor planet. This planet was discovered on plates taken at Cracow by K. Stein on January 24, 1936, and the position is given. It is possible that this planet may prove identical with the planet 1936 AB. K. DZIEWONSKI, T. MAJEWICZ and L. SCHIMMER: New studies on the bisubstituted derivatives of naphthalic acid. B. HRYNIEWIECKI and MLE. W. KURTZ: The distribution of the siliceous cones in the cells of the Cyperaceae and their correlations. J. MOTYKA: A monograph of the genus *Usnea*. H. SZARSKI: Contribution to the study of the physiology of the worms included in the genus *Chaetogaster*. J. ZACWILCHOWSKI: Researches on

the innervation of the sensorial organs in the wings of *Aphrophora alni*. J. TUR: A double neoplastic embryo. P. SLONIMSKI: The figured elements of the blood of *Amphiuma means*.

GENEVA

Society of Physics and Natural History, February 6. E. GUYENOT, E. HELD and A. MOSZKOWSKA: (1) Habituation to prehypophysal hormones. (2) The production of anti-hormones in the serum of habituated animals. Female guinea pigs, after prolonged treatment with prehypophysal extracts, become refractory to the action of these hormones. Experiments prove that this is the result of the production of anti-bodies, present in the serum and capable of conferring a passive immunity on fresh animals. A. JAYET: Some new observations on the Magdalenian of Veyrier sous Salève (Hte. Savoie). A. PERIER: Various anatomical types of the tubercle of Carabelli. W. H. SCHOPFER and A. JUNG: Researches on the measurement of vitamin B₁ activity with the aid of a micro-organism (*Phycomyces*). A certain number of substances, known for their content of vitamin B₁, are examined simultaneously with the test animal (rat) and plant (*Phycomyces*). The results are partially satisfactory. If, in a concentrated extract, the vitamin B₁ is the only effective factor, the plant test is susceptible of practical applications, at any rate in certain cases.

February 20. A. LENDNER: Hereditary 'alcoholism' in the bean (*Phaseolus vulgaris*). CH. BAEHNI: A new genus of the family of the Icacinaceae, Neoloretia. B. SUSZ and E. PERROTTET: The Raman spectrum of iso Eugenol and of the safrol series.

MOSCOW

Academy of Sciences (*C.R.*, 4, No. 4-5; 1935). L. V. KANTOROVITCH: Some particular methods of prolongation of Hilbert space. A. TICHONOV: Mathematical theory of the thermo-electric couple. V. FABRIKANT, F. BUTAJEVA and J. CIRG: Influence of pressure on the discharge radiation in mercury vapour. A. V. SOLOVJEV: (1) Effect of the water vapour pressure on the rate of the interaction between iodine and metals (iron and copper). (2) Interaction between aluminium and iodine in an air atmosphere of varying humidity. A. POLESSITSKIJ: Solubility and activity of the halogenates of some bivalent metals. (1) Solubility and activity of Ba(IO₃)₂ in water and in solutions of electrolytes. (2) Solubility and activity of Pb(IO₃)₂ in water and in solutions of electrolytes. K. S. TOPCIJEV: Cases of mobility of the nitro-group. A. VEDENEJEVA, S. GRUMGRZIMAJLO and A. VOLKOV: Microscopic determination of the refractive indexes of resinous substances of highly refractive minerals. Z. KATZ-NELSON: Sources of development of the latero-ventral part of the trunk muscles and the caudal muscles in Amphibia. The muscles develop from the mesenchyme. A. J. CHARITE: Flavins and metabolism. (1) Flavins and amylolysis. (2) Flavins and proteolysis. S. I. KRAJEVOJ and R. A. RASSULY: Frequency of translocations in different sections of the chromosome in *Pisum*. A. F. BUCHINSKIJ: Inheritance of duration of vegetative period in tobacco. V. I. KROKOS: Stratigraphy of the quaternary deposits of the south-western portion of the ice lobe in the Don River basin.

ROME

Royal National Academy of the Lincei (*Atti*, 22, 1-91; 1935). G. A. CROCCO: Safety of gliders on encountering an ascending gust. P. ALOISI: Some flint-stones of anagenite-verrucano from Monte Pisano. L. TOSCANO: Permutable operators with the power of a special linear operator (2). L. ERMOLAEF: Surface couples with corresponding asymptotes and having a pair of common conjugate straight lines at homologous points. A. TONOLO: Integration of the differential system of Dirac. R. WOJNAROSKÝ: Kinematics of a solid body in Euclidean space of n dimensions. N. SPAMPINATO: Extension to the bi-complex field of two theorems of Levi-Civita and of Severi, through the holomorphous functions of two complex variables (1). G. SCORZA DRAGONI: Some theorems relative to a problem of limits through a differential equation of the second order. G. MATTIOLI: Internal forces in turbulent media and general equations of turbulence. D. GRAFFI: Effect of variation of mass on a planetary orbit. N. W. AKIMOFF: The paradox of Dubuat. C. M. MALDURA: Chemical researches on the Orbetello lagoon with regard to the biology (1). A. SPIRITO: Influence of continuous electric current on meristems of roots. G. SCHREIBER: Atypical regeneration of the limbs of *Proteus anguineus*, Laur. M. ROMANO and G. SCHREIBER: Changes of the eye of Anurans during normal and accelerated metamorphosis. V. FAMIANI: Anti-neuritic vitamin (B_1) content of germinating grain, and of some varieties of Italian grain. T. DE SANCTIS MONALDI: Experimental human malarial infection from sporozoites.

VIENNA

Academy of Sciences, February 20. RICHARD SCHUMANN: Report on further investigations of latitude variations. OTTO DISCHENDORFER and AUGUST VERDINO: Condensation of benzoic acid and thymol (1). Preparation of 2-benzoyl thymol and determination of the constitution of desyl thymol. JOSEF A. PRIEBSCH: Study of the secondary radiation of cosmic rays at 2,300 m. by counters. The number of coincidences recorded at high altitude by three counters arranged in a triangle below a sheet of scattering material varies more with barometric pressure, temperature, and time of day than either the total or the vertical radiation. ELISE HOFMANN: A silicified palm in the Tertiary at Retz (Austria). ERNST MELAN: Theory of statically indeterminate systems made of ideally plastic material. GERHARD HEINRICH: Theoretical and experimental study of the water-jet suction pump. R. JAGITSCH: Reactions in the solid state. E. HAYEK: Crystallisation and dehydration of copper hydroxide. ODOMAR GUGENBERGER: (1) The Trias at Eberstein (Carinthia). Ninety further species have been distinguished in the fauna of the *Cardita*-bearing stratum at Eberstein. Of these, fifty-nine have previously been found in the related Launsdorf deposits, while of the remainder nine are entirely new. (2) Unknown species in the sub-Lias (Buckland zone) of the province of Palermo.

February 27. KARL GIRKMANN: Yielding of tie rods under local loads. F. WESSELY, K. SCHÖNOL and W. ISEMANN: The bitter principle of Columbo wood. HERBERT SCHOBER: Study of the spectra of the inert gases by means of a short wave generator.

Forthcoming Events

CHEMICAL SOCIETY, April 16-17.—Anniversary Meeting to be held at Bristol.

April 16, at 4.45.—Presidential Address. Dr. N. V. Sidgwick.

April 17, at 11.30.—Prof. T. S. Moore: Hatzsch Memorial Lecture.

GEOGRAPHICAL ASSOCIATION, April 17-20.—Spring Conference to be held in the University of Sheffield.

BRITISH PSYCHOLOGICAL SOCIETY, April 17-20.—Extraordinary General Meeting to be held in Leeds.

Official Publications Received

Great Britain and Ireland

Falmouth Observatory. Report of the Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council. By H. Dent Gardner; with Meteorological Notes and Tables for the Year 1935, also Additional Meteorological Tables for the Lustrum 1931-1935, with Mean Values for 65 Years (1871-1935), by W. Tregoning Hooper. Pp. 17. (Falmouth: Falmouth Observatory.) [193

The Board of Greenkeeping Research. Report for 1935. Pp. 54. (Bingley: St. Ives Research Station.) [203

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 31: The Preparation of Alginate Acid and its Constitution. By Vincent C. Barry and Dr. Thomas Dillon. Pp. 285-287. 6d. Vol. 21 (N.S.), No. 32: Derivatives of Alginate Acid, Part 1: The Acetylation of Alginate Acid. By Vincent C. Barry, Dr. Thomas Dillon and Pádraic O'Muineacháin. Pp. 289-296. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [233

Other Countries

Indian Forest Records. New Series, Vol. 1, No. 11: New Indian Circulionidae (Col.). By Sir Guy A. K. Marshall. Pp. 205-232. (Delhi: Manager of Publications.) 1 rupee; 1s. 6d. [163

Education, India. Education in India in 1933-34. Pp. vii+127. (Delhi: Manager of Publications.) 2.2 rupees; 4s. [233

Ministry of Finance, Egypt: Survey of Egypt: Geological Survey. Leaves of Dicotyledons from the Nubian Sandstone of Egypt. By Prof. A. C. Seward. Pp. iii+23+3 plates. (Cairo: Government Press.) [233

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 15, No. 3: Additional Creataceous Plants from Western Greenland. By A. C. Seward and Verona Conway. Pp. 41+6 plates. (Stockholm: Almqvist and Wiksells Boktryckeri A.-B.) [233

Report of the Aeronautical Research Institute, Tókyó Imperial University. No. 133: Experimentelle Untersuchungen über Augen-Blendung. Von Yenziro Awadi. Pp. 60. 55 sen. No. 134: On the Directional Properties of Airscrew Sound. By Jūichi Obata, Yaei Yosida and Umezirō Yosida. Pp. 61-79. 35 sen. (Tokyo: Kōgyō Tosho Kabushiki Kaisha.) [233

Indian Forest Records, New Series, Vol. 1, No. 2: Experiments on the Air Seasoning of Softwood Railway Sleepers. By Dr. S. N. Kapur, assisted by Azizul Rehman. Pp. iv+43-75+2 plates. (Delhi: Manager of Publications.) 1.4 rupees; 2s. [233

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium, Vol. 26, Part 8: New Species of Pilea from the Andes. By Ellsworth P. Killip. Pp. viii+367-394. (Washington, D.C.: Government Printing Office.) 10 cents. [233

Smithsonian Miscellaneous Collections, Vol. 95, No. 1: Observing the Sun at 19,300 feet Altitude, Mount Aunconguicha, Chile. By C. P. Butler. (Publications 3379.) Pp. ii+4. Vol. 94, No. 17: Growth of a Green Alga in Isolated Wave-Length Regions. By Florence E. Meier. (Publication 3377.) Pp. ii+12+1 plate. (Washington, D.C.: Smithsonian Institution.) [233

U.S. Department of Agriculture. Technical Bulletin No. 486: Cotton Bollweevil Survival and Emergence in Hibernation Cages in Louisiana. By R. C. Gaines. Pp. 28. 5 cents. Technical Bulletin No. 499: The Cannibalistic Habits of the Corn Ear Worm. By George W. Barber. Pp. 19. 5 cents. Technical Bulletin No. 502: The Chemical and Physical Properties of Dry-Land Soils and of their Colloids. By Irvin C. Brown and Horace G. Byers. Pp. 56. 10 cents. (Washington, D.C.: Government Printing Office.) [233

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 2: Statistics of Private Elementary and Secondary Schools, 1932-33. (Being Chapter 6 of the Biennial Survey of Education in the United States, 1932-34.) Pp. 71. (Washington, D.C.: Government Printing Office.) 10 cents. [233

Catalogues

The Wild-Barfield Heat-Treatment Journal. Vol. 1, No. 8, March. Pp. 97-110+iv. (London: Wild-Barfield Electric Furnaces, Ltd.) Radiography and Clinical Photography. Vol. 1, No. 1. Pp. 8. (London: Kodak, Ltd.)

Vitreosil (Pure Fused Quartz or Silica Ware) for use in Chemical and other Laboratories. Pp. 58. (Wallsend-on-Tyne: The Thermal Syndicate, Ltd.)

A Complete List of Chapman and Hall's Scientific and Technical Books. Pp. 158+xxxviii. (London: Chapman and Hall, Ltd.)