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The Forestry Commission*

THE fifteenth annual report of the Forestry Commission presents a record of the work carried out by the Commissioner since its establishment in 1919. The fifth and the tenth annual reports gave similar general reviews of the work done in the first and the second quinquennium respectively.

The wide and expanding scope of the work which is being carried out by this young and energetic Government Department is shown at a glance by the full 'contents' of the report before us. In spite of its fifteen years of existence, the Forestry Commission is still merely in the first phase of its existence; the Commission, like the forest, cannot be regarded as full fledged and in full working order until a complete forest rotation has run its course, and, as is well known, a forest takes many decades to reach maturity. The Transfer of Woods Act, 1923, however, placed fifty-six thousand acres of existing forest under the care of the Forestry Commissioners, and this brings under their administration the whole range of forestry practice. Nevertheless, the chief function of the Commission is meantime to create and re-establish forests adequate to supply at least part of the needs of Great Britain in timber of economic value.

At September 30, 1934, the Commissioners had under their charge approximately 909,000 acres of land, which gives an indication of the progress made since 1919. A further idea of the progress being made in afforestation by the Commissioners is afforded by the number of manual workers employed in their forests. The summer minimum in 1920 was 210; and the winter maximum in 1920–21 was 935. In 1934, the summer minimum had increased to 3,015, and the winter maximum of 1934–35 was 4,020. The intermediate figures of employment show a steady increase during the intermediate years, and as time goes on the numbers are bound to increase not only as the area under forest expands, but also as the plantations approach the thinning stage. These operations will involve cutting, haulage, preparation, and road, rail and to some extent sea transport to the mines and other timber consuming centres. A drop of a thousand or two in the figures of unemployment is hailed with delight as a sign of economic progress and recovery. This new national industry, set upon its feet by the establishment of the Forestry Commission, is undoubtedly pulling its weight.

The funds at the disposal of the Commissioners are being deposited in a safe bank. If we look at the question from the point of view that it is not the forester but Nature which produces the timber, we get a clearer idea of the economic basis of forestry. The forester by his labour and a certain amount of capital outlay in material produces conditions which enable Nature to become his ally in the direction he desires. Once he has placed the right tree in the right environment, natural growth factors such as sunlight and temperature, with a suitable amount of air and soil moisture, enable the living machine to get to work and from the carbon dioxide of the air and a small amount of mineral food materials from the soil, timber, which consists mainly of carbon, is produced. The raw material is cheap and abundant. The carbon from the air costs nothing and the small quantity of minerals from the otherwise idle soil is being put to a useful purpose, and as time goes on the productive capacity of the soil is improved, under suitable sylvicultural management. Surely then, something for nothing, with

* Forestry Commission. Fifteenth Annual Report of the Forestry Commissioners for the year ending September 30th, 1934. (London: H.M. Stationery Office, 1935.) 2s. net.

raw material inexhaustible, if properly used, is an attractive proposition. The forest capital is increasing in direct ratio to the rate of growth of the trees. The forester organises the industry in which Nature supplies the driving power and the raw material. The trees are his 'workmen', which if properly treated are busy night and day with no 'off' time or unemployment. There are therefore, surely, a few concerns in which money, especially national funds, can be applied with more safety or greater mutual benefit to all.

A perusal of the Forestry Commissioners' report shows that everything possible is being done in regard to land acquisition and planting, education, research, and the development of forest technique. Research and experiment in regard to the production of timber under varying conditions, the establishment of new plantations, the treatment, protection and utilisation of established plantations, have already led to improved and more efficient methods of practice. Sound methods of practice depend upon as complete a knowledge as possible of the biology of our trees and of the forest as a whole. One of the weak points in British forestry until now has been our almost complete neglect of the study of the relationship between our trees and soil. This has been due mainly to lack of men and facilities, but it will be remedied in the future, as the Commissioners have made a grant to the Macaulay Institute for Soil Research at Craigiebucklar near Aberdeen for the investigation of forest soils, including questions relating to the fertility of forest tree nurseries. Such investigation, in conjunction with studies in forest biology, is the safest method which is likely to lead to improvement in the productive capacity of our existing forest soils and to bring many extensive areas at present considered doubtful or unsuitable for tree growth into a fit state for afforestation.

Nor is the æsthetic aspect of forestry being neglected. The provision of future national forest parks is being kept in mind. The forests are still too young to permit of general access by the public, but in due course suitable areas will be opened up for health and recreational purposes. The Commissioners are co-operating with the Director and staff of the Royal Botanic Gardens at Kew in the formation of a new arboretum at Bedgebury near Goudhurst in Kent, away from the smoke and fumes of London. The arboretum is being laid out to show fine specimen trees singly and in groups. At Benmore in Argyllshire, an estate comprising 10,200 acres was gifted to the Forestry Commission in 1925 by Mr. Harry George Younger, and three years later he generously augmented his gift of land by creating a trust known as the Younger Benmore Trust, the income from which is used for the maintenance of the gardens and grounds, which are now open to the public. The gardens, by arrangement with H.M. Office of Works, have been placed under the control of the Regius Keeper of the Royal Botanic Garden, Edinburgh. The rest of the estate is administered by the Forestry Commissioners.

Forest worker's holdings, which were not part of the original programme of the Commission, were started in 1924 as a scheme of land settlement, but since 1931, the creation of new holdings has been restricted to such as are essential to the proper working of the forest. The number of forest workers resident on the holdings is 1,176, and including their families there is a total residence on the holdings of 4,978. Figures compiled from careful records show that, as a whole, the holders, most of whom started with no capital, now own live stock to the value of £43,173.

In co-operation with the Ministry of Labour, instructional centres and camps have been established, about twenty-eight in all, near land belonging to the Commissioners. Each centre accommodates about two hundred men, who are drawn from areas of heavy and prolonged unemployment, and are given a three months' training course to develop physical fitness. The type of manual work provided for the trainees consists mainly in clearing sites for forest roads, quarrying stone and laying road foundations, the building of bridges and culverts, land drainage, scrub clearing and grubbing roots—constructive work which will be of permanent value.

A series of four sketch maps illustrating the progress of the acquisition of forest units at the end of each five years from 1919 until 1934, shows an increase from eighteen units in 1919, to one hundred and eighty-six units in 1934.

Under the exceptionally difficult conditions, especially in rural areas, which have existed since the War, it is not surprising to learn that afforestation by private owners has not come up to the expectations of the Acland Committee Report. The Commissioners have done their best to come as near as possible, in the circumstances, to the provisions for the acquisition of land laid down in that report, but much leeway in both State and private effort still remains to be made up, and

surely now is the time when the State can, with present and future advantage, speed up the development of forests and forestry.

In presenting this review of their first fifteen years' work, the Forestry Commissioners are able to show a creditable record of achievement. The foundation for the future development of State forestry has been well laid and, as time goes on, we shall begin to reap the increasing benefits, industrial, economic and social which cannot fail to follow a wise forest policy. This report is of outstanding national importance, and the reader who is interested in the development of forest policy in Great Britain will, we feel sure, conclude that the interests of the country in this respect are in safe keeping.

Inductance, Capacitance and Frequency Measurement

The Measurement of Inductance, Capacitance and Frequency

By Albert Campbell and Dr. Ernest C. Childs. Pp. xxiv+488. (London: Macmillan and Co., Ltd., 1935.) 30*s*. net.

WHEN we consider that all matter is composed of electric ions which are in constant oscillation, it is evident that the study and measurement of electrical oscillations must always remain a leading feature of physical investigations, and the measurement of inductance, capacitance and frequency over an enormously large range must form a major part of laboratory testing. But this wide range of frequency, from a few cycles per second to the hundreds of acoustic measurements, the millions of wireless signalling, the billions of thermal and luminous radiation, and the trillions of X-rays, calls for constant development of such methods as different sections of the frequency range are utilised, so that the number of methods of measurement is already legion and must become even larger in the future.

However familiar the laboratory worker may be with certain methods, he is unlikely to select the method which is most suitable for any particular purpose, without a comprehensive survey of all the various methods and devices now available; and a single volume in which they are described and critically compared has long been needed. Mr. Campbell's inventiveness and long experience in this sphere renders him specially qualified to write such a volume, and in conjunction with Dr. Childs he has produced a book which should be at hand in every test room, and is likely to remain the standard work on the subject for many years to come.

Those who are familiar with Mr. Campbell's articles in the "Dictionary of Applied Physics" will recognise the simple concise manner in which the various methods and instruments are described; all essential theory being included without redundant detail or complexity. These articles form the nucleus of the present volume; but the sections dealing with vibration galvanometers and inductance and capacitance measurements have been greatly expanded, and the value of the book has been greatly enhanced by the addition of a long chapter on frequency measurement, and, especially, by four chapters on alternating current potentiometers. The latter addition is especially welcome, as, in spite of the great convenience, universality and range of alternating current potentiometers, they have hitherto been little used, and it is to be hoped that this account of them and indication of their many applications will conduce to their wider appreciation and use.

A brief opening chapter on alternating current theory is followed by one on sources of current which describes various forms of alternators, interrupters, microphone and tuning fork hummers, arc and valve oscillators, and frequency stabilisers. Chapter iii, on measuring and detecting instruments, includes electrodynamometers, alternating current galvanometers, thermal instruments and telephones, amplifiers, rectifiers and valve-voltmeters; while Chapter iv, on vibration galvanometers, describes practically all the types which have been devised, with their theory and application. Resistances for use in inductance measurements are dealt with in Chapter v, which includes all the best-known types of anti-inductive resistances, including tubular forms, but reference might have been made to the extremely valuable tubular resistance of A. E. Moore which is the only perfectly non-inductive one.

Inductance measurements occupy Chapters vi–xiv, commencing with the calculation of inductances both by rigid methods and the most convenient approximate formulæ, and passing on to the construction of mutual inductances, including of course the valuable Campbell types of absolute standards and variable inductors; transformers; construction of fixed and variable self-inductors; electrical networks and bridges; measurement of mutual inductance; testing of transformers; measurement of self-inductance and

effective resistance ; and inductance of measuring instruments.

Condensers and capacitance measurement are considered in Chapters xv–xviii, dealing respectively with theory ; dielective constant and power loss ; construction of condensers ; and methods of measurement. This portion of the work contains much useful information concerning the properties of dielectrics.

Chapter xix, on the measurement of frequency, covers a very wide field from counters and synchronous motors, and standard frequency control to stroboscopes, resonance and deflectional frequency meters, bridge methods and wave meters.

The remaining four chapters, xx–xxiii, on alternating current potentiometers, deal respectively with their general principles and history ; theory of phase splitters ; description of various alternating current potentiometers ; and uses of alternating current potentiometers. As above stated, these form one of the most novel and important features of the book.

The whole volume is attractively got up and clearly illustrated, and a short bibliography of the most important papers on each subject is included at the end of each section, as well as an appendix of books of reference. Copious references to special papers are provided in the text. C. V. D.

A Landmark in the Study of Optical Activity

Optical Rotatory Power

By Prof. T. Martin Lowry. (Text Books of Physical Chemistry.) Pp. xiii+483. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1935.) 30*s*. net.

IN view of Prof. T. M. Lowry's remarkable industry as an investigator, it is a matter for further admiration that he should be able to produce, as a sort of by-product, this extensive work on optical activity. Nothing of an equally original character has hitherto appeared in book form in English ; and its arrival is very welcome on that account, as also because it is an attempt to give a conspectus of the whole field, including, happily, the historical development of the subject.

The first of the four parts into which the book is divided is general in character, and deals briefly with the phenomena leading up to the discovery of the polarisation of light by reflection from glass ; the discovery of the rotation of the plane of polarisation in quartz ; with Fresnel's views ; with the work of Pasteur ; and with rotatory dispersion, circular dichroism and magnetic rotatory power.

Part ii, covering nearly one hundred pages, is devoted to a description of the apparatus used in various kinds of polarimetric work, and will doubtless be found very useful in giving a clear idea of the principles underlying the operation of many instruments presently in use ; but inexperienced readers may occasionally be a little misled by the fact that the two Nicol prisms, which form part of much of such apparatus, are usually, or always, shown in the parallel position, whereas in fact their action depends upon their principal planes being almost at right angles.

In Part iii are discussed a number of important topics, such as muta-rotation, optical superposition, anomalous dispersion, induced dissymmetry and circular dichroism ; whilst Part iv deals with theoretical considerations, too various to specify, but concerned largely with electrons and circular dichroism.

In spite of the wide range of the work, it may, nevertheless, scarcely be described as a textbook. It is, rather, a comprehensive monograph ; since it deals so largely with the views and work of the author himself, or with such views and work as he happens to approve of. This is not said in disparagement : rather the contrary, since a description of an author's own views is likely to be more stimulating than would be his description of the views of others. But it is surprising that Alexander McKenzie's work, notably in regard to the Walden inversion, to asymmetric synthesis and to asymmetric induction should receive no mention at all.

In the first edition of a book which contains so much matter, it would scarcely be possible altogether to avoid mistakes. There are, here, at least two which might easily be very misleading. On p. 330 is given a diagram, taken from one of Winther's papers, which professes to represent the specific rotation of nicotine in different solvents. In fact, however, it represents that of ethyl tartrate, the mistake being due to two blocks in the original publication having been interchanged. The correct diagram is given in *Z. phys. Chem.*, 60, 652 ; 1907. Fig. 48 also, on p. 154, which purports to represent Cotton's results, although given originally by Cotton himself (*Ann. Chim. phys.*, [7], 8, 408 ; 1896), is also incorrect. As Cotton pointed out in a later paper (*J. Phys.*, [3], 7, 84 ; 1898) the curve of ellipticities shown here ought to be inverted.

Generally speaking, however, those parts of the book dealing with facts, either regarding apparatus or experimental results, will be found clear and useful. The theoretical parts, at least to the present reviewer, appear much less convincing and satisfactory. They are, certainly, altogether in the modern style, but are really a kind of make-believe, a superficial plausibility—little more than casuistry. Thus, although it is some sixty-three years since Arndtsen first suggested that what is arbitrarily termed 'anomalous' rotation-dispersion is due to the presence of isomers, and this is the popular view to-day, no progress whatever has been made in identifying or isolating these highly elusive isomers, except by showing that a large number of other compounds also exhibit the same phenomenon. The idea, however, by constant iteration, appears to be regarded, popularly, as proved, although the argument amounts merely to this: "Why does this compound—tartaric acid for example—exhibit anomalous rotation-dispersion?" "Because it contains two isomers of opposite and different dispersion." "How do you know that it contains two isomers of opposite and different dispersion?" "Because it exhibits anomalous rotation-dispersion." It is the same kind of argument that Lavoisier exposed very devastatingly: "Why does a substance burn?" "Because it contains phlogiston." "How do you know it contains phlogiston?" "Because it burns."

Similar criticism could easily be directed against most of the theoretical parts of the book. Optical superposition is referred to in various places, but none of the work described can give a definitive solution of the problem, whilst the only work on record which, from the theoretical point of view, is sound, is not mentioned at all.

In regard to solvent influence on rotation, a numerical parallelism can be instituted in several cases between rotation and dipole moment. The large number of exceptions are then, quite arbitrarily, attributed to some other cause, such as association, without any kind of proof that association—if it occurs at all, which is doubtful—does affect rotation. The causes are mere *Dei ex Machina*.

Two other examples will show how facile is modern argumentation. If, in the substance $\begin{matrix}CH_3\\C_2H_5\end{matrix}\!\!>\!CXY$, the CH_3 group is replaced by a C_2H_5 group, the resulting product will be inactive, but, according to Prof. Lowry (p. 303), if the CH_3 is replaced by C_3H_7 "It is generally admitted that the sign of the rotation will be reversed", and an argument is actually founded on this exceedingly slender basis. There does not seem to be a particle more than a 1 : 1 chance of this general admission being true (the result would probably vary with the nature of the groups XY, the solvent, colour of light, concentration and temperature); and arguments, in any event, ought to be founded, not on general admissions, but on experimental facts, which, here, are lacking. Again on p. 364, Prof. Lowry approves Boys's attempts to calculate certain rotations, "in spite of the impossible character of the assumptions made in reference to the more complex radicals". It is to be hoped that conclusions based upon impossible assumptions will not become too common.

In spite of such criticisms, however, the book is a notable addition to the literature of optical activity: a production of which the author and the publishers may well be proud.

T. S. PATTERSON.

Experimental Linguistics

L'Analisi elettrocustica del linguaggio

Per Agostino Gemelli e Giuseppina Pastori. (Pubblicazioni della Università Cattolica del Sacro Cuore, Serie 6: Scienze biologiche, Vol. 7.) 1: Testo. Pp. xxviii+250. 2: Atlante della tavole. Pp. iii+88 plates. (Milano: Società Editrice "Vita e Pensiero", 1934.) 2 vols., 75 lire.

FOR the purpose of studying spoken language from the linguistic point of view, the authors obtained registrations on strips of sensitised paper by means of a microphone connected to a wire-loop oscillograph (Duddell). One of the problems handled is the nature of the vowels. A curve of *ah*, for example, is divided by the authors into 75 vibratory bits of similar, but not identical, character occurring in immediate succession. To obtain a numerical expression for the curve in a vibratory bit two methods are used. In one of them the form of the wave—the vibration profile—is expressed as the sum of a series of sinusoids with frequencies in the relations 1, 2, 3, . . . whereby the number 1 corresponds to the number of times with which the entire length of the wave could be repeated in 1 sec. (Fourier polynomial, harmonic series). With the other method (Vercelli) the wave form is expressed as the sum of a set of sinusoids in the series 1, .., .., ... in which the number 1 has the same meaning as in the harmonic series and the other numbers may stand in any relations whatever to the first one.

The results with both methods agree in having

very small values for the first member ; in all other respects the results disagree completely. The harmonic analysis showed strong amplitudes occurring in groups and small amplitudes everywhere else. The Vercelli analysis showed a few strong amplitudes that were not grouped ; these belonged to frequencies not harmonic to the first member. The authors do not attempt to explain the complete discrepancy or to interpret either set of results. The fact that every vibration profile consists of a wave movement that begins strong and fades rapidly to zero is quite overlooked. A prime characteristic of such a wave is its factor of decrement. Neither of the two series provides for an expression of the decrement. It shows itself by modifying the values for the amplitudes, by producing amplitudes for all members and by adding a meaningless constant. Vibrations with decrements may be aroused by suddenly releasing a spring, by uncorking a bottle, by snapping the thumb out of the mouth or by suddenly releasing a pressure of the air at the glottis with the mouth open. The curve of the vibration from the spring is a slowly fading one with smooth waves. That from the bottle is a rapidly fading one with smooth waves. That from the mouth in the last two cases is exactly like a curve of a vibratory bit in a vowel ; the sound is, in fact, a real vowel consisting of only one bit.

The results of Fourier and Vercelli analyses of various vowels are given. The authors reach the conclusion that the specific nature of a vowel vibration is not the result of the presence of a specific frequency or frequencies (Willis-Helmholtz-Hermann theory of formants) or of specific relations among the frequencies (Lloyd), but of a special complex of elements to which they apply the term 'specific character'. The specific profile is the expression of the specific character. Just what elements go to produce the specific characters remain unstated. This view is identical with that expressed in the profile theory, according to which vibratory bits are perceived as unanalysed profiles (NATURE, **130**, 275 ; 1932).

By an extension of the term, it becomes possible to speak of the profile of a whole vowel, of a word, of a phrase, etc. Just as a vibratory bit is perceived as a profile without analysis, so a whole vowel is perceived as a profile without analysis into vibratory bits, a word as a profile without analysis into speech sounds, a phrase as a profile without analysis into words, etc. Interesting in this connexion is the fact that when speech vibrations are amplified sufficiently to be perceived by the sense of touch (Gault's teletactor) the tip of the finger recognises the various vowels, consonants, words and phrases by their vibration profiles.

The physical vibrations are expressions of what the speaker 'intended to say'. The ultimate unit of inner speech—that is, of language—is termed a 'phoneme'. This is defined by the authors as "any sound or noise used in language that cannot be divided into other elements of language but only into vibratory phenomena". The phonemes include vowels, semi-vowels and consonants. It is to be clearly understood that these are inner (or psychic) units, and not physical ones. The word *luna*, for example, is assumed to be composed of four speech sound phonemes indicated by the letters *l*, *u*, *n*, *a*. The authors divide the registration of this word into four portions and consider each portion as the expression of one phoneme. According to the authors, the word consists both psychically and physically of a succession of four portions. The registration, however, shows that the characteristics of the wave forms present during the portion assigned to *l* are present also in the waves of the first part of the portion assigned to *u*, and, conversely, characteristics of the waves in the portion assigned to *u* can be traced in the waves of the last part of the portion assigned to *l*. This indicates that the phonemes *l* and *u* were overlapped before they were expressed in physical speech. The phenomenon of overlapping occurs everywhere in the registrations. The word *luna* is to be considered as the sum of the four speech sound phonemes occurring not in succession but with overlapping. The registration of the word must be taken as a whole ; it cannot be divided into a succession of sounds.

Fifty years ago, Rousselot sought to overcome the impossibility of analysing speech by listening to it. To register it on a phonograph would have been of no use, because all he could have done with his registrations would have been to listen to them again. The oscillograph and the sound film had not been invented. The method that he devised consisted in placing a cuplike receiver over the mouth and the end of a tube in a nostril and conducting the changes in the breath issuing from the mouth and nose to membranes the movements of which were registered on a moving surface. His registrations were of the mass movements of air that constitute macrophonic speech (see NATURE, **132**, 138 ; 1933). Macrophonic speech produces microphonic speech by arousing vibrations in the vocal cavities. The authors of this work have contributed to the foundation of linguistics as an exact science by analyses of microphonic speech. They make use of comparisons with macrophonic registrations. With these and some other methods linguistics begins to become a science based on numbers.

E. W. SCRIPTURE.

Weather Parallels and Paradoxes

(1) Through the Weather House:
or, The Wind, the Rain, and Six Hundred Miles Above. By R. A. Watson Watt. Pp. xi+192+8 plates. (London: Peter Davies, Ltd., 1935.) 7*s*. 6*d*. net.

(2) Weather Proverbs and Paradoxes
By Dr. W. J. Humphreys. Second edition. Pp. xii+126+16 plates. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1934.) 9*s*.

(1) EARLY in 1934, Mr. Watson Watt gave a series of broadcast talks on weather which attracted considerable interest from the novelty of the treatment and the vividness of the imagery. These talks have now been published in a very readable book, illustrated by some good cloud pictures. The "Weather House" as pictured in the frontispiece is a super-sky-scraper of ultra-modern design, with a hundred stories each six miles high, fitted with all modern conveniences in the form of electric lighting, heating and decoration, and all supplied by 'wireless'.

The matter is the familiar matter of any popular textbook on meteorology, with a few additions from the author's special sphere of research, but the exposition is very clear and is certainly helped by the analogies with domestic appliances, though to the meteorologist these become a little tedious at times. Water in various forms naturally plays a large part—"Damp in the Weather House", "Cloud-Weaving", and "The Water Supply", but the author is most at home in the upper stories and his treatment of atmospheric electricity, the ionosphere, ozone and meteors ("Throwing Stones at the Weather House") is especially good. Unusual also is his account of the organisation of synoptic forecasting in a meteorological office—"The Servants' Quarters"—for when looking at a weather map one is apt to forget, for example, the "comrade in Moscow stamping through the snow" to read his instruments. There is much sound sense if little enthusiasm in the short chapters on "Saws, Saints and Sages", "Controlling the Weather", and "Further Outlook— ?"; the last chapter in fact is definitely pessimistic; but the warning is timely.

(2) Weather proverbs are many and varied; some are useless but others contain a grain of truth. Prof. Humphreys sets out to rescue the latter from their undesirable companions, and to clothe them in a garb of logic. The result is an attractive essay in popular science, though not everyone would agree that all the selections are justified, and a few of the explanations seem a little far-fetched. The belief that a grey morning sky betokens a fine day may be capable of explanation, but a 'grey' sky is presumably an overcast sky, and in Great Britain the observations of Spencer Russell have shown that an overcast sky at sunrise is about as likely to be followed by rain before sunset as is a red morning sky. One proverb with at least as much justification as the grey sky at morning has been omitted from the chosen company, namely:

"Rain before seven
Lift before eleven."

We should like to see more of these proverbs subjected to the test of observation. A few of them are probably true of North America, but will not bear transplanting to Great Britain. Some of the "paradoxes" of part 2 are rather forced, but a few provide interesting examples of the curious working of physical laws. On the whole, the selection, like that of the proverbs, is good, while there can be no two opinions about the excellence of the sixteen plates.

Spektroskopie
Von Prof. Dr. Karl Wilh. Meissner. (Sammlung Göschen, Band 1091.) Pp. 180. (Berlin und Leipzig: Walter de Gruyter und Co., 1935.) 1.62 gold marks.

THIS little book is not intended for spectroscopists, but rather for non-specialised students of physics who need a straightforward elementary account of spectroscopic principles and methods. The scope is wide, scarcely any major branch of the subject escaping at least brief notice, the presentation orderly and clear, and the diagrams astonishingly numerous in relation to the low price of the book. The emphasis is laid, on the whole, on the instrumental side of the subject, and the explanations of the various types of high-resolution spectroscope are particularly well done.

It is, in fact, just the right kind of book for an honours student of physics who wishes to read some German, for, though simple in style and in matter, it is yet sufficiently informative to be read for its own sake and not merely for reading practice.

Numerical Studies in Differential Equations

By Prof. H. Levy and E. A. Baggott. Vol. 1. Pp. viii+238. (London : Watts and Co., 1934.) 12*s*. 6*d*. net.

THE teaching of differential equations in English universities usually follows an unsatisfactory middle path. General theory is omitted as too difficult, while numerical methods are considered unworthy of notice. In consequence, the student is made acquainted with only a small number of special types of equation and is left to believe that nothing can be discovered about the solutions of other types. A reading of even the first two chapters of this book by Prof. Levy and Mr. Baggott would alter the outlook of many such students completely. The second chapter, on graphical methods of solution, would form an excellent addendum to a course in curve-tracing, the two together being used to illuminate wide tracts of algebra, geometry, and the calculus.

The main portion of the book is concerned with the numerical solutions of ordinary differential equations of the first and higher orders, consideration of partial differential equations being reserved for the second volume. Many methods, some well-known, some apparently new, are given and their degrees of accuracy are discussed and compared. It is impossible to estimate the value of these methods without long experience in their use, but they appear to be sufficient for most purposes and some of them are of considerable theoretical interest.

There are a few obscurities which might have been removed by careful revision, and a larger number of examples for practice might well have been included. These are minor criticisms, and detract but little from the value of a book which should be in the hands of all who are engaged in research in applied mathematics and of all who are interested in the improvement of mathematical teaching.

Faune de France

28 : Diptères (Brachycères), (Muscidae Acalypterae et Scatophagidae). Par E. Séguy. (Fédération française des Sociétés naturelles : Office central de faunistique.) Pp. iii+832+27 plates. (Paris : Paul Lechevalier et fils, 1934.) 300 francs.

THIS systematic survey of the acalyptrate muscid flies testifies to the skill and industry of its author. Numerous keys in the form of tables, short clear descriptions with remarks on differential characters of the families, genera and species, and 903 text figures in addition to 27 plates facilitate, so far as is possible, the identification of these flies. Under each species is a note of the area of distribution and, where known, the period of occurrence of the imago. In those species, the larvæ of which are phytophagous or parasitic, the food-plant or host is stated. In nine pages is a summary of the bionomics of these lower muscids, and at the end of the volume are alphabetical lists of their animal hosts, with their respective parasites and commensals, and of the plants and their respective muscid parasites. A good bibliography and systematic index complete this very satisfactory work.

Wild Flowers of the Great Dominions of the British Empire

By The Lady Rockley. Pp. xii+380+32 plates. (London : Macmillan and Co., Ltd., 1935.) 16*s*. net.

THE non-botanical traveller, who is unable to use a technical flora, often feels in need of a book which will help him to appreciate the vegetation of the various lands he visits and which will indicate what floral treasures are especially worth his notice in particular areas. Lady Rockley, in the present volume, has given the traveller in the British Dominions just such a guide, and her book will undoubtedly appeal to a large public of flower-lovers.

The countries dealt with include Canada and Newfoundland, Australia, New Zealand, South Africa, Rhodesia and Kenya. An immense amount of information has been packed into Lady Rockley's attractively written pages, and the coloured illustrations, many of them painted by the author during her travels, with no thought of publication, add greatly to the value of the volume.

Birth Control and its Opponents

By Frank W. White. Pp. xi+164. (London : John Bale, Sons and Danielsson, Ltd., 1935.) 3*s*. 6*d*. net.

IN this little book, the facts of population and over-population, and the wastage of human life that results under uncontrolled conditions of mass reproduction, are first marshalled. The regulation of births and limitation of population by artificial methods are then detailed, and the benefits likely to arise therefrom stated. Finally, the arguments of the opposition to artificial methods for the control of pregnancy are set out and examined.

No better brief and popular summary of the subject of birth control could be found than is given here, and as Lord Horder says in his foreword, Dr. White deals patiently and convincingly with the arguments that are advanced against it by a small section of the community. It may be hoped that a growing public opinion will in time convert religious authority, from which the chief opposition at present emanates.

R. T. H.

A Flower Book for the Pocket

By Prof. Macgregor Skene. Pp. 380. (London : Oxford University Press, 1935.) 7*s*. 6*d*. net.

THIS pocket-book is meant for the layman and also as a first 'flora' for use in schools. 501 flowering plants are illustrated in coloured plates, most of which are reproductions of the paintings by the late Miss C. G. Trower. The rest, together with 28 black and white drawings of grasses, are the work of Miss Ruth Weston. To our knowledge, there is no other book at the price which is so profusely and well illustrated. So far as is possible, technical terms have been avoided. The key includes all British families, and the sequence follows that of the standard British 'floras'. It has been compiled by Prof. Macgregor Skene. Thus, the book has the stamp of authority, is well produced and, unlike many 'floras', is easy to follow. This, together with its low price, should ensure the book of the success that it clearly deserves.

Some Aspects of the Polar Regions*

By Prof. F. Debenham

THERE is now a vast literature of the polar regions, both north and south, but the proportion of those books and papers which deal with the subject on a broad basis is very small, and is certainly not easily accessible. In many of these books we are invited to conjure up the sensations of the polar explorer, to feel his frost-bites, to savour his pemmican, to glory in his pack-ice and his glaciers, even to die his death. Not the least part of our interest in polar work is due to these invitations so graphically offered to us in text and illustration. Much more rare is it to find a polar explorer viewing his territory as a whole, and trying to fit it into the scheme of the world in general. In a word, we are rather encouraged to regard the polar regions as places apart, extraneous to the real comity of the world. We will first consider the kind of value of the polar regions which appeals most quickly to the public.

Trade and Trade Routes

There is little need to sketch the history of man's attempts to achieve economic gain from the polar regions. From the days when Martin Frobisher attempted to find a quick route westwards to the Spice Islands *via* the North-West, and Barents a similar route eastward, down to more recent times when, though the routes had lost value, the products of hunting, fishing and mining attracted venturers with similar motives, the chief aim of promoters of polar expeditions has been one of ultimate gain. It is true that many of the leaders of the expeditions had little care for the commercial side, but the money that sent them forth was, in the greater number of cases, put out in the time-honoured hope of all ages that it would bring in interest in some form or another.

There is certainly such a thing as the romance of commerce in the North, for most of its industries have something peculiar and unusual about them. We may instance the cryolite mines of Ivigtut in Greenland—a strange mineral found in quantity nowhere else in the world, which however is almost essential to the large-scale production of aluminium. Again, until recently a large proportion of the ivory for use in northern China did not come from the present-day elephants of the rain forest belt of Asia, but from the mammoths of primeval times the tusks of which lay for many thousands of years buried in the mud of the great Siberian rivers flowing into the Arctic Ocean.

Romantic or not, the story of Arctic trade has a grim and melancholy side, in that several of its most promising ventures have died a slow and painful death by reason of the cupidity of man and his unwillingness to co-operate either to preserve life or even to preserve it sufficiently for his own benefit. The history of the whaling industry in the Arctic is an instance of this incapacity of man to co-operate in taking the most common-sense measures to cherish a valuable industry. There is every reason to hope that the day of non-co-operation has passed and that a similar fate to whaling in the Antarctic will not take place, for it is probably common knowledge that many bodies, in which we may include the League of Nations, the Norwegian whalers themselves and the "Discovery" Committee of the British Government, are at work in their various spheres to prevent any extermination of the southern whales, and at the same time to regularise an industry which, even in these days of synthetic materials, still has its vital uses to man. How large that industry now is may be gathered from the fact that the annual catch of whales in the southern seas is about 20,000 : how mindful it now is of its own future may be seen from the fact that whereas the average whale used to provide only 60 or 70 barrels of oil, it is now made to yield nearly 120 barrels of oil besides other products.

These products of hunting, fishing and mining were the natural resources of the North and were the first to be exploited, but quite recently a new factor in the commercial aspect of the North has come to the forefront. With the progress of long-distance aviation and the simple application of the principle of great-circle navigation, the idea of using these northern latitudes for passenger and even freight routes in the air has become not only prominent but also almost insistent.

Owing to the misleading projections on which most of our maps are constructed, it is not usually recognised that the most direct route between, say, Berlin and Montreal, or Glasgow and Winnipeg, is over Greenland, but it is so. It seems to be only a matter of time and the inevitable improvement of aeroplanes before some use is made of a route which was first investigated as to conditions by the Watkins Expedition of 1930.

Summing up this economic aspect of the polar regions, the warning may be given that even now,

* From the presidential address to Section E (Geography) of the British Association, delivered at Norwich on September 5.

as in the past, there is a tendency to ascribe potential wealth merely on account of the existence of land masses. Indeed, even explorers, who should have known better, have been heard to speak glibly of the untapped mineral resources of the polar lands, neglecting to tell their public that though these resources undoubtedly exist, they are for the most part covered by thick ice sheets or rendered inaccessible by topography, or climate, or both. Quite a brief calculation, for example, would show that the proportion of the Antarctic continent available to the prospector and miner is to the total land mass in somewhat the same proportion as the area of the city of Norwich is to the whole of England.

Although the land can have little value in the Antarctic there is, strangely enough, a natural resource in the air which, however fantastic it may appear to us, may yet have a substantial interest for our descendants. It is a truism of science that we draw practically all our sources of power from the sun, either indirectly in the form of coal and oil, or directly in the form of water-power, in which the sun by evaporation has raised water to a height from which gravity, suitably used, returns power to us. Now, although water is one of the things of which there is a great scarcity in the polar regions, and the movement of ice masses can scarcely be handled by engineers, yet meteorological processes are doing the same thing for air, raising masses of air in one area which sink down in another, and so provide a source of power less tangible but just as real as that of water in a highland lake. The persistence, the strength and the frequency of the Antarctic blizzards compels anyone who has experienced them to feel that here is a vast source of power as yet untapped. May we be permitted to forecast that some day the miseries of the storm-bound parties of Mawson's expedition, when for a whole year the wind averaged gale force, may be atoned for by our descendants making use of this power when coal is scarce and oil exhausted, while all the water-power in the temperate regions is fully harnessed? Compare the power in the well-known falls of Niagara, about 6,000 tons of water falling per second, with the power in the little-known Adélie Land, where an air river of at least 50 miles in width and probably some hundreds of feet in depth is moving outwards from the plateau at an average velocity of 50 miles per hour, or about 70 ft. per second for most of the year.

The Poles as Sanatoria

We pass now from the economic aspect of our subject to some others which have less appeal to the man in the street, but which must never be omitted in any consideration of a region by a geographer.

The consideration of the polar regions as a holiday resort for the citizens of crowded lands leads us naturally to a far greater value which has as yet scarcely been considered by civilisation, a value which indeed may yet prove to be more worthy of study than all those we have so far mentioned. It is reasonable to suppose that when some far-travelled medical man comes to write a book on the geography of diseases, we shall be able to come by a clear idea of where health is best to be sought. The ordinary geographer would, however, even now be able to make something of an essay on the distribution of healthiness over the world. Leaving out cities as unnatural, or at least unhealthy aggregations of humans, he would at once say that, on the whole, the most unhealthy parts of the world are in the tropics, though he would have to have a special category for tropical and oceanic islands, which as a rule are decidedly healthy. He would, if he were wise, consider that the steppe deserts are healthy zones; but probably he would decide that the temperate zone as a whole, provided it is not too far from the sea, is the healthiest belt of the world for man. It is almost certain that he would entirely forget that the polar regions are definitely the most healthy segments of the earth's surface, for the simple reason that the ordinary disease-bearers, whether they be rodents or insects or minute bacilli, find the conditions either impossible for existence or inhibitive.

But we are not concerned here so much with the healthiness of the zone as with its value from a remedial point of view, for we are certainly not going to migrate in millions to the Arctic just because we cannot there contract the diseases of our own lands. But what we may well pay attention to is the corollary to that healthiness, namely that many, though not all, of the diseases contracted in temperate climates can be cured by residence in the polar regions.

I am aware that it is more than dangerous, indeed provocative in the highest degree, for anyone outside the medical faculty to say how far special diseases are curable by residence in a pure air and a cold one. It seems, however, from the experience of sanatoria in the Alps, etc., that it is the sufferers from pulmonary diseases who are most likely to get benefit from such residence. The question will at once be asked as to what the polar regions can supply which is not already obtainable, say, in the Alps. For an answer to this question we must look to the medical men; but it does seem likely that residence in a vast territory free from germs or the conditions for their transport must, *prima facie*, be better than

residence in an alpine region which is surrounded by, and is merely above, zones teeming with possibilities of disease. If this thesis is correct, and it is one which a small period of research could easily confirm or refute, then surely we are neglecting an aspect of the polar regions which is of major importance to mankind, more valuable than all the industries they will ever support.

To test the value of the suggestion there is needed research and experiment, most appropriately to be carried out under the auspices of one of those international bodies such as the Rockefeller Foundation, which has already done so much for remedial medicine. For assistance in carrying out this research there is needed the sympathy of Governments, especially that of Norway, in the care of which is the most promising territory in the Arctic for that purpose, namely, Svalbard or Spitsbergen.

Let us remember too, before we allow hands of horror to be raised at the expense of such research, that in the past sums of money have been spent in Spitsbergen itself for the erection of an airship hangar and provision of the airship itself for a few hours' flight to the Pole, which would be sufficient to erect a hospital and run it for many years in an experiment which might be of permanent value to the world. We must be properly cautious as to results, but at the same time let us preserve our sense of proportion in the value to man of how we spend money in the polar regions. It is almost lamentable to consider the sums of money which have been spent in what may be understood by the term of 'stunt expeditions' and place those sums in contrast to the difficulty in raising money for such an object as this.

World Meteorology

We may now turn to yet another aspect of the polar regions, namely, the value to the scientific worker, both pure and applied, of the phenomena which are peculiar to these regions—phenomena well known to exist but the study of which is still in its early stages.

No doubt each science will claim the chief value of these phenomena for itself, but it is without any particular bias to one or the other that I should venture to place in the first rank the subject of meteorology as likely in the future to gain most by a prolonged and more intensive study in high latitudes.

We have spoken of the more or less permanent blizzards on parts of the Antarctic continent, and we ourselves live under the intermittent threat of depressions over Iceland. We can therefore, without much imagination, see that even if our weather is not actually manufactured at the polar ends of the world, it is profoundly affected by them. Meteorologists themselves have long been aware of this, and in two successive onslaughts, namely, in 1882 and in 1932, a determined effort was made to collect data simultaneously and widely within the precincts of the Arctic. The conclusions which have been drawn from these results are, as yet, scarcely in full circulation, but few meteorologists do not sigh for more and more data from the polar regions.

The phenomena of magnetism and aurora, which are somewhat akin to those of meteorology in that they occur in the atmosphere, are also best studied in high latitudes, where, too, the most promising investigations of the ionosphere seem to be likely.

Geology

When we come to the more earthly sciences, the immediate value to mankind is perhaps less evident. In the science of geology, for example, especially in its branch of tectonics, we cannot afford to do without close investigation of two segments of the earth comprising together nearly one tenth of the surface of the globe, and indeed the structure of the earth must become the more interesting the nearer one gets to its axis of rotation. The geologist has a hard task in lands where the rocks are usually buried beneath ice-caps, and has to be more than usually ready with the inspired guess than in other parts of the world.

In the Antarctic in particular, the highest of all continents and the most closely hidden, there are obviously to be found keys to some of the major problems of earth structure. We may instance only one which, no doubt, is occupying the attention of the geologists of the British Graham Land Expedition at the present moment, an expedition which hopes to press far to the south of the Archipelago where they are wintering, and to determine why and where the folded ranges of South America and Graham Land merge into or butt against the faulted escarpments of the Australian sector of the Antarctic.

It is in these larger problems of geology that the polar geologist can give most assistance to science. It is not long since the papers, in America at all events, were full of the discovery of coal beds by Admiral Byrd's geologist within 300 miles of the South Pole, and it was interesting to see that this discovery, which however was originally made by the Shackleton party in 1908, moved the Press public to exclamations of wonder that such things could be. Nevertheless the great controversies of whether the Poles have shifted in the past, and whether the continents are drifting, must draw their best evidence, both for and against, near the axis of the earth.

There has recently been published a fresh determination of the position of Sabine Island on the coast of north-east Greenland which tends to show that there is a definite westerly drift of some metres a year. Similar observations of Jan Mayen are even more startling. For these and other reasons, therefore, the geophysicist, whom we may call the mathematical cousin of the geologist, must keep his attention on the polar lands.

In the biological sciences also there are major problems to which the data of high latitudes alone can give the key, such as the drift of oceanic waters and the movements of plankton and their associated salts. The biologists, however, are already active in these investigations and need no spur to action. The many-sided character of the work of the "Discovery" Committee in this branch, over all the waters of the Antarctic ocean, is evidence of how carefully work on this aspect of the polar regions is being carried out.

The Spirit of Exploration

Lastly, I would consider yet another aspect of the polar regions, one which is perhaps more psychological than geographical, namely, their value as an outlet to that spirit of adventure and urge for exploration which has always been an attribute of man, and which will not diminish, however small the world may grow. It is a spirit which is at work equally in the small child climbing the apple tree, the schoolboy exploring his own small horizon, the undergraduate forming alpine clubs to scale the peaks of his own college, and the city clerk spending his week-ends living dangerously in sailing dinghy or on motor-bicycle.

In all of these there is a curious combination of an urge to test one's abilities and yet a desire for a secondary and more useful object in the deed itself, and this dual purpose is particularly evident in most of the young men who come to the Scott Polar Research Institute in Cambridge seeking ways in which to visit the Arctic.

Looking over the files of the geographical journals of the past few years, it is possible to see how many young men turn annually to the Arctic to satisfy their need for an outlet. If we include the official expeditions of Governments such as that of the Soviet, we shall find that every summer more than fifty groups of investigators go to the Arctic and, were it less expensive, the number would easily be trebled. Only a few of these groups go for purely scientific work, and still fewer for hunting alone. They are, in fact, as a rule imbued chiefly with a desire to see strange places and endure strange things, and only in a secondary way to bring back useful results. There has been of recent years a happy tendency for these groups to go and come back without undue fuss and publicity. I would suggest that this use of the Arctic as an outlet to a healthy and laudable desire is one which should not be left out of any assessment of values even though it must necessarily apply only to a small number of people.

Problems of Plant Pathology

THE presidential address of Mr. F. T. Brooks to Section K (Botany) of the British Association delivered at Norwich on September 9 began in very pleasing vein by describing some of the outstanding contributions to botany made in East Anglia, wherein Norwich is an ancient and important city. It is fitting that upon such an auspicious occasion, the president of the Section should remind his audience of the deep roots of botanical lore in Great Britain—roots which go back to the enthusiasm of the ardent amateur. One heard the names of W. H. Burrell, W. A. Nicholson and Dr. C. B. Plowright coupled, in the recital of botanical progress in Norfolk, with more professional workers such as Dr. M. C. Cooke, Sir W. J. Hooker, Prof. F. W. Oliver, Prof. E. J. Salisbury, and many others.

The title of the address was "Some Aspects of Plant Pathology", and after showing that Norfolk farmers were among the first to realise the damage caused by disease, Mr. Brooks continued with a discussion of disease control by the use of resistant varieties of crop plants. The bad effects of several wilt diseases, the leaf-curl disease of cotton, and black rust of wheat can now be controlled with considerable success by planting new varieties with resistant qualities, but it seems very unlikely that all diseases will be amenable to control by this method. New diseases are continually appearing, parasitic fungi are amongst the most variable of living organisms, and the capacity for disease resistance in the host is very much in the nature of a mutation. The nicely-adjusted equilibrium between parasite and host can be upset when the latter mutates towards resistance, but the fungus can also vary, to give a new physiological form capable of attacking the host mutant. Thus the biological race for

supremacy continues, and leads the plant pathologist to investigate further principles of control. Moreover, although the use of resistant host varieties is the most care-free method of disease control, it is not always the most efficacious. Bunt in wheat, for example, may be totally eliminated by simple fungicidal treatment of the seed before sowing, and infection of fruit trees with *Stereum purpureum* can be greatly minimised if the fungus is merely prevented from fructifying in and near the orchard. Such simple methods of plant hygiene should be part of the routine of every good gardener or farmer.

The ecological study of fungi is in its infancy, but the effect of climate on some diseases has been investigated. Prof. L. R. Jones and his colleagues at the Department of Plant Pathology, University of Wisconsin, have inquired into the effect of soil temperature upon disease incidence. Such parasites as *Urocystis cepulae*, for example, cannot infect the onion plant when the soil temperature rises above 29° C.[1]. Reinking[2] has shown that differing types of soil may play a controlling part in fungal attack, for the wilt disease of bananas in Central America is much more severe on sandy soils than on clay. High humidity may also inhibit parasitic attack, for the pink disease of rubber in Malaya only appears in the regions of highest rainfall. It seems likely that in the near future it may be possible, by studying weather conditions, to advise growers of the appropriate times to spray potatoes and vines with *protective* fungicides against blight (*Phytophthora infestans*) and downy mildew (*Plasmopara viticola*) respectively. Such treatment, if performed thoroughly and as a matter of routine by all growers would, in all probability, entirely prevent the development of either disease.

The physiology of parasitism is now fairly well understood. The Tulasne brothers, de Bary, Brefeld, and Marshall Ward carried out much pioneer work, and the subject has been further interpreted by Prof. V. H. Blackman in more recent years. Mr. Brooks himself, in his specialist work on *Stereum purpureum*, has shown that the characteristic silvering of fruit tree foliage can be produced by injecting the stem of a healthy plant with non-living extracts of the fungus.

Our ancestors must have felt despondent and impotent when a sudden attack of black rust spread amongst their wheat, or when blight devastated their potatoes. We can scarcely wonder that they used the term 'magic' to account for such epidemics. Yet the glamour of magic is far surpassed by the fascinating results of investigations into the cause of such apparently spontaneous outbreaks. Mr. Brooks chose a sufficiently sensational example from the work of Mehta[3] in the lowlands of northern India. Uredospores of the fungus *Puccinia graminis* cannot withstand the very high temperatures of the plains in summer, yet the parasite appears year after year. The usual alternative host, *Berberis vulgaris*, here plays no part in the life-history. Infection comes each year from stray wheat plants growing above a height of 4,000 ft. in the Himalayas. Summer temperatures there are relatively moderate, and uredospores multiply normally, infecting the wheat crop of the hills during November and December. There is thus a continual source of spores, some of which are carried many hundreds of miles to the plains, by the prevailing north-westerly winds.

Research into physiological forms of parasitic fungi has been very active during the past ten years. More than a hundred such forms of *Puccinia graminis* are now known. The structure of each form is identical with that of all its fellows, but its host relations are different. Many other species of fungi have numerous physiological or biological forms, and it is obvious that the plant breeder is confronted by a very difficult task in his search for new host varieties which would be disease-resistant. The range of physiological forms does not seem to be standard, for types of *Puccinia triticina* and *P. glumarum* have been found at Cambridge, which do not appear on the Continent, and vice versa. This multiplicity of strains may even include non-pathogenic forms, as happens in the fungus *Fusarium cubense*, causing wilt disease of the banana[4]. Physiological forms may have arisen as a result of hybridisation, but some must also have arisen as gene mutants, since they appear in fungi such as *Puccinia glumarum* which are now, in all probability, entirely asexual. Mr. Brooks discountenances the idea of a 'bridging species', originally introduced by Marshall Ward to mark a host plant which was susceptible to distinct physiological strains of fungi from two further hosts which would not inter-infect. The bridging species would 'educate' the strains to infect their mutual hosts. A simpler explanation of Marshall Ward's results seems to lie in the large number of physiological forms which are now known to exist.

The interaction of two or more fungi upon one another has a profound influence on plant pathology. A rotting log provides material for a succession of fungi, one after another, and each with its own particular taste for wood at a certain stage of decomposition. Similarly, a wheat plant normally resistant to *Puccinia glumarum* becomes susceptible to that fungus if attacked also by bunt (*Tilletia Caries*). More severe attacks of citrus trees follow infection by *Diplodia natalensis* and *Colletotrichum gloeosporioides* together than is the case with either organism alone[5].

Two organisms may also act in antagonism to one another. Mr. Brooks's experiments on various species of *Stereum* show that oak wood attacked by *S. hirsutum* is not a suitable habitat for the more harmful *S. purpureum*. Fawcett and Lee[6] could not obtain any effect on the walnut tree by inoculating it with two parasitic fungi, each of proved pathogenicity. Millard and Taylor[7] also found that the organism causing common scab of potatoes lives in antagonism with a harmless species. The latter can be stimulated by the addition of organic matter to the soil, thus controlling the disease. Weindling[8] found that *Trichoderma lignorum*, a saprophytic fungus, produces a substance which is toxic to the hyphæ of *Rhizoctonia solani*, and, indeed, the depredations of the latter can be curtailed if spores of *T. lignorum* are added to the soil. The old saying "Set a thief to catch a thief" seems to be justified even in the realm of plant pathology.

Many disorders of plants appear for which no definite causal agent can be demonstrated. Certain crops, for example, do not make good growth if the element boron is absent from the soil. Heart-rot of sugar beet and mangolds seems to be due to such lack. Manganese deficiency is responsible for grey leaf or grey-speck of oats, whilst insufficient sulphur produces a serious disease of tea bushes in Nyasaland[9]. Several diseases of apples during storage are due to inordinately large amounts of carbon dioxide in the atmosphere. Brown heart is such a disease which can be overcome entirely by proper ventilation[10]. Injury by frost can also produce symptoms which are similar to those caused by some fungi. Canker of the larch tree, for example, may be caused either by frost, or by the depredations of *Dasyscypha*[11], both of which, in all probability, kill groups of active cambium cells.

Many of the researches outlined in Mr. Brooks's address have added to general botanical knowledge. It is often necessary for the pathologist to study a new phase of plant physiology, and alternatively, the physiologist can supply knowledge which is useful to the pathologist. The address was pre-eminently what we have come to desire of a sectional president—a point of view, emanating from his own specialist knowledge, and linking up with other branches comprised within his Section ; the orientation of scattered facts into one harmonious whole.

[1] *J. Agric. Res.*, **22**, 235 ; 1921.
[2] *Zentralbl. Bakt.*, II, **91**, 243 ; 1935.
[3] *Indian J. Agric. Sci.*, **3**, 939 ; 1933.
[4] Hansford, *Kew Bulletin*, p. 257 ; 1926.
[5] Fawcett, *Florida Agric. Exp. Sta. Ann. Rep.*, 1912.
[6] "Citrus Diseases and Their Control", p. 38 ; 1926.
[7] *Ann. App. Biol.*, **14**, 202 ; 1927.
[8] *Phytopath.*, **22**, 837 ; 1932.
[9] Storey and Leach, *Ann. App. Biol.*, **20**, 23 ; 1933.
[10] Kidd and West, Dept. Sci. and Ind. Res., Food Investig. Board, Special Rept. No. 12 ; 1923.
[11] Day and Pearce, *Oxford Forestry Memoirs*, No. 16 ; 1934.

Speed*

By Prof. B. Melvill Jones

THE factors which have limited speed in the past can be grouped under two main heads, which may be roughly described by the words *Track* and *Power*. To move rapidly over the ground a smooth track is necessary in order to prevent the vehicle from bumping itself to pieces and from overturning, while power is required to overcome the internal friction of the mechanism and the head resistance which must always oppose motion, until we can arrange to do our travelling entirely outside the earth's atmosphere. These two factors, track and power, have alternately imposed limits on the speed of travel, one coming into operation whenever the other was temporarily removed.

The power to fly through the air at a height sufficient to be clear of the irregular air flow near the ground has at last disposed of the track problem as a factor limiting speed. For although the aeroplane has to lay its own track, in the sense that it has to expend power in doing something to the air in order to keep itself from falling, that power becomes continually less the greater the speed of flight and, of itself, is incapable of placing any limit on speed.

In the early days of flying, we were unable to separate the power essentially required for support—for track laying as we may describe it—from the power required merely to drag the aeroplane through the air. That this can now be done is due to the work of Prof. L. Prandtl, which was itself founded on some earlier work of that amazing mechanical genius, Dr. F. W. Lanchester. Looking back from our present point of view, Lanchester's insight into this very difficult problem seems almost miraculous, but he did not put his ideas into a form which appealed to the conventional man of science, and it was not until

* From a Friday evening discourse delivered before the Royal Institution on March 22.

they had been developed and given greater precision by Prandtl that they received any wide recognition.

The Lanchester-Prandtl calculations, as they are now called, may become very complicated, but the ideas behind them are not difficult to grasp. Everyone is familiar with the idea that when a body is projected suddenly in any direction the apparatus which does the projecting experiences a recoil. The rocket, for example, obtains the lifting force which sends it up by generating gas within itself and continually projecting the gas downwards, so that there is a continuous recoil which drives it upwards. The aeroplane obtains the lift which supports it in a manner similar to the rocket, except that it does not itself generate the gas which it projects downwards, but uses the air through which it is passing. The wings, driven through the air in an attitude slightly inclined to the direction in which they are moving, force down the air directly below them and suck down the air immediately above them, and in so doing experience the continuous recoil which keeps the aeroplane from falling. The air, however, forms a continuous medium around the aeroplane, and a downward current in one part implies an upward current in other parts, with outward cross currents below to relieve the congestion there, and inward cross currents above to fill the partial vacuum which would otherwise be formed.

These air movements can be calculated and, at the moment when the aeroplane is passing, they take the form shown in Fig. 1, where the aeroplane is seen from behind passing through the vertical

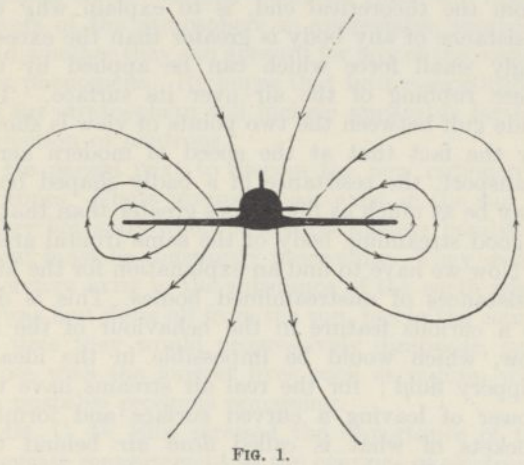

FIG. 1.

plane represented by the paper. The curved lines show the directions of flow ; the distances between them being inversely proportional to the speed of flow. As soon as the aeroplane has passed, the flow pattern which is left behind begins to modify itself and ultimately takes the form shown in Fig. 2, which is simply the system of flow known as the *vortex pair*. These vortices, which are generally described as the *trailing vortices*, because they trail behind the aeroplane, remain in the air for several minutes after the aeroplane has passed, and are the cause of the bump which one feels on flying through the track of another aeroplane. It is by continually setting these air whirls, or vortices,

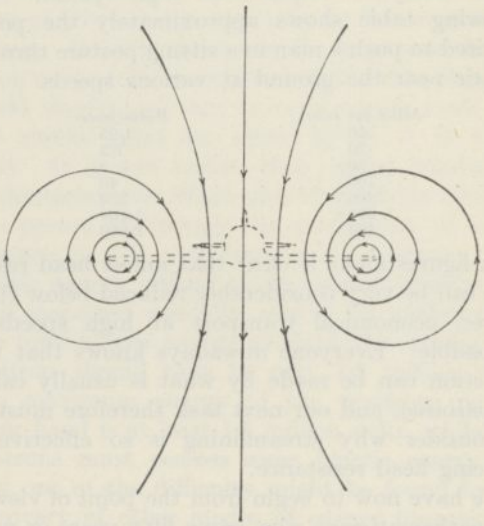

FIG. 2.

into motion, that the aeroplane supports itself, and it is because these whirls have to be continually created that power must be expended to obtain support. In effect, therefore, the aeroplane has to use some of its available power to create its own track, which is left behind in the air after it has passed.

The Lanchester-Prandtl calculations enable the power expended merely in supporting an aeroplane to be calculated with considerable accuracy ; they show, for example, that the power required for this purpose, for every thousand pounds of weight of a modern civil transport aeroplane, ranges from about eight horse-power at one hundred miles per hour, to four horse-power at two hundred miles per hour, and is still less at higher speeds. Since the power actually available in civil aircraft of the present day, after allowing for losses in the screw propulsion, is of the order 60–70 horse-power per thousand pounds weight, it is clear that, although the aeroplane must pay for the elimination of the track problem by the expenditure of extra power, the amount of this extra power and the way in which it varies with change of speed are such as to place no final limits upon speed.

Having reached this conclusion, we are free to turn our whole attention to the remaining factor which does, and probably always will, limit speed : the resistance which has to be overcome merely to drag the aeroplane through the air.

Anyone who has ridden a bicycle must know that the air can exert a very considerable resistance to the passage of a man through it, even when the speed is so low as 15–20 miles per hour. Since the power required to overcome this resistance increases about eight-fold every time the speed is doubled, it is at once apparent that very great powers may be required at high speeds. The following table shows approximately the power required to push a man in a sitting posture through the air near the ground at various speeds.

Miles per hour	*Horse-power*
10	1/25
20	1/3
50	5
100	40
200	320
300	1,100
400	2,600

Such figures make it clear that unless head resistance can be very considerably reduced below these figures, economical transport at high speeds is impossible. Everyone nowadays knows that this reduction can be made by what is usually called *streamlining*, and our next task therefore must be to consider why streamlining is so effective in reducing head resistance.

We have now to begin from the point of view of the mathematicians who, some fifty years or more ago, studied the basic problems of fluid motion. They observed that water and air are very slippery substances, and they conceived the idea of studying an ideal fluid which they imagined to be absolutely slippery. Almost at once they reached the astonishing conclusion that solids of any shape whatever would be expected to move through such a fluid—if it could exist—without any resistance whatever. Impressed by this paradox they, for the most part, gave up any attempt to apply their theory to practical purposes; but fortunately for us this did not in any way damp their enthusiasm for the subject itself, which they pursued, one must suppose, for the sheer love of the game, or perhaps with the idea of providing problems for university examinations. But whatever the impulse behind their work, Providence has, as usual, seen to it that their efforts were not wasted, for they laid the foundations of the science which has enabled us to seek for and obtain the very great reductions of resistance which are essential for high speed transport. For it so happens that when bodies are given the now familiar streamline shapes, the flow around them takes almost exactly the form imagined by the mathematicians for their ideal fluid, and the pressures exerted by the fluid on the surface of the body are so nearly the same as those given by the theory, that their net effect in resisting motion is, as the theory suggests, practically zero. Fig. 3 shows the theoretical flow and pressure distribution of the ideal fluid about a good streamline body; the real flow and pressure distribution for this body would be almost indistinguishable from these theoretical values.

Why then does a perfect streamline shape experience any resistance at all to motion? It is because the air, unlike the ideally slippery fluid, cannot actually slip over the body, but must exert a very slight dragging force along its surface, and it is this dragging force, or *skin friction* as it is called, which alone offers any appreciable resistance to the passage through the air of the best streamline shapes. Here then is a curious situation, for while everyday experience makes it seem 'natural' for us to suppose that the air should strongly resist the rapid passage of bodies through it, the difficulty, when the matter is approached

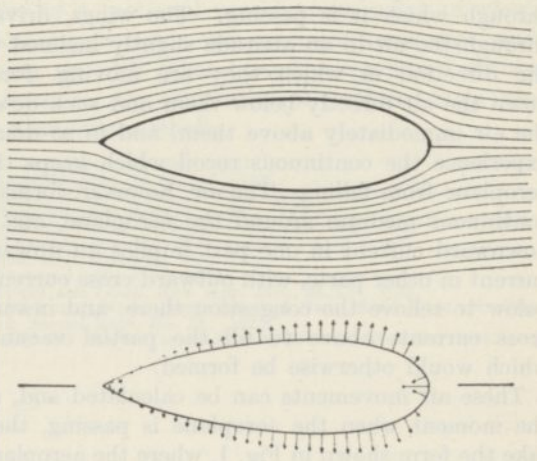

FIG. 3.

from the theoretical end, is to explain why the resistance of any body is greater than the exceedingly small force which can be applied by the mere rubbing of the air over its surface. The wide gulf between the two points of view is shown by the fact that at the speed of modern aerial transport, the resistance of a badly shaped body may be as much as fifty times greater than that of a good streamline body of the same frontal area.

Now we have to find an explanation for the high resistances of unstreamlined bodies. This is due to a curious feature in the behaviour of the air flow, which would be impossible in the ideally slippery fluid; for the real air streams have the power of leaving a curved surface and forming pockets of what is called *dead air* behind the bodies. Within these pockets the pressure is low and so the bodies are, as it were, sucked backwards. On closing up behind these pockets the air stream becomes very turbulent and full of regular or irregular eddies which continually carry away the energy corresponding to that expended in moving the body against the high resistance.

(*To be continued.*)

Nuclear Physics

THE British Association discussion at Norwich on nuclear physics on September 5 was opened by Lord Rutherford. After a review of progress resulting from the application of high voltages to nuclear transmutation, he passed on to discuss the rapid development of our knowledge of artificial radioactivity and in particular the production of such radioactivity by neutron bombardment. Neutrons, being uncharged, penetrate the heaviest nuclei without difficulty, and radioactive isotopes of the great majority of the elements have already been discovered. The effectiveness of neutrons in producing some types of transmutation is increased largely by slowing them down by passage through paraffin, water or other substances containing hydrogen, the neutrons losing energy by collision with the protons. By slowing them down in this way to thermal velocities, their adsorption by boron is increased 350 times, by cadmium 3,000 times, and by gadolinium 30,000 times, the effective cross-section for capture then being of the order of 10^{-20} sq. cm. A demonstration that neutrons actually obtain thermal velocities is afforded by slowing them down in paraffin wax cooled to liquid air or liquid hydrogen temperatures. This extra cooling reduces the velocity still further, and an increase in the efficiency of disintegration has been observed by P. B. Moon and others.

Lord Rutherford considers that it would be of interest to see whether neutrons reach the upper layers of the atmosphere in appreciable numbers, and whether they can account for any of the cosmic ray phenomena. He hopes that future expeditions to the stratosphere will include apparatus for the detection of neutrons.

He passed next to discuss the new radioactive isotopes. These isotopes must exist in the sun or other hot stars where a natural nuclear bombardment must be constantly proceeding. They would therefore exist in the substance of the earth when it was first flung off from the sun, but in the course of time they would progressively disappear, only those with the longest lives such as radium with its unstable products remaining.

Dr. C. D. Ellis stressed the importance of the accurate measurement of the energies of electrons, γ-rays and protons emitted in related transmutations. Thus aluminium bombarded by α-particles can change into Si^{30} and a proton, or to Si^{30}, a neutron and a positron. An accurate measurement of the kinetic energies in the two alternative modes of transmutation would show whether in all cases the energy liberated in the positron emission is given by the maximum positron energy. It appears that many of the measurements made hitherto were quite unreliable, estimates of maximum positron energies varying by factors so large as two. Dr. Ellis expressed the hope that the exciting work of discovering new radioactive elements would shortly give way to more precise work.

A similar point was raised by Dr. J. D. Cockcroft. It is well known that carbon bombarded by deuterons can either give C^{13} with the emission of a proton or through the production of radionitrogen to C^{13}, a positron and a neutron. The kinetic energy release in the proton reaction has been measured carefully, and is 2·7 million volts. The total kinetic energy available for neutron and positron should thus be only 1·3 million volts. The maximum energy of the positrons on the other hand is at least 1·4 million volts, whilst the neutrons must possess some kinetic energy. A way out of the difficulty might be found by the discovery of other modes of energy liberation in the proton reaction although strong theoretical arguments have been advanced against the possibility of such other modes.

Dr. Cockcroft referred also to the properties of the new radioactive isotopes produced by proton and deuteron bombardment. Radioactive isotopes of lithium and boron have been discovered emitting electrons up to 11 million volts energies. Radiosodium which emits penetrating γ-rays can be produced by voltages so low as 500 kilovolts, but a 10-hour bombardment of a rock salt crystal with 10 microamps will produce a source emitting only 2,000 electrons per second, whereas an increase of voltage to 1·7 million increases the yield by a factor of 10,000. Prof. Lawrence hopes by advances in technique to increase the yield by a further factor of 1,000, and so to produce in a day a source of the same order of activity as a gram of radium. Prof. Lawrence considers that such sources might have great importance in biological work.

Dr. M. L. Oliphant showed how the accurate measurement of the kinetic energy changes in nuclear transmutations has led to a revision of the scale of nuclear masses. Until recently, the mass spectrograph data have been accepted without question, but several serious discrepancies have forced a reconsideration of the position. The mass of Be^{9} has caused the greatest difficulty, for on Aston's and Bainbridge's figures it should be able to disintegrate spontaneously into 2 α-particles and a neutron. It appeared that all

the difficulties were removed by the assumption that a small error had been made in determining the mass of helium relative to oxygen. Since most of the masses were measured in terms of helium, a complete revision of the mass scale necessarily followed. Dr. Aston has since repeated his mass spectrograph measurements using the more accurate brackets now possible with the use of deuterium, and has confirmed that revision was necessary.

Mr. M. Goldhaber reported the experiment of Dr. J. Chadwick and himself on the γ-ray disintegration of the deuteron. The neutrons resulting from the transmutation have been detected by their action in disintegrating lithium ; the proton energies have been estimated at 240 kilovolts using radium γ-rays.

Dr. N. Feather reported a more accurate determination of this energy by the use of a Wilson chamber filled with 'heavy methane'. 40 proton tracks were measured, the proton energy being about 180 kilovolts. The distribution of tracks was similar to that expected for a photo-electric effect. The new work requires a proton mass of 1·0086 on the revised scale.

Dr. P. B. Moon demonstrated the production of induced radioactivity by neutrons, and in particular showed how enormously the effect with rhodium is increased by slowing down the neutrons by paraffin wax.

News and Views

Demonstration of Firewalking

A DEMONSTRATION of firewalking was given by an Indian, Kuda Bux, before members of the University of London Council for Psychical Research and other men of science at Carshalton, on September 17. The fire was contained in two trenches about 12 ft. long, 6 ft. wide and 8 in. deep. Barefooted, Kuda Bux walked along the trenches twice, and his feet made contact with the burning embers for some five seconds each time. Prof. C. A. Pannett of St. Mary's Hospital sends us the following account of his observations : "Kuda Bux is physically of the typical, slightly built, Indian type. The soles of his feet present no unusual features. The skin is not callous but soft, as the skin of so many individuals who walk barefoot. The feet felt cold to the hand, and a skin thermometer registered 93·2° F. This was about twenty minutes before the attempt, during which time the performer walked about the lawn. A five-eighths inch square of zinc oxide plaster was attached to the sole of the right foot. The skin of the feet was very dry. The feet were washed and dried carefully about fifteen minutes before the walk. After the steps had been taken, with a delay of perhaps ten seconds, the temperature of the soles of the feet was again taken. It was now 93° F. There was no sign of burning of the skin.

"AT the conclusion of the performance, after Kuda Bux had walked twice over the pit, an interval of perhaps forty minutes having elapsed, the feet were again examined. By careful scrutiny could be seen here and there the whitened appearance of the skin which occurs when the very surface of the epithelium is scorched without blistering. Yet with the pigmentation present it was very difficult to be positive of this. There were no signs of hyperæmia or blistering. The patch of plaster was quite unharmed, except that the fluff of the cotton basis at the cut edge looked very slightly scorched. If this were so, these cotton fibres must have reached a temperature approaching 120° C. Mr. Digby Moynagh, who had made an attempt to carry out a firewalk ten days previously, made a second one. The soles of his feet had a number of blisters on them, which were in the healing stage. After two steps he acquired new blisters. The soles of his feet were noticeably moister than those of the Indian, and this factor may be of importance, because at one place the dampness had caused a piece of the charcoal to adhere. Underneath it a burn occurred. Mr. Maurice Sheepen also made two steps on the glowing charcoal. Hyperæmic patches occurred on his soles, which doubtless were the beginning of blisters."

Our Indian Contemporary—*Current Science*

To those who are interested in following from afar the remarkable increase in the appreciation of scientific education and research in India, which has recently become so apparent, our contemporary *Current Science* has been indispensable. This journal, which now enters upon its fourth year, is ably edited by Prof. C. R. Narayan Rao, of Bangalore, with the active co-operation of all the leading men of science in India. It has been their aim to provide India with a periodical similar in its aims to NATURE and in this they have undoubtedly been successful. In the July issue, the future of Indian university education is discussed at length, more especially as it affects the pass degree graduates who are so numerous in India. The problem of finding employment for these is not solely an Indian problem, but there it attains a magnitude not met with elsewhere. It is suggested that the courses of study require modification to meet this difficulty, but we doubt if this would provide more than a partial solution of the problem. We think that much might be done by the introduction of Civil Service examinations for the lower grades of civil servants, which would remove from the colleges many unsuitable students. The question is one well worthy of study by an independent committee.

THIS issue of *Current Science* contains also a number of valuable scientific articles. Of especial interest is that by S. Rangaswami and M. Sreenivasaya on the disease of sandal. The discovery, that this disease is insect borne, has resulted from research work in which the biochemists of the Indian Institute of Science, Bangalore, and the entomologists of the Forest Research Institute, Dehra Dun, have been prominent. This investigation provides an excellent example of the value of well-organised team work, and it should result in the control and the gradual elimination of this disease from the Madras and Mysore forests. We congratulate the editor and his collaborators on the high measure of success achieved by *Current Science* and we note with pleasure that in future the journal is to appear fortnightly instead of monthly.

Hittite Art

A REPRESENTATION of a bull in silver from recent excavations in Anatolia, and described as the most important work of art of Hittite origin yet discovered, is to be exhibited at the forthcoming Antique Dealers Fair to be held at Grosvenor House, London, W.1. The figure is seven inches high, and is mounted on bronze and inlaid with gold. It is dated tentatively at the third millennium B.C. As an evidence of high artistic culture, it is without parallel among Hittite antiquities. An obvious comparison with Sumerian bulls from Ur is suggested. To this, reference is made by Prof. Ernst Herzfeld, whose authority on Hittite objects is unquestionable. In an interview with a representative of *The Times*, which appears in the issue of September 16, he discusses the affinities of the Hittite bull with other finds from Anatolia and elsewhere, mentioning in particular the figurines from mounds in south Russia and the Caucasus, of which the best known are in the Hermitage Museum, and a terra-cotta bull (*Bos primigenius*) from Nihawand in his own collection, which belongs to the Early Bronze Age of the third millennium B.C. Prof. Herzfeld also directs attention to the principle, important in discussion of the qualities and characteristics of art in the ancient East, and of a relevance here, which will be immediately apparent to archæologists, that down to Achæmenid times verisimilitude in line is frequently sacrificed to an artistic convention in attitude, which assimilates one species to another. This is apparent in this example in the manner in which the legs of a bull are represented in an attitude essentially capriform. It is thus evident that even at the early date to which this bull is assigned, an art, Hittite in all essentials, already conformed to a generalised eastern convention.

Fen Drainage Problems

IN view of the contiguity of the fen district to the locality of the Norwich meeting of the British Association, the presentation at the meeting of a paper on problems in fen drainage was appropriate. Major R. G. Clark, the writer of the paper, pointed out that there is an estimated total of 1,279,000 acres of fenland and lowland in England and Wales protected by artificial works from inundation by the sea or flooding from the rivers conducting the surplus water to the sea, and that the Bedford Level, which extends into the counties of Cambridgeshire, Norfolk, Huntingdonshire, Isle of Ely and other counties, comprises about 836,000 acres of fenland. The Bedford Level is traversed by the Rivers Nene and Ouse which serve to subdivide it into the North, Middle and South Levels.

ARTIFICIAL works in this district date back to about 1631, when Cornelius Vermuyden, the celebrated Dutch engineer, was commissioned to convert the Level area into 'summer lands', which he did by constructing various barrier banks, new cuts, etc. He appears, however, to have allowed insufficiently for the shrinkage of the newly-protected land, mainly composed of peat, in illustration of which, a photograph was shown of a column at Whittlesea Mere, the top of which marks the original level of the ground when drained in 1851 and now stands 11 ft. above it. The paper described the means adopted to produce evacuation of the water, and instanced the modern pumping installation at St. Germans consisting of three oil-driven units of the Premier-Crossley horizontal *vis-à-vis* type, each of 1,000 b.h.p., coupled through reduction gears to a horizontal centrifugal pump constructed by Messrs. Gwynne's Pumps, Ltd., the capacity of each pump varying from 1,000 to 300 tons per minute according to tidal conditions. Mentioning that the Middle Level Board has spent more than half a million sterling on new works and maintenance during the past twelve years, Major Clark concluded with the affirmation that, in future, State assistance will become necessary, urging that it will be a national disaster if these large food-producing areas of fen and lowland are not maintained and protected.

Meare Lake Village, 1935

AN exceptionally interesting find in the excavations of the Somersetshire Archæological and Natural History Society at Meare Lake Village of the present season, which ended on September 19, is that of a timber substructure of a remarkable and unusual character in one of the mounds. It consists of a squared arrangement of oak beams, 11½ feet in length, crossed at the angles and secured by oak piles or corner posts placed vertically through the mortice holes. The arrangement was almost square, the area enclosed by the timbers being fifty-three square feet. The inner area was crossed by one large oak beam; and poles of alder and silver birch laid out in parallel order in both directions under the oak beams combined to form a raft-like structure. The earlier rectangular building on this structure would appear, judging from the position of piles around the area, to have been superseded by the more usual round dwelling, of which the superimposed hearths were found in the position and relation in which they were to be expected. A somewhat similar square timber structure was found in the west village some years ago, and traces of rectangular huts were found

at five points, though not *in situ*, in the Glastonbury Lake Village. From the range of finds in the area of excavation of the present season, it is evident that this quarter of the village was a centre for weaving. Weaving combs, bobbings, needles of bone and no less than twenty-four spindle whorls were found. Among other objects were an iron dagger with bronze fittings, bronze finger rings, yellow paste beads, three spurs of fighting cocks, linked bronze wire and two 'cheek-pieces' of horses' bridle bits. Among the finds from the excavations of this and previous seasons, to be exhibited in the new Wyndham Galleries of the Somerset County Museum at Taunton, is a mounted set of the spikelets and grains of *Triticum dicoccum* found at Meare, with a set of its modern counterpart by its side. These have been prepared by Sir Rowland Biffen.

Spanish Influence on Progress of Medicine

On the occasion of the International Congress of the History of Medicine, to be held at Madrid on September 23–29, the Wellcome Research Institution has issued a booklet illustrating Spain's contribution to medical science from the earliest times down to the discovery of cinchona in the seventeenth century. After alluding to Spanish contacts with former civilisations such as those of the Phœnicians, Carthaginians, Greeks, Romans and Visigoths, the work deals with the Hispano-Moresque Renaissance, which was remarkable for the foundation of schools of medicine and pharmacy and the establishment of hospitals, some of which were equipped with large libraries, as well as for the appearance of eminent medical men, including Albucasis, the author of a great medico-chirurgical treatise which remained the leading textbook until the time of William of Saliceto (1275), Avenzoar, the greatest of the Hispano-Moresque physicians, and Maimonides, the Hispano-Jewish philosopher and physician, the octocentenary of whose birth has recently been celebrated. During the sixteenth and seventeenth centuries a large number of hospitals were founded in different parts of Spain, especially at Barcelona, Granada, Malaga and Madrid. The outstanding medical personalities of the sixteenth century in Spain were Nicolás Monardes, of Seville, whose private museum of natural objects was one of the earliest, if not the first, in Spain; Francisco Hernandez, physician to Philip II and author of a monumental work on the natural history of Mexico; and Andres Laguna, physician to Charles V and Pope Julian III and professor at the University of Alcalá de Henares, where Cardinal Ximenes the founder had endowed six professorships of medicine and two of anatomy and surgery. The booklet is illustrated by facsimiles of pages from Spanish medical works, portraits of Spanish doctors and views of the old hospitals.

Snake Bite in the United States of America

In 1908, Prentiss Willson gathered reports of 740 bites by poisonous snakes covering a period of almost a century. That result gave an entirely false idea of the prevalence of snake-bite in the United States, for Dr. T. S. Githens now records 2,376 cases which have come to his notice during the past eight years, and estimates that there may be 1,500–2,000 cases each year (*Scientific Monthly*, August 1935, p. 163). It may be, also, that the number of snakes is increasing, for when wilderness is converted into farm land, small rodents increase greatly in number, and these form the mainstay of the snakes' diet. The danger to health varies most with the amount of venom injected, and this is closely related to the size of the snake involved, so that the most dangerous species are the large Florida and Texan diamond-backs. The only local measure having any real value is the application of a moderately tight tourniquet, associated with free incision of the site of the bite and the swollen area and persistent use of suction. But the mainstay of treatment is the use of adequate doses of antivenum, a specific serum effective against the bites of North American vipers, which has reduced the mortality rate from 14·3 to 3·7 per cent. Of the 72 persons who died in spite of serum treatment, 25 were near death when the serum was first given, and in 6 other cases death was due to gangrene resulting from too tight tourniquets; more than half were children less than fourteen years of age.

The Voyage of Peter Mundy

In the *Proceedings of the Linnean Society of London*, Session 1934–35, Part 2, Mr. N. B. Kinnear and Mr. F. C. Fraser direct attention to the remarkable journals and zoological notes from the voyage of Peter Mundy, 1855–56. Some very clever sketches are reproduced showing a remarkable vivacity, and his notes show that he was a careful observer. Three volumes of his travels have already been published by the Hakluyt Society; the fourth and final volume is being edited by Miss Anstey, who assisted the late Sir Richard Temple with the earlier volumes. The running bird from Ascension Island illustrated which "can neither fly nor swimme" is identified as a rail, now extinct, and the strange seal-like creature from St. Helena is thought to be a sea elephant, which, although never recorded from so far north, is a very strong swimmer, and it is apparently just possible that one could have reached this island. The third picture represents a whale, identified by Mr. Fraser as an adult Atlantic right whale. Mundy's description of the feeding mechanism is stated to be quite correct, and he is probably one of the first to have given a true account of this.

Zoological Gardens of Travancore

It is not easy to realise what great efforts are being made in all parts of the Empire for the interest and instruction of the people in matters of natural history. The Zoological Section of the Public Gardens at Trivandrum contained last year ("the year 1109 M.E.") 149 mammals, 225 birds, 26 reptiles and 20 fishes; and the growing popularity of the institution was indicated by an increase in the number of visitors to 462,566 from the 302,425 of the preceding year.

Extensive improvements were carried out, including the building of a new aviary, the extension of the carnivora house, and an open arena for lions and tigers. And "all the members of the menial staff of the three Sections were provided with suitable uniforms, for the first time, with suggestive badges for the respective groups; and the whole staff looks exceedingly smart when thus arrayed on ceremonial and festive occasions. . . . The year 1109 was one of the most progressive in the annals of the institution, and has marked an important land mark in the various stages of its development for years." (Administration Report to the Government of His Highness the Maha Raja of Travancore, 1109 M.E.)

Marine Biology in Ceylon

THE administrative report for 1934 of the marine biologist of Ceylon, Mr. A. H. Malpas, shows that as the results of restricted inspections by dredging of the pearl banks there were no spatfalls in the northern paars and Cheval paars. A certain number of second and third year oysters were, however, present, but not in sufficient quantities to offer a prospect of immediate fisheries, although if conditions are favourable they may provide heavy spatfalls. A scheme has been prepared for the establishment in Colombo of a fisheries research station combined with an aquarium which is under consideration. This provides in the first instance for a small biological research station capable of being enlarged as funds are available. It will be equipped with research laboratories and fresh-water and marine aquaria essential for fisheries investigation work. An aquarium will be attached, to which the public will be admitted. This is an alternative scheme to one outlined in earlier reports which provided for exhaustive investigations in these waters with a modern fishing vessel equipped with the latest fishing appliances in order to determine the lines on which the local industries could be most profitably developed, which the Executive Committee for Local Administration has definitely decided to abandon. Under the new scheme, the field of research will include investigations into life-histories and general bionomics of all aquatic animals of importance in Ceylon, into the culture of pearl and edible oysters, into the farming of estuaries and fresh-water fishes and turtle, and into the importance of various indigenous larvivorous fishes in relation to the suppression of tropical fevers and the breeding and distributing of the most active forms throughout Ceylon.

Baltic Countries

THE Baltic Institute, which was founded at Torun in Poland in 1926 for the investigation of Polish and Pomeranian economic problems, has widened its scope in the publication of a journal entitled *Baltic Countries*, which is to appear three times a year at the annual cost of five dollars. The August number contains more than a dozen articles, all in English, on various aspects—geographical, economic and historical—of Sweden, Finland, Denmark, Estonia and other Baltic lands. Russia and Germany are excluded from the scope of the review. The editorial committee of twelve is drawn from the universities of Baltic and Scandinavian countries, England and the United States. A supplement to the issue contains the first instalment of the proposed Baltic Year Book which gives the usual statistical tables. This is to be completed in four issues, and then published separately. *Baltic Countries* promises to be a useful addition to geographical and economic journals.

Religious Broadcasting at the Eucharistic Congress

THE broadcasting of the services at the International Eucharistic Congress of World Catholicism at Buenos Aires in October 1934 to the largest and most widely diffused religious congregation in history was made possible by the radio telephone. On the closing day, October 14, the Pope, Pius XI, speaking into a microphone on his desk at the Vatican, gave the concluding message not only to a million worshippers kneeling in the streets of the Argentine capital, but also, by means of retransmissions from Buenos Aires to broadcasting stations on three continents, to a very considerable proportion of the clergy and laity throughout the world. In *Electrical Communication* of July, two papers describe the broadcasting arrangements and the radio telephone system which rendered possible this world-wide service. No longer are the delegates to these international congresses crowded together in a cathedral with straining ears. Walls or park boundaries or national frontiers or even oceans now offer no restrictions. Without wireless, the management of the large crowds drawn from a metropolitan area having nearly three million inhabitants would have presented almost insuperable difficulties. Chile, Peru and Colombia were linked up by transcontinental land lines and Uruguay by a subfluvial cable. The able and willing co-operation of the Government telephone departments of many of the leading countries in the world ensured the success of the international broadcasts.

Industrial Power in Great Britain

AT the National Electrical Convention held at Bournemouth on June 3–8, a paper on industrial power supply was read by F. Forrest, H. Hobson and C. Taite. They examine very thoroughly the dependence of Great Britain upon her manufacturing industries and how much mechanical and electrical power they take. Although widely extended use is being made by industry of the public electric supply services, a still wider use is advocated, as it has a cumulative effect upon economy of production, and many of the existing mechanical power plants are not economical. The introduction of labour-saving devices has proceeded more slowly in Great Britain than elsewhere; mass production methods also are much more widely applied in the United States and Germany. Compared with her principal competitors, there is a relative deficiency in the total power equipment per wage earner of Britain. This deficiency is partly due to the nature of British industries, which demand a greater proportion of hand processes, and

in part to their earlier and more gradual development. The percentage of workers engaged in manufacture is appreciably higher in Britain than in the United States, France or Germany. The total horse-power has advanced from 1½ horse-power per wage earner in 1907 to 2·81 per operative in 1930. Taking the average price of coal and electric power to be 100 in 1922, their prices fell to 75 and 59 in 1932. The advent of the Grid has enabled great reductions in capital cost owing to the use of much larger dynamos. In 1934, the average size of *machine* ordered was 40,000 kilowatts, which is four times the average size of a generating *station* in 1926. Examples are given showing how the Grid is leading to the decentralisation of industry.

Progress of Welding

THE new Institute of Welding founded this year amalgamates the two organisations formerly known as the Institution of Welding Engineers and the British Advisory Welding Council. An abstract of the address of the new president, Sir Alexander Gibb, to the Institute appears in the *British Engineers' Export Journal* for July. It is pointed out that, on the Continent, there are many buildings more than twelve stories high constructed by welding. In Great Britain the entertainment hall at Bexhill is the first large building in which welding was used. Several all-welded ships have been constructed, and have proved very successful in everyday use. In most ships, including destroyers and cruisers, bulkheads and strength decks are welded. Welded underframes will be used for the Silver Jubilee train which will run from London to Newcastle (268 miles) in less than four hours—necessitating long stretches at more than 100 miles an hour. In the United States, the Burlington Zephyr diesel high-speed train, built of welded stainless steel, attains a speed of 100 miles an hour in its daily service between Kansas City and Lincoln, doing the 251 miles in four hours. In the electrical industry, practically all the largest machines are now fabricated by electric welding. In hydro-electric development, welded high-pressure pipe lines are the standard practice. Many bridges have been constructed in this way. In Belgium two dozen truss bridges are being built over the Albert Canal, some of the spans being 250 feet long. In Germany more than two hundred railway bridges have been built with spans up to 170 feet, and road bridges with spans of 300 feet.

Norman Lockyer Observatory

THE second edition of the Handbook of the Norman Lockyer Observatory (Sidmouth : Norman Lockyer Observatory. 6*d*.), compiled by Dr. W. J. S. Lockyer, director of the Observatory, is dedicated to the late Miss Winifred Lockyer who until her death in July 1934 voluntarily acted as assistant secretary and librarian. The handbook refers warmly to her willing and cheerful service, and to her many generous gifts. The beginnings of the Observatory date from 1912, shortly after the retirement of Sir Norman Lockyer from the Solar Physics Observatory at South Kensington, and the transference of that Observatory to Cambridge. To promote its development, the Observatory in 1916 was formed into a Corporation. The Observatory was originally known as 'The Hill Observatory', but in 1921 the Council of the Corporation changed its name to that which it now bears as a fitting reminder of its founder's eminence in astrophysics. The principal instruments are the 12-in. McClean telescope, the 10-in. Kensington telescope and the Mond photographic equatorial. The first two are devoted to astrophysical problems —the study of *B*-type stars which exhibit emission lines in their spectra, and the determination of spectroscopic parallaxes (of which more than 2,000 have been measured up to date) form the main investigations. The third instrument, presented to the Observatory by Sir Robert Mond four years ago, consists of a battery of four short-focus telescopes designed for photographing large regions of the sky. Of the history of the Observatory and its programme of work, the Handbook gives an interesting account, and it is well illustrated with photographs.

Mining Electrical Engineering

AT the annual conference of the Association of Mining Electrical Engineers held in Nottingham last July, suggestive comments were made on the directions in which engineering progress could be most helpful in mining. During recent years, notable advances have been made in developing safety lamps, flameproof switchgear of all kinds and signalling. In the latter department, experiments between the surface of the ground and the workings underneath have been made with a fair amount of success by means of wireless, but sub-surface radio still remains a possibility of the future. In his presidential address, Mr. A. W. Williams, whilst admitting the progress that has been made, urged that they must never be content with the present degree of efficiency. Engineers at the present time pay special attention to standardisation. Practically every commodity used in connexion with electrical apparatus is either standardised or is being studied with that end in view. He fears that this tendency will retard efforts to further research in the directions of safety and efficiency, and tends to put a check on individual initiative and investigation. Mr. Williams does not approve of some of the devices introduced to control apparatus at a distance, for they cannot always be trusted to work satisfactorily ; they make for safety in some ways, but increase the risks in others. From the mining engineer's point of view, they offer few, if any, compensating advantages by increasing the efficiency of coal production.

Destructive Earthquakes in 1934

IN the last two numbers of the *Matériaux pour l'Étude des Calamités* (79–84, 152–155 ; 1935), M. Charles Bois has given a list of 54 destructive earthquakes that occurred during the year 1934. The only great earthquake of the series was that of northern Bihar on January 15. Three others, one in China and two in Mexico, may have reached the highest

of Prof. Milne's three degrees of intensity. The most remarkable feature of the year was, however, the occurrence of only one semi-destructive shock in each of such well-known seismic regions as Italy, Greece, Japan, the Philippines, California and New Zealand. The total number of lives lost was unusually small, in Bihar about 2,000, and in all the rest, according to M. Bois, the total is only 39.

Animal Welfare

THE third "Animal Year Book", published by the University of London Animal Welfare Society (price 2*s.* 6*d.*), contains a variety of articles of interest to naturalists. Most important of these are A. H. B. Kirkman's account of whales and whaling; a summing up of the state of affairs in regard to oil pollution of coastal waters by J. McMath and L. Parker; and a symposium in which correspondents in different lands abroad give summaries of their own country's legislative and other efforts for the protection of animals. The hon. editor is Dr. C. M. Knight.

Science in Hong-Kong and South China

THE first number of a new volume (4) of the *Hong-kong Naturalist* (May 1935) carries on the tradition of its predecessors in offering articles dealing with many different aspects of scientific knowledge. An excellent account of stone rings and their manufacture, and the first of a series of articles on the legends and stories of the New Territories are of archæological interest; and the curious Chinese habit of eating melon-seeds is described and discussed historically. The pipe-fishes and their relatives continue the synopsis of Chinese fishes, and the series on the birds and the orchids of Hong-Kong are continued.

Key to British Trees and Shrubs

A USEFUL key to British trees and shrubs has recently been compiled by C. T. Prime and R. J. Deacock (Cambridge: W. Heffer and Sons, Ltd., 1*s.*). The key is divided into two sections, the first giving the summer diagnostic features (chiefly the leaves), and the latter the winter features. The key is arranged in a simple flora style, and should not give rise to any difficulty. There are 57 diagrams. Unfortunately these are in very rough outline, and in many cases will not help in identification; this applies especially to the diagrams of winter twigs. More detail is not only desirable, but also essential, if these illustrations are to carry out their intended function. The price is high for a pamphlet of 39 pages.

Canadian Minerals

A USEFUL publication is "The Canadian Mineral Industry in 1934" published by the Department of Mines, Ottawa. It gives in alphabetical order, for a score of metals and some thirty minerals, details of occurrence, production and trade as regards Canada. Details are given also of important developments and prospective sources of further supply within the Dominion. The volume provides in a convenient form a complete survey of Canadian mineral resources and also authoritative figures.

Announcements

M. ALFRED LACROIX, perpetual secretary of the French Academy of Sciences and professor at the Museum of Natural History, Paris, has been nominated Grand Officer of the Legion of Honour.

THE tercentenary of the university of Budapest founded by Peter Pazmany in 1635 will be celebrated at Budapest on September 27–29, when the following, among others, will receive the title of doctor *honoris causa*: Sir Frederick Gowland Hopkins, Sir Charles Sherrington, Prof. Ludwig Aschoff, of Freiburg im Breisgau, Dr. G. Roussy, dean of the medical faculty in the University of Paris, and Prof. Anton von Eiselberg of Vienna.

THE following have recently been elected honorary members of the German Röntgen Society: Dr. Antoine Béclère of Paris, Prof. Rudolf Jaksch-Wartenhorst of Prague, Mr. A. Charles Thurston Holland of Liverpool, Dr. J. M. Woodburn Morison of London, and Dr. Pfahler of Philadelphia.

THE International Society of Medical Hydrology will hold its annual meeting in Brussels and Ostend on October 12–17, when the following subjects will be discussed: the action of carbon dioxide on the peripheral circulation, the therapeutic action of mud baths, and the therapeutic action of a sea climate. The first two subjects will be discussed in Brussels on October 13–14 and the third at Ostend. The intervening days will be spent on a visit to Mordorp and Spa. Further information can be obtained from the Secretary of the International Society of Medical Hydrology, 100 Kingsway, W.C.2.

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

A lecturer in agricultural botany in the Edinburgh and East of Scotland College of Agriculture—The Secretary (Sept. 25).

An entomologist in the Horticultural Research Station of the University of Cambridge—The Secretary, School of Agriculture, Cambridge (Sept. 25).

A part-time demonstrator in zoology in the University of Manchester—The Registrar (Sept. 26).

Junior assistant in the Directorate of Ballistics Research—The Chief Superintendent, Research Department, Royal Arsenal, S.E.1 (Oct. 3).

A research assistant in the Mathematics Department of the Imperial College of Science and Technology—The Secretary (Oct. 4).

A curator of the Department of Archæology and History, and a curator of the Departments of Ethnology and Ceramics in the Art Galleries of Glasgow—The Subscriber, City Chambers, Glasgow (Oct. 15).

A lecturer in structural engineering and mechanics in the Borough Polytechnic, Borough Road, London, S.E.1—The Principal.

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. 479.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Precursors of Coprosterol and the Bile Acids in the Animal Organism

THE transformation of cholesterol into coprosterol in its passage through the body involves a reduction of the $C_5 : C_6$ double bond, and a transition from the *allo*cholanic- to the cholanic-ring system. Although it is established that the bacterial flora of the intestine is concerned in the reduction process, the mechanism by which the stereochemical change is brought about is unknown. A clue was afforded by a study of the properties of cholestene-3 : 4-diol, a primary oxidation product which is formed under various conditions of mild oxidation from cholesterol, and is also a constituent of the resinous product called 'oxycholesterol'[1]. Being an α-glycol, this substance easily rearranges by loss of water into the corresponding ketone, that is, cholestenone. Since cholestenone (= coprostenone) yields coprostanone on reduction, which in turn is reducible to coprosterol (= coprostanol) and *epi*-coprosterol[2,3], we formed the working hypothesis that the reactive primary oxidation product, cholestene-diol, may play a role in cholesterol metabolism, giving rise to the formation of cholestenone as an intermediary product. On this assumption, cholestenone and coprostanone, and not cholesterol itself, are the immediate precursors of coprosterol which is formed from them in the intestine by bacterial reduction. Further, an explanation is afforded for the origin of the *epi*-hydroxycholane system in lithocholic acid (and the other bile acids ?)[4], which may be derived from *epi*-coprosterol by oxidative cleavage of the side chain with loss of acetone.

On subjecting this hypothesis to experimental test by means of feeding experiments on animals, we found that the addition of cholestenone to various diets poor in cholesterol gave rise to a large increase in the excretion of faecal coprosterol. This increase did not, however, account for the whole of the ingested cholestenone, and since only a small amount was excreted unchanged, it is possible that the remainder may have been converted into bile acids. This question, as well as the action of intestinal bacteria on cholestenone, is being further investigated.

It may be pointed out that a similar mechanism may underlie the metabolic processes leading from cholesterol to certain sexual hormones (progesterone, androsterone) which contain either a keto group or an epimerised hydroxyl at C_3.

O. ROSENHEIM.
T. A. WEBSTER.

National Institute for Medical Research,
N.W.3.
Sept. 5.

[1] Rosenheim and Starling, *Chem. and Ind.*, **52**, 1056; 1933.
[2] Grasshof, *Z. physiol. Chem.*, **225**, 197; 1934.
[3] Ruzicka, Brüngger, Eichenberger and Meyer, *Helv. Chim. Acta*, **17**, 1407; 1934.
[4] Ruzicka and Goldberg, *Helv. Chim. Acta*, **18**, 668; 1935.

Statistical Tests

IN a letter to NATURE of August 24, Prof. Karl Pearson states: "From my point of view, the tests are used to ascertain whether a reasonable *graduation* curve has been achieved, not to assert whether one or another hypothesis is true or false."

This assertion must come as a surprise to many who are familiar with Prof. Pearson's writings. It should not, however, be permitted to divert attention from the points raised in Mr. Buchanan-Wollaston's letter of August 3, for whatever may have been Prof. Pearson's original intention in introducing the term 'goodness of fit', and in publishing a table of the distribution of χ^2 (the theoretical form of which had been previously determined by Helmert in 1875), it is certain that the interest of statistical tests for scientific workers depends entirely from their use in rejecting hypotheses which are thereby judged to be incompatible with the observations.

It is certain, too, from many passages which could be cited from Prof. Pearson's own writings, that he has himself used the χ^2 test, not only in connexion with the graduation of frequency curves, but also as a means of testing the truth of theories or hypotheses. As one example, I may mention an appendix of five pages entitled "On the Test of Goodness of Fit of Observation to Theory in Mendelian Experiments" (*Biometrica*, **9**, pp. 309–314). In this paper he insists very clearly, and quite in accordance with modern usage, taking the extreme case $P = 0$, that either the theory or the observations must be rejected.

Mr. Buchanan-Wollaston's point that the χ^2 test, like the other tests of significance, is cogent for the rejection of hypotheses, but, in the opposite case, by no means cogent for their acceptance, deserves to be widely appreciated. For the logical fallacy of believing that a hypothesis has been proved to be true, merely because it is not contradicted by the available facts, has no more right to insinuate itself in statistical than in other kinds of scientific reasoning. Yet it does so only too frequently. Indeed, the "error of accepting an hypothesis when it is false" has been specially named by some writers "errors of the second kind". It would, therefore, add greatly to the clarity with which the tests of significance are regarded if it were generally understood that tests of significance, when used accurately, are capable of rejecting or invalidating hypotheses, in so far as these are contradicted by the data; but that they are never capable of establishing them as certainly true. In fact that "errors of the second kind" are committed only by those who misunderstand the nature and application of tests of significance.

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South and East African Stone Age Typology

Two separate communications[1,2] this year on the archæology of South Africa bear indirectly on East African problems now being investigated in Uganda by this expedition.

In the first, Prof. Dreyer directs attention to the similarity that exists, in his opinion, between certain human skulls found in association with implements of Early Mossel Bay type, and those of Kanjera, Kenya. From the fact that these relics came from the base of a superficial black layer, he draws the conclusion that they are of post-Pleistocene age. Below the black layer is a red sand deposit which contains Late Stellenbosch implements (Acheulean cum Levalloisian) with which, in a shelter, Prof. Dreyer has also had the good fortune to find human remains. He makes the dubious assumption that if we regard the Middle Stellenbosch as being the culture of the same people "we at last come to the [man] more or less contemporaneous with Leakey's Kanjera man".

The uncertainty of the association of the Kanjera fragments[3] with the Chellean tools found in the same area precludes discussion of the relative ages of these two sets of human remains; but as Prof. Dreyer suggests that owing to the thickness of the beds at Kanjera, Leakey may have over-estimated their age, it should be noted that the East African Chellean forms part of a very long evolutionary sequence and that no late dating will satisfy the period of time required. Moreover, Middle Stellenbosch is not the same stage as the Chellean found at Kanjera, but several stages later. Actually, it is more akin to the East African Early Acheulean. In Uganda this stage marks the beginning of a large-core technique for the manufacture of *coups de poing* and cleavers, and many of the finished implements have inclined platforms very like the Clactonian, and simply due to the same sort of core technique for the detachment of flakes. Evidence is available in Uganda which suggests the presence here of a large flake culture, separate from, but contemporary with, the Chellean.

In the second communication, Prof. van Riet Lowe again directs attention to the use of a prepared core technique for the production of large flakes, afterwards trimmed into handaxes and cleavers of Upper Stellenbosch age, and deals, let us hope, the final blow to the Victoria West Mystery.

In Uganda, geological proof of the date of the Early Acheulean is more or less settled, and shows that the industry had begun when the Intrapluvial in Pluvial II (Wayland) started, and is the same as the stage near the top of the red Bed III, at Oldoway, which similarly marks the climatic break. This oscillation may be equated with that between the Kamasian and Gamblian pluvials—the evidence being based on the succession of types following the Early Acheulean in Kenya, at Oldoway and in Uganda.

Owing to the fact that the Upper Stellenbosch is followed by Lower Fauresmith (Late Acheulean cum Old Levalloisian), whereas in East Africa the Early Acheulean is followed by several stages which are, at first, free from Levalloisian influence, one is inclined to think that the presence of a core and flake technique in a *coup de poing milieu* of early date is not necessarily evidence of the appearance of proto-Levalloisian, but rather due to the tardy borrowing of a Clacton or other early flake technique, which was especially suited to the production of cleavers.

In East Africa, as in South Africa, the earliest appearance of the true Levalloisian (with tortoise cores and faceted striking platforms) as a contemporary of a *coup de poing* group was in Upper Acheulean times.

T. P. O'BRIEN.

African Prehistoric Research Expedition,
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Kampala, Uganda.

[1] NATURE, **135**, 620, April 20, 1935.
[2] NATURE, **136**, 53, July 13, 1935.
[3] NATURE, **135**, 371, March 9, 1935.

Emission of Positrons from a Thorium-Active Deposit

USING the magnetic focusing method, we have investigated the energy distribution of the positrons emitted by a source of thorium-active deposit. The positrons were registered by counting the coincidences they produce in two Geiger-Müller counters[1]. The source from which the positron emission was observed was an aluminium strip 10 μ thick activated with thorium B + C. The total number of positrons was about 0·02–0·03 per cent of the number of β-particles from thorium C + C″.

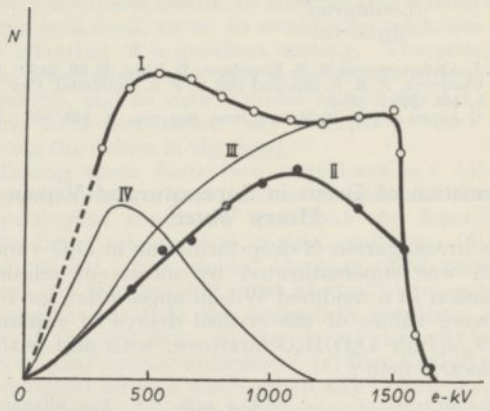

FIG. 1.

Chadwick, Blackett and Occhialini[2] inserted a weak preparation of thorium-active deposit in a cloud chamber, and observed a few (24) positron tracks issuing from the source. According to their data, the number of positrons was nearly 1 per cent of the number of β-particles, about 50 times the ratio we find in our experiments, but their statistical error was large. We have also compared the number of positrons emitted by the source with the number obtained by the process of materialisation of γ-rays from thorium C″. In this experiment the same source was surrounded by a lead shield 3 mm. thick; in this case the number of positrons measured was four to five times greater than with the source uncovered. In Fig. 1, curve I, the energy distribution curve of positrons emitted by the thorium-active deposit is given. For each point on this curve about 1,500 particles were counted, the statistical error being thus not greater than 3 per cent. The very abrupt fall of this curve near the end of the spectrum corresponding to the energy $h\nu - 2mc^2$ should be noticed. For comparison, we give a positron distribution curve, II, obtained by irradiating a lead strip 25 μ thick by the γ-rays from thorium C″. The asymmetry of this curve shows very clearly the effect of the nuclear field on the positive charge of the positron.

The very abrupt fall of the curve near the end of the spectrum ($h\nu - 2mc^2$) in the case of positrons from a thorium-active deposit is in good agreement with the theory of internal conversion of γ-rays on negative levels, worked out by Hulme and Jaeger[3]. In Fig. 1, curve III shows the theoretical curve for the conversion of the γ-line ($h\nu = 2{,}620$ ekv.) according to Hulme and Jaeger. The remaining portion (IV) of curve I, as we have already suggested in a similar connexion in the case of radium C, is probably to be ascribed to the effect of the β-radiation. If we separate in this way the effect of the γ-rays, we obtain for the probability of the internal conversion of the γ-rays of thorium C″ about $4{\cdot}5$–$5{\cdot}5 \times 10^{-4}$, close to the theoretical value of $4{\cdot}6 \times 10^{-4}$ given by Hulme and Jaeger. The remaining number of positrons, which we ascribe to the effect of β-radiation, amounts to about one positron per 1×10^4 disintegrating atoms of thorium C and C″. More accurate measurements with radium C showed that for the positron yield a value of 0·02–0·03 is to be accepted.

A. I. ALICHANOW.
A. I. ALICHANIAN.
M. S. KOSODAEW.

Physico-Technical Institute,
Leningrad.
June 16.

[1] A. I. Alichanow und M. S. Kosodaew, *Z. Phys.*, B, **90**, 249; 1934.
[2] J. Chadwick, P. M. S. Blackett and G. P. S. Occhialini, *Proc. Roy. Soc.*, A, **144**, 235; 1934.
[3] J. C. Jaeger and H. R. Hulme, *Proc. Roy. Soc.*, A, **148**, 708; 1935.

Formation of Drops in Supersaturated Vapour of Heavy Water

AN investigation of drop-formation in D_2O vapour, which was supersaturated by means of adiabatic expansion in a modified Wilson apparatus[1], gave the following values of the critical degree of expansion ($E = v_2/v_1$) for D_2O/H_2O mixtures, with and without an electric field:

Mol per cent D_2O	$T_{abs.}$	$E_{crit.}$ with electric field	$E_{crit.}$ without electric field
99	289·5	1·252 ± 0·003	1·230 ± 0·002
43	288·5	1·262 ± 0·003	1·240 ± 0·003
0	289·0	1·276	1·248

$T_{abs.}$ is the temperature of the vapour before expansion.

From the figures, the critical supersaturation of D_2O vapour at $T_{abs.} = 264$ was calculated to be 4·5, whereas the corresponding value of H_2O was 4·8. The result is quantitatively not in full agreement with Volmer's theory of formation of nuclei, which has been proved to hold good for a number of substances. According to Selwood and Frost[2] the surface tension of heavy water should be 5 dynes/cm. lower than that of normal water, and thus after Volmer the critical supersaturation of D_2O at $T_{abs.} = 264$ should be 4·2.

This slight discrepancy might be due to an error in the surface tension value of heavy water (too low), and this point is to be further investigated.

The large quantity of heavy water needed for the present investigation was provided by Norsk Hydro-Elektrisk Kvælstof A/S.

L. TRONSTAD.
H. FLOOD.

Technical University of Norway,
Trondhjem.

[1] M. Volmer und H. Flood, *Z. phys. Chem.*, A, **170**, 273; 1934.
[2] P. W. Selwood and A. A. Frost, *J. Amer. Chem. Soc.*, **55**, 4335; 1933.

Isotopic Constitution of Gold from Band-Spectroscopic Examination

PROF. A. J. DEMPSTER has recently announced[1] his mass-spectrographic result on the suspected gold isotopes Au^{197} and Au^{199}, using his newly designed positive ion source, and his results point to the non-existence of Au^{199}.

For several years I have made many exposures of the AuH violet $^1\Sigma \rightarrow {}^1\Sigma$ band system in the hope of detecting Au^{199} by this method, using a 25-plate reflecting echelon, a quartz Lummer plate or a 40-plate transmission echelon. The resolving power should be adequate to separate the two isotope lines if the ratio of Au^{199} to Au^{197} existed approximately in the ratio of 1 : 8·3 (or 1 : 7·0, if the atomic weight is recalculated on the $O^{16} = 16$ scale), as expected from the accepted chemical atomic weight of gold, namely, 197·21, and also if the two AuH molecules behaved normally, that is, had no appreciable electronic isotope effect compared with the already very small vibrational plus rotational effect (usually smaller than 0·05 $cm.^{-1}$). On none of the plates, on which the main line is strongly over-exposed, has the satellite been recorded, in agreement with Dempster's result.

Details of this work with photographs will be published in the Institute's *Scientific Papers*.

SUNAO IMANISHI.

Institute of Physical and Chemical Research,
Komagome, Hongo, Tokyo.
Aug. 12.

[1] A. J. Dempster, NATURE, **136**, 65, July 13, 1935.

Mechanism of Three-Carbon Tautomerism

WITH the object of throwing light on the mechanism of three-carbon tautomerism, we have studied the equilibration of vinylacetic and crotonic acids in the presence of 1·05 mols of sodium hydroxide in dilute 'heavy water' at 100° C. As a check, we have also examined the behaviour of butyric acid under the same conditions. The isotopic ratio in both the recovered solvent and the water obtained by combustion of the residual sodium salts has been determined by a flotation method accurate to one part per million of density; the necessary purifications were carried out without loss of water, thus avoiding the possibility of isotopic fractionation.

The results are summarised in the following table, in gm. of D_2O, calculated from the experimental density values and theoretical yields of solvent and combustion water respectively.

Acid	Original solvent	Final solvent		Combustion water	
		Found	Calcd.	Found	Calcd.
Butyric	0·6533	0·6542	0·6533	0·0001	0
Crotonic	0·8704	0·8658	0·8704	0·0002	0
Vinylacetic	0·8704	0·8613	0·8631	0·0068	0·0073

It is evident that whilst there was no detectable interchange with butyric and crotonic acids, substantial interchange occurred in the case of vinylacetic acid. The theoretical values in the latter case (corresponding to the interchange of one atom) have been calculated on the assumption that no isotopic discrimination occurs in the interchange reaction. This assumption is not necessarily valid (cf. A. Farkas, "Orthohydrogen, Parahydrogen and Heavy Hydrogen", Cambridge University Press, 1935, p. 200) and it is proposed, in extending the

work on interchange reactions of this type, to treat this aspect quantitatively.

Our results indicate, however, that there is a parallelism between isotopic interchange and isomerisation. Of the various mechanisms which have been proposed for three-carbon tautomerism, those representing the change as purely intramolecular appear to be unacceptable. Further discrimination between intermolecular mechanisms must await evaluation of the equilibrium constant of the exchange reaction; this work is actively in hand.

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H. N. RYDON.

Imperial College, London, S.W.7.

Aug. 21.

Fertilisation of Successive Broods of *Gammarus chevreuxi*

IN a letter in NATURE of May 18, p. 832, an account was given by Mr. K. W. Yarnold of some breeding experiments with red-eyed animals of a new stock (1933) of *Gammarus chevreuxi*, Sexton, crossed with the red-eyed Stock II (1922). Both these stocks originated in the Marine Biological Laboratory, and have always given red-eyed young when bred *inter se*, or when crossed with each other.

Mr. Yarnold, however, records an instance of a single black-eyed appearing in the offspring from a mating of two red-eyed (new red × Stock II red), the female of which had been previously mated with a black-eyed male. His explanation is "that some of the sperms from the previous mate of the female had remained behind and fertilised one or more of the eggs, causing the appearance of a heterozygous black-eyed specimen—not an unusual phenomenon in *Gammarus*".

It seems to me that if this explanation were correct, the parentage of the offspring from any cross-mating would always be in doubt, and the genetical work done on *Gammarus chevreuxi* would have no value. In my own experience—and I have worked on this species for twenty-three years—I have never had a single instance of this carrying over of sperm from one mating to the next in the many hundreds of similar cross-matings made, and I think that a study of the structure of the animals and of their mating habits proves conclusively that such an occurrence is impossible.

The female *Gammarus chevreuxi* has an external incubatory pouch made up of four pairs of brood-plates or lamellæ attached to the ventral surface of the 2nd, 3rd, 4th and 5th peræon-segments. The oviducts, one each side, open into the pouch on the ventral surface of the 5th segment. The pouch is held together when in use by long flexible hairs, and is open at both ends, where the lamellæ are separated by the width of the body. A constant steady stream of water is beaten through it from behind forwards by the pleopods, which serves to keep the eggs aerated and to remove all extraneous matter, for example, eggs which are not fertilised macerate, and are swept away by this current.

The cuticle, of hard unyielding chitin, is continuous over the entire body surface. This hard skin has to be sloughed off before the female can mate, and mating can only take place directly after the moult while the new skin is soft and elastic enough to permit of the passage of the eggs through the oviduct apertures into the pouch.

In moulting, the cuticle cracks across the *dorsum* just behind and around the head, and the animal heaves itself up and draws out backwards, leaving the old skin unbroken on the ventral surface. The moults are always perfect to the last detail in healthy specimens but, unless carefully watched for, they are very rarely seen in this condition owing to the habit amphipods have of devouring their cast skins immediately after ecdysis.

Sickly animals have great difficulty in moulting, and an incomplete or imperfect moult always ends in death, but sickly animals do not breed. I have never seen a healthy *Gammarus* pair with an unhealthy one; it may take hold of it, but only for the purpose of killing and eating it, never for breeding.

Fertilisation takes place outside the body. The male, which has paired with and carried the female for some days, assists her in moulting, and then it ejects the sperm into the open pouch. The female commences to extrude the eggs, and as she does so, she breaks free and resists any further mating. No pairing, even, takes place until she is once more in the right physiological condition, and no mating again without a complete moult.

We have made it a rule here, in all cross-matings, after the females moult, to give the pair a fresh bowl, water and food, so as to avoid any confusion with the offspring of a previous mating. The young are semi-transparent and only a millimetre in length on hatching, and as their instinct is to keep out of the light, it is sometimes very difficult to find them among the debris in the bowl.

Taking these facts into consideration: (*a*) that the animals never pair until the female is in the right physiological condition, and that the female will resist being taken unless in this condition; (*b*) that, once paired, they remain together until mating is over; (*c*) that mating must always be preceded by a moult; (*d*) that the animal in moulting comes out of the old skin, on the dorsal surface, leaving the ventral surface unbroken; (*e*) that the old pouch is sloughed off as a whole (with any young that may still be in it); (*f*) that fertilisation takes place in the open pouch; (*g*) that the sperm of the new mating is ejected into the new pouch; and (*h*) that a steady current of water is driven through the pouch from end to end during the whole period of incubation, I think it is evident that some other explanation than the one given by Mr. Yarnold for the appearance of a black-eyed young in his red-eyed cultures must be looked for.

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Plymouth.
Aug. 16.

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J. Mar. Biol. Assoc., **9**, No. 4, 550; 1913. **11**, No. 1, 19; 1916. **15**, No. 1, 41; 1928.

Distribution of Nematodes in the Small Intestine of the Sheep

IN the course of ecological studies on the nematodes of the small intestine of sheep, particularly during their parasitic existence, it has become apparent that the manner of their distribution throws light upon the relation between host and parasite.

The jejenum is the favoured region of infection of species naturally occurring in sheep; those of any one genus share a common area, while species of different genera vary in the degree to which their infections overlap.

In healthy sheep the species: *Cooperia curticei*, *Nematodirus filicollis*, *N. spathiger*, *Strongyloides papillosus*, *Trichostrongylus colubriformis*, *T. vitrinus*, have each a normal frequency distribution which retains its identity throughout the period of infection; probably other species normally parasitic in sheep have a similar form of distribution. The position of the peak numbers of each species may vary in different animals, but its relation to those of other species in mixed infections is constant. For example, the peak of infection of *N. filicollis* always occurs at a shorter distance from the abomasum than that of *N. spathiger*, while those of species of different genera tend to array themselves along the intestine in the following order: (1) *Trichostrongylus*, (2) *Strongyloides*, (3) *Nematodirus*, (4) *Cooperia*. With increase of the distance of peak numbers from the abomasum there is a correlated increase in the area of distribution of the greater numbers of a species. Generic differences in this connexion are marked.

From the constancy of the form of distribution in sheep of various ages, under various conditions, at different times of the day and at different seasons, it is concluded that:

(1) Neither active nor passive migration on the part of adult worms takes place.

(2) The site of infection is determined during the larval stage.

(3) The stimuli causing larvæ to take up their station are present in the contents of the small intestine, and arise in the duodenum at the point of entrance of the bile and pancreatic juice.

(4) Specific differences in distribution are due to inherent dissimilarities in rates of reaction to the stimuli.

(5) *Trichostrongylus* spp. respond to stimuli in the abomasum as well as in the jejenum. *T. axei* is sensitive to these, but *T. colubriformis* and *T. vitrinus* are less so, with the result that the populations of the latter two species become divided between the abomasum and the small intestine. Other species found in the small intestine in their passage through the abomasum apparently do not remain there long enough to enable stimuli to have effect upon them.

There is evidence that in unhealthy animals distribution is erratic.

C. oncophora, *C. punctata* and an unidentified third species of *Cooperis* are normally parasitic in cattle. In sheep they have an erratic distribution, and this, I believe, is an expression of their inadaptability to this host.

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Aug. 8.

Fibre Forms in Animal Hairs

UNDER the above title Mr. H. J. Woods[1] proposes three alternatives to the 'weathering' hypothesis tentatively advanced by me[2] to account for supernormal curvature in the apical region of certain guard hairs. Of the opposing evidence, it will suffice to point out that, in the light of a previous communication by Woods[3], the fibres should, if his views are correct, easily acquire permanent set. If the phenomenon is due to extensive oxidative degeneration, this should be impossible. Straightening the fibres and steaming under various strains for periods up to one hour, then releasing and re-steaming resulted only in further contraction. Moreover, differential super-contraction does not follow strain in saturated sodium bicarbonate solution, which has a considerably higher *p*H than the maximum recorded for suint.

However, Woods's suggestion that asymmetry of lateral bonding may exist is very interesting—at least, as a contributory factor—although there is no record of super-contraction being produced in chemically sound α-keratin by the action of steam alone. Structural asymmetry of some kind is probably a widespread phenomenon, occurring in sound as well as in damaged fibres. Experimental evidence in support of this view will appear in due course.

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[1] NATURE, **136**, 262, Aug. 17, 1935.
[2] NATURE, **136**, 28, July 6, 1935.
[3] NATURE, **132**, 709, Nov. 4, 1933.

Flying Fishes

DURING a voyage down the west coast of Africa, I have been watching the flying fishes, moved partly by vague recollections of the contradictory opinions that have been published regarding their flight. Without the literature I cannot make specific reference to the controversies, but a brief summary of what seem to me the most obvious facts about the 'flight' of flying fishes may be of interest.

(1) The motive power is the same in the air as in the sea: it is that of the tail-shaft musculature exerted through the tail against the water.

(2) The flight is usually started by a swift rush at a low angle up to and through the surface. But if this fails, for example, through jostling in a crowd, the fish is easily able to make a 'standing start' from the surface itself; a quivering vibration of the tail launches it almost instantaneously into full flight.

(3) The same manœuvre is regularly used to prolong the flight. At the end of the initial skim the fish often abruptly dives, but almost as often it dips the lower blade of the tail into the water instead and drives itself on for another stage. This may be repeated up to five or six times. It is perhaps the easiest thing to observe about the actions of a flying fish, and it is a never-failing surprise to see how short is the duration of the quivering dip and what a vigorous fresh impulse is derived from it.

(4) There is never the slightest sign of any impulse being derived from any other source. The fins during the flight are stiffly spread; they are used with great skill as planes, but never as wings.

(5) The flight is not a blind rush; while its way lasts, the fish can steer and turn up and down the waves and along them as gracefully as a petrel.

(6) The usual end of a flight is a sudden dive with shut 'wings'. But sometimes the dive is preceded by a sailing action with slightly up-tilted body and planes, like a seagull gliding to rest on the sea—one of the prettiest things a flying fish does.

(7) The flight is made at all angles to the wind, and in any wind from a calm to half a gale. Naturally the most difficult direction is down-wind, because the fish must push off at a considerably greater speed than that of the wind in order to rise at all. For the same reason a down-wind flight is made in a noticeably tilted-up position; it is in the nature of a prolonged sailing to rest.

(8) It is probably true that the fishes fly more freely in sunshine than in dull weather, but they do fly under an overcast sky as successfully as in sunshine. They are also known to fly at night, especially when they are disturbed by artificial light.

A good deal of unnecessary mystery seems to have been made about the flying fish's flight. The real mystery is the acquisition, by this one small group, of a fin and tail structure adapted to 'flight' and a singular adroitness in using it.

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July 27.

Structure of the Proboscis in Blood-sucking Diptera

WITH reference to Dr. B. Jobling's letter[1], I wish to point out that, as already mentioned[2], the hypothesis advanced by me concerning the feeding mechanism in blood-sucking diptera was of a tentative character, and that the object of my communication was not to generalise, but to report certain observations made by me on the feeding mechanism in one species of blood-sucking fly, namely, *Stomoxys calcitrans*. As a matter of fact, I have since carried out a large number of dissections upon specimens of several species of *Culicines* after feeding them on a strong solution of eosin sweetened with sugar, and while in a few instances no staining was found to have occurred in any part of the proboscis, in others it was the labrum-epipharynx that was found to have taken the stain along the whole of its length, indicating that the food-channel in insects of this class is probably formed by the apposition of the labrum-epipharynx and the hypopharynx.

As to the salivary duct in *S. calcitrans*, it terminates, as already mentioned, at the base of the hypopharynx, the lumen of the latter being a groove running centrally to near its tip.

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Aug. 20.

[1] NATURE, **136**, 145, July 27, 1935.
[2] NATURE, **135**, 915, June 1, 1935.

Points from Foregoing Letters

FEEDING experiments on animals, carried out by Dr. O. Rosenheim and T. A. Webster, have shown that the immediate precursor of faecal coprosterol is not cholesterol but cholestenone, arising presumably from a primary oxidation product, cholestene-diol. The possible role of cholestenone in the conversion by the animal body of cholesterol into bile acids and certain sexual hormones is discussed.

The interest of statistical tests for scientific workers, Prof. R. A. Fisher writes, lies in their use in rejecting certain hypotheses incompatible with observations. He agrees with Mr. Buchanan-Wollaston that the logical fallacy of believing a hypothesis to be true merely because it is not contradicted by the available facts, does frequently occur.

The type and succession of prehistoric stone implements (Chellean, Acheulean) found in East Africa (Uganda) are compared by T. P. O'Brien with those from South Africa, recently described by Prof. Dreyer and by Prof. van Riet Lowe, and their bearing on the geological age of Dr. L. S. B. Leakey's Kanjera man is critically discussed.

The number and energy distribution of positive electrons emitted by thorium-active deposit agrees with the view that the electrons are produced by the materialisation of γ-rays of thorium C″, according to measurements by Prof. A. I. Alichanow, A. I. Alichanian and M. S. Kosodaew. The graphs show a residual effect ascribed by the authors to the production of positrons accompanying negative electrons (β-radiation).

The critical supersaturation at which drops of heavy water are formed (by adiabatic expansion) has been determined by Dr. L. Tronstad and H. Flood. They point out that if the value obtained is to agree with Volmer's theory of the formation of nuclei, the surface tension of heavy water must be greater than that reported by Selwood and Frost. (H. Lachs and J. Minkow have actually reported, in NATURE of August 3, p. 186, a higher surface tension for heavy water.)

Spectrographic investigations by Dr. Sunao Imanishi of the violet bands of gold hydride indicate the absence of a gold isotope of mass 199; his findings are in agreement with the negative result obtained by Dempster with the mass-spectrograph.

Drs. D. J. G. Ives and H. N. Rydon, from the results of equilibration experiments in dilute 'heavy water', deduce that purely intramolecular mechanisms for three-carbon tautomerism are not acceptable.

To account for a black-eyed offspring of the freshwater shrimp *Gammarus chevreuxi* of two red-eyed parents, K. W. Yarnold assumed that some sperms from a previous black-eyed mate had remained behind and fertilised the new eggs. As such an occurrence would render doubtful all genetical work done with that species, Mrs. E. W. Sexton gives a full account of the mating habits of *Gammarus*, indicating that no such successive fertilisation can occur.

The location of various species of parasitic nematodes in the small intestine of the sheep has been investigated by J. H. Tetley. It is concluded that the site of infection is determined during the larval stage, and that the stimuli determining the position arise in the duodenum at the point of entrance of the bile and pancreatic juice.

Dr. R. O. Hall finds that straightening and steaming certain animal (guard) hairs with supernormal curvature at the tip results in further contraction. This evidence, he maintains, opposes the three alternatives put forward by H. J. Wood to the 'weathering' hypothesis suggested to account for the apical curvature of those hairs.

Observations on the flying fishes off the West African coast are reported by Dr. E. L. Gill. The fishes fly through the air by repeatedly dipping the lower blade of the tail in the water in order to propel themselves, using the fins as planes.

Research Items

Divine Kings in Southern Nigeria

AMONG the Umundri group of the Igbo of southern Nigeria, there are two divine kings who are the spiritual heads of the people, and occupy different towns in the Akwa District, Onitsha Province. Originally there was only one king, but dissensions arose and part of the town of Aguku seceded to found Oreri with its own divine king. The descendants of the royal family live at Aguku and claim descent from a sky-being, Eri, who was sent down by Chiuku, the sun-god. They call themselves Umundri and declare that they are not Igbo. The king is chosen from three, originally four, royal families and is usually a youngest son, whose choice must be accompanied by wonders and signs. The coronation ceremonies, which have been studied by Mr. M. W. D. Jeffreys, administrative officer (*Africa*, **8**, 3), have the twofold object of transforming a man into a god and of recreating the world. One condition must obtain invariably. Both the candidate's parents must be dead. Also he must make three prophecies which must be fulfilled. The ceremony opens with ritual death, burial and resurrection. The candidate remains buried for several hours and his tree of life is cut down and the usual sacrifices made. When the body is exhumed at sunset a banana-stem takes its place. The candidate's body is whitewashed with clay and water that he may fulfil the prayer that he shall rise with a vivid and shining body. He discards his ordinary clothes and thereafter wears only white or blue Igala ones. Copper greaves are put on his legs, but he goes barefoot. Henceforth he is a god, and his person sacred. His first wife, or queen, is also whitened and wears white garments. Together they begin a circumambulation, which occupies several months. On his return to Aguku, the king may never leave the royal city again. At the close of a year, before he ascends the throne, a ritual combat takes place in which he overcomes first a young and then an old man.

Amber in Palæolithic Times

AMBER, which becomes abundant in neolithic times, is rare on palæolithic sites. The first specimen of palæolithic age was found at Arensan (Pyrenées) and some fragments appeared at Isturitz, where also the Comte R. de Saint-Périer found a bead, the first find of a definite form. Some fragments have also been recorded on central European sites. The Comte de Saint-Périer now reports (*L'Anthropologie*, **45**, 3–4) the discovery in October 1934 of the first specimen of palæolithic sculpture in amber. It was found in the Isturitz cave in the middle of a stratum, of which the age had already been determined as lower Magdalenian. It was beneath another Magdalenian level, which itself was beneath a stalagmite sheet. There can be no question, therefore, of an intrusion. The character of the material was not at first recognised. It was thought to be ivory; and it was only some time after that it was suggested by the Abbé Breuil, when he saw the object in the laboratory, that it might be amber. This opinion was confirmed by tests applied in the laboratory of the Louvre. The sculpture represents the head of a horse, of which the anterior portion has suffered an ancient fracture. The head is massive in form, with a heavy mane; the neck, where it joins the head, is thick. The eyes, which are level with the surface of the head, are differently treated on either side. The musculature is well marked, especially on one side. The style is good and typically Magdalenian. The patination on one side is reddish-brown, and on the other yellowish-orange. Before this find, objects of art carved in amber were not known before the mesolithic, when animal figures appeared in Prussia and Scandinavia. Objects of neolithic age which have been found do not include animal figures.

An Ancient Aztec Herbal

THE Smithsonian Institution has published a pamphlet to make known the discovery of the Badianus Manuscript in the Vatican Library ("Concerning the Badianus Manuscript, an Aztec Herbal, 'Codex Barberini, Latin 241' (Vatican Library)", by Emily Walcott Emmart. Smithsonian Miscellaneous Collections, vol. 94, No. 2). This treatise—a herbal describing the various plants and other materials used in Aztec medical prescriptions—was the work of two Aztecs who were educated at the College of Santa Cruz, founded by the Spaniards in 1535. Composed originally in Aztec, it was immediately translated into Latin in 1552. The chief author appears to have been a certain Martin de la Cruz, the other was Juannes Badianus, the translator. The first chapter deals with head ailments; the second describes the treatment of sore and bloodshot eyes, cataract, fever and insomnia; the third is devoted to ear infections. Two interesting plants are described as cures for pain, which can be identified as being members of the *Datura* family. Besides the plants, various animal products, stones, earths and carbon, salts, 'bezoar stones', and others, were used in various concoctions. Facsimiles are given of the first and last pages of the Badianus Manuscript, and of the plate of the two plants of the *Datura* family. It is proposed to publish a facsimile of the full manuscript with its 91 colour plates should funds become available.

Alligator-Lizards in South-West America

A SYSTEMATIC study of the natural history of *Gerrhonotus* in south-western America (H. S. Fitch, *Trans. Acad. St. Louis*, **29**; 1935) describes the alligator-lizards as showing indications of learning and rapid habit-forming, ranking high among reptiles for intelligence. These wood inhabitants exist on a diet ranging from the larger insects to small mammals and birds' eggs; hibernation and viviparity vary with the climatic characteristics of the habitat. As a means of self-protection, they will encircle a tree-branch with their bodies, holding the tail firmly in their mouths, or discard their tails as a decoy to divert the attention of the snakes and hawks that prey upon them. The high percentage of regenerated tails suggests that this ruse is frequently successful. The alligator-lizards show practically no trace of social behaviour; mating occurs once annually at a definite season governed by locality and species.

Gill Formation in the Embryo of *Triturus*

In the earlier stages of the embryo of *Triturus*, gill formation can be effected by transplantation of any portion of the body surface, excepting the medullary plate; for self-differentiation of the surface tissue in this way, mesoderm appears to be essential for the formation of the gills (M. Ichikawa, *Mem. Coll. Sci., Kyoto Imp. Univ.*, Ser. B, 9; 1933). Transplantation of all three germ layers invariably causes perfect gills to develop, while if the endoderm is excluded in such grafting, gills are sometimes produced and sometimes not. As the embryo develops, the gill-forming faculty becomes increasingly restricted to the forward portions of the body; when the tail-bud appears, only the branchial ectoderm is capable of producing perfect gills, which have in all cases a definite polarity. The power of gill-production is now located solely in the proper position—the differentiated branchial ectoderm.

Colour Changes in the Eye of a Grasshopper

In 1916, Prof. Okazaki noticed that the eyes of a long-horned grasshopper (*Hexacentrus japonicus*) were jet black when he collected the insects one evening, but on the following day were golden yellow. Several other insects show a similar change, and Hajime Uchida has studied the changes in another long-horned grasshopper, *Homorocoryphus lineosus* (*J. Fac. Sci., Imp. Univ. Tokyo, Zoo.*, 3, 517; 1934). Surrounding the cone of each ommatidium are two principal pigment cells which change their position according to the intensity of the light. They contain black granules. Accessory pigment cells occupy the interspaces between ommatidia, and contain yellowish reflecting pigment granules. When the eye is exposed to light, the principal pigment cells and the granules within them retreat proximally, so that the apparent colour is due to the accessory cells. In the dark-adapted eye the principal cells entirely encircle the cone, pushing aside the accessory cells. When light-adapted insects are transferred to a dark room, the distal migration of pigment granules takes place very rapidly during the first twenty minutes, and thereafter slows down, so that the full dark-adapted condition is attained only after fifty minutes. In the reverse process, the rate of retreat of the black pigment granules in the principal pigment cells is proportional to the intensity of the light.

High Temperature Variations in Fungi

Dr. B. Barnes has shown that heating the spores of *Eurotium herbariorum* and *Botrytis cinerea* has induced relatively permanent variations in the morphology of these two species. He has now studied a third fungus, with similar results ("On Variation in *Thamnidium elegans*, Link, induced by the Action of High Temperatures", *Trans. Brit. Mycol. Soc.*, 19, Part 4, June 1935). Two separate variants were produced when spores were heated to 55° C. for two minutes, and another mutant appeared on heating to 70° C. for a similar period. Temperatures above 70° C. killed the spores. *Thamnidium elegans* is normally a fungus of stable character, and remains unaltered through several years of artificial culture. The variants produced by the lower temperature began to revert to the original form after three years of culture; but the other has remained permanent. Variations relate to the size of the spore-bearing head and prolificacy of spore production.

Secondary Spores of Polyporous Fungi

A short paper by S. R. Bose in *Phytopathology* (25, No. 4, 426–429, April 1935) traces the cytology of secondary spore formation in *Ganoderma*. Peculiar bodies which are really hyphal projections appear in the hymenium, between the normal basidia. The projections are at first binucleate, but the two nuclei quickly fuse, then split into a number of dark-staining bodies, which migrate to the apex of the protrusion. This swells to form the secondary spore, and the dark bodies afterwards reunite to form the spore nucleus. The paper mentions other Polyporaceous fungi which produce secondary spores, and discusses the effect of weather upon their appearance.

Identification of Australian Woods

Noteworthy contributions to this important, but difficult, problem are contained in two publications (Technical Papers Nos. 15 and 16; 1935) issued by the Council for Scientific and Industrial Research of Australia. The first, by W. E. Cohen, deals with the coloured species of *Eucalyptus*, and describes a series of simple chemical tests such as the determination of the alkalinity of the ash, extraction tests, colour- and turbidity-reactions between extracts of the wood in various solvents and ferric chloride, water, or potassium ferricyanide, and several specific chemical reactions of a similar nature. These tests have been combined to produce a systematic scheme of identification into which fall the 540 samples examined; these represent 37 species. The second paper, by H. E. Dadswell and A. M. Eckersley, is concerned with the remaining principal commercial Australian timbers, which are mainly pored woods (hardwoods). The scheme of identification evolved in this case is based principally on those macroscopic features which can be conveniently ascertained by means of a hand-lens, such as the nature of the pores, parenchyma, rays, gum ducts and ripple marks. These are supplemented in some cases by microscopical data, and in a few instances by chemical tests.

Geology of Northern Nevada

We have received from the United States Geological Survey, Bulletin 847—A, The Contact Mining District (Elko County, Northern Nevada) by F. C. Schrader. The district appears to consist of carboniferous rocks, mainly carboniferous limestone, intruded by a mass of grano-diorite with intrusive dykes of alaskite, andesite and other igneous rocks, the Palæozoic rocks being in places locally covered by Tertiary rocks, partly volcanic and partly stratified deposits. The ore deposits appear to be mainly distributed round the border of the grano-diorite, but are also associated with alaskite dykes. A large number of mines have been worked in this district, originally apparently for gold, but more recently for copper, which appears to be the main product, though none of the workings is very deep. Of course, with the low price of copper in recent years, operations have fallen off considerably.

Rock Salt in Road Construction

Secondary roads serving as connexions and feeders to the main highways are of two types, the 'floating surface' type and the soil stabilised type. The former is made by adding loose gravel or similar material to the road bed, the latter contains gravel

kept in place by a material containing clay which acts as a binder. The floating surface type requires almost constant maintenance as the loose material is cast about by the traffic. Unfortunately, clay expands and contracts between fairly wide limits when alternately damped and dried by rain, wind and sunshine. Untreated clay shrinks as it dries, and permits embedded material to form a floating surface. In *Roads and Streets* (U.S.A.) of August, the results of experiments on the effect of salt on clay, by Prof. H. Ries of Cornell University, are described. He finds that clay treated with salt shrinks much less than untreated clay and that it holds moisture much better. The rate of the capillary action of the soil moisture is slightly increased and this leads to the compaction of the soil producing greater density. Actual road construction in America during the last three years has proved the effectiveness in practice of rock salt for road stabilisation. It is not necessary to add salt to more than the top three inches of the road. The quantity of salt recommended varies from 8 tons per mile for a road 14 ft. wide to 12 tons per mile for a road 20 ft. wide. The amount of water required to produce the best compaction is more than sufficient to dissolve all of the salt. In dry weather a properly moistened surface 'sets up' in less than a day and requires little attention.

Research on Motor Vehicles

THE Research and Standardisation Committee of the Institution of Automobile Engineers has recently issued its fourth annual report. Two reports have been issued of the researches on cylinder wear, special attention being paid to the influence of various constituents in the lubricants used on the wear by abrasion and corrosion. The engine was run on medicinal paraffin to which various fatty acids were added. Much useful information was obtained in this way. A report of experiments on the wear and friction of brake linings has been issued, and gives the results of experiments on twenty-two different materials. The rate of wear and the coefficient of friction was found over a temperature range of 100°–400° C. Many manufacturers are urging the importance of carrying out further experiments on 'brake squeak', as definite information concerning its origin is lacking. It is interesting to notice that the results of the tests are improving the durability and performance of the vehicles. The vehicle operators therefore get the main benefit from these researches.

Ignition of Firedamp by Compression

WE have received from the Safety in Mines Research Board, Paper No. 93; not only is this paper interesting in itself, but it derives further interest from the fact that it is one of the last pieces of work done by the late Prof. H. B. Dixon (Mines Department: Safety in Mines Research Board. Paper No. 93: The Ignition of Firedamp by Compression. By the late H. B. Dixon and J. Harwood. Pp. 23. London: H.M. Stationery Office. 6*d*. net). The paper describes a series of laboratory tests, carried out with an appliance designed for the purpose, of the ignition temperatures and ignition pressures of various combustible gases together with air, mixtures of methane and air being, of course, the most important for the purpose of the Safety in Mines Research Board. It was found that a wide range of mixtures between 2 and 75 per cent of methane could be ignited, but that mixtures containing between 7 and 7·5 per cent of methane had the lowest ignition temperatures when compressed, the pressure being about 20 atmospheres and the temperature being about 450° C., whilst mixtures of firedamp and air containing less than 5 per cent or more than 14 per cent of methane cannot be ignited in the ordinary way. It was further found that in order to ignite mixtures of methane and air, containing 7–10 per cent of methane with air at ordinary pressures, this mixture could easily be ignited when the hole in the end of the pressure piece of the apparatus was about 2·25 mm. in diameter; when larger holes than these were used, copper discs of varying thickness, through which a hole was blown by the operation itself, were found capable of igniting the methane-air mixtures. It is obvious that these experiments can, as indicated by a paper of Dr. Wheeler's, have certain results in practice, but the paper itself does not indicate the practical application of the results obtained experimentally.

Mandelic Acid in Urinary Infections

THE use of the so-called 'ketogenic' diet in the treatment of certain urinary infections is now well established. Mandelic acid has recently been shown to serve as a useful substitute. The acid has now been put on the market (NATURE, Sept. 7, p. 401). As supplied by the British Drug Houses, Ltd., London, N.1, the daily dose recommended is 12 gm. The acid is issued in the form of 3 gm. tablets, each containing also 1·6 gm. sodium bicarbonate, to neutralise the acid, and flavoured. One tablet should be taken after each meal dissolved in two tablespoonfuls (one fluid ounce) of water. As the acid exerts its bacteriostatic effect only in an acid urine, it is also necessary to give a drug which will keep the acidity of the urine at or below *p*H 5·3. For this purpose, ammonium chloride is recommended, and two 1 gm. capsules should be taken four times a day after the mandelic acid. The *p*H of the urine is conveniently tested with methyl red, a slightly pink colour indicating a *p*H of 5·3 or slightly less. The British Drug Houses, Ltd., issues a special outfit for the treatment, including mandelic acid tablets, ammonium chloride capsules and the indicator.

Photometry of Nebulæ

THE first of a series of studies of extra-galactic nebulæ by P. C. Keenan (*Astrophys. J.*, 82, 62) describes the method in use at the Yerkes Observatory for measuring the total magnitudes of nebulæ by comparisons of extra-focal images. This work forms part of a co-operative survey of nebulæ organised by the International Astronomical Union under the leadership of Dr. Hubble, of the Mount Wilson Observatory. The zone assigned to the Yerkes Observatory being from + 50° to the North Pole renders it possible to make direct comparisons with stars of the North Polar Sequence. Nebular images only slightly out of focus are used (the total blackening of the plate being measured), and the most serious source of error is the irregularity in the shapes of the images. Corrections are applied for differential atmospheric extinction and for size of image, the probable errors of the resulting magnitudes being about ± 0·06. During the progress of this work, a number of hitherto uncatalogued nebulæ were discovered. A list of thirty-two of these, with their positions and magnitudes, is given at the end of the paper.

Hearing and Aids to Hearing

DURING the discussion on "Hearing and Hearing Aids" held by Sections J (Psychology) and I (Physiology) of the British Association in Norwich on September 5, the major point considered was the effect of intense stimuli upon the performance of normal and deaf ears. The matter was approached from two points of view; of the increase of intelligibility of speech, when amplified, for partially deaf patients, and of the effect of listening to loud pure tones upon the acuity of pure tone hearing in both normal and partially deaf ears.

Dr. A. W. G. Ewing and Mr. T. S. Littler, of the Department of Education of the Deaf, University of Manchester, first described the apparatus which they are using for investigating the first of these points. This consists of a microphone and amplifier situated in a small sound-proofed room. The output of the amplifier passes via a decibel attenuator to the reproducing system. In this way, the intensity of the sound applied to the observer's ear by speaking into the microphone can be varied at will from a subnormal loudness to one of 110 decibels above the normal threshold. The power-level reached at any moment can be read from an output meter connected in the outgoing power-line.

Dr. Ewing then dealt with the effect of amplifying speech by these means upon its intelligibility for partially deaf observers. He showed, for example, that out of eight such observers, for five the intelligibility could reach 100 per cent. Of these five, two required an intensity level of 110 decibels, and the remainder required 70–90 decibels. In a control experiment upon normal subjects, 100 per cent intelligibility could not be achieved with loudnesses greater than 70 decibels; the intelligibility tests employed were of normal speech one foot from the microphone, and of 20 consonant sounds specially chosen.

Whilst it is clear that the number of observers used is too small to permit of any generalisation with regard to the deaf population as a whole, it is none the less a remarkable fact that more than half of these cases were enabled to hear speech, under amplified conditions, almost perfectly. Dr. Ewing stressed the fact that these results were obtained under laboratory conditions—it is clearly unlikely that so favourable an effect would be found when using any of the easily portable aids to hearing at present available. It must also be stressed that in these experiments, background noise, so evident when using a normal hearing aid, where it arises from defects inherent in the apparatus itself as well as from the more important source of the extraneous noise present in any normal environment, has been reduced to a minimum. The installation of the microphone in a sound-proof room, to take but one example of special precautions, would clearly be quite out of the question with a portable deaf-aid.

In the discussion at the end of the meeting Major Tucker, of the R.A.F. Research Establishment, Biggin Hill, raised an interesting point with reference to this paper. When listening to speech at very high intensities, he pointed out, the intelligibility is often lowered by masking of high-frequency (consonant) sounds by low-frequency (vowel) sounds. He suggested the possibility of increasing the intelligibility of much amplified speech by the introduction of suitable high-pass filters into the system. He pointed out that at least an experiment on these lines might be worth trying. Mrs. Ewing disagreed about the desirability of doing this, on the grounds that it might lead to distortion of a partially deaf child's speech. Mr. Littler also disagreed, on the grounds, among others, that if low tones are led to one ear and high tones to the other, a peculiar sensation that the sound is spinning round the head was sometimes experienced.

In his paper, Mr. A. F. Rawdon-Smith discussed somewhat different aspects of deafness. He described an apparatus, installed in the Psychological Laboratory, University of Cambridge, with which it is possible to produce very pure tones of great and controllable intensity, and of frequencies throughout almost the whole of the auditory spectrum. The apparatus is used for investigating the phenomena of experimental deafness, and consists of a beat-tone oscillator, amplifiers and attenuators, together with subsidiary frequency checking and monitoring apparatus; sinusoidal voltages from this equipment are led to a moving-coil ear-piece, situated in a highly sound-proof room. With this equipment, the modification of the normal audiogram by listening to intense pure tones for periods up to five minutes has been investigated. If sufficiently intense, such tones lead to a very considerable, though temporary, loss of acuity. Mr. Rawdon-Smith demonstrated that this acuity loss is not confined to the single ear stimulated—on many occasions a loss of acuity almost as great has been found in the ear nominally unstimulated. This, together with the fact that the losses in both ears may sometimes be temporarily removed or lessened by subjecting the observer to an unexpected stimulus, such as momentarily switching off the lights in the sound-proof room, has led him to the conclusion that these losses, usually referred to as being due to auditory fatigue, are partly of cortical mediation. Undoubtedly, peripheral fatigue losses do occur also, as it is possible to show that, in the mammalian ear preparation, using Davis and Saul's method of recording the electrical activity of the auditory mid-brain, a peripheral sensitivity loss occurs; this has been found using the mid-brain action potential (not to be confused with the Wever and Bray (cochlear) effect) as an index of auditory function. The phenomenon of experimental deafness can be regarded, therefore, as of dual origin—in part peripheral, which may be termed auditory fatigue, and in greater part of cortical mediation, for which auditory inhibition is the preferred terminology.

At the end of his paper, Dr. Ewing produced interesting evidence that such partially deaf patients as he has tested are immune from either of these effects; in short, the production of temporarily increased deafness in the already deaf, by listening to loud pure tones or to much amplified speech, even for relatively long periods of time, is impossible.

It is regretted that exigencies of space do not permit of a more detailed discussion of the remaining two papers. If the author has devoted overmuch

space to those already considered, it is only because he is necessarily more familiar with that material.

Dr. P. M. T. Kerridge dealt with the history and causes of deafness in London children in schools for the deaf. It is interesting to note from her analysis that, in the severely deaf group, almost half had been deaf from birth. Miss E. L. S. Ross discussed and analysed the results of an experiment in which a short story was read to two small groups of partially or severely deaf children, first without and secondly with an electrical aid of commercial manufacture. The children's reproductions of this story were marked according as they had, for example, grasped or missed the point, or understood or misunderstood the name of the central character. She showed that only with some of the children was a partial improvement of understanding secured by these means.

A. F. RAWDON-SMITH.

Ability, Opportunity and Social Status

IN a paper entitled "Ability and Educational Opportunity in Relation to Parental Occupation", which appears in the *Sociological Review* (27, No. 3, July 1935), J. L. Gray and Pearl Moshinsky bring forward evidence to show that the children of the less prosperous social classes lack the opportunity for higher education available to the equally able children of the financially prosperous classes. The investigation on which the evidence is based was carried out on nearly 9,000 children, between the ages of 9 years and 12 years 6 months, drawn from primary, post-primary (including central), grant-aided secondary, private, and preparatory schools in the London area, during the year 1933–34. Individual ability was assessed by the Otis Advanced Group Intelligence Test (Form *A*), and each child was questioned individually regarding parental occupation.

The authors point out that every attempt at morphological classification in social orders presupposes a social philosophy and a knowledge of the causes of social differentiation. The classification finally adopted by them represents a compromise between several current systems. The basis of group differences is taken as the nature of the work performed, but is modified "where it seemed advisable" by combination with differences in average income and in social status: the six main groups thus obtained are relatively homogeneous. They are: (*A*) Employing and Directive Classes; (*B*) Professional Classes; (*C*) Minor Professional and Other Highly Skilled Occupations; (*D*) Clerical and Commercial Employees; (*E*) Manual Workers; and (*F*) Miscellaneous Workers and Unknown Occupations.

The significant differences in educational opportunity between these socio-economic categories, revealed by the final analysis, certainly confirm the authors' belief that the groups do constitute real socio-economic strata.

It is evident that this classification correlates to some extent both with parental intelligence and with nurtural and environmental factors in the life of the child. The acceptance of the genetic evidence that highly intelligent parents tend to produce highly intelligent children, or the acceptance of the doctrine that nurture is the dominant factor in intellectual development, leads to the expectation of a small positive correlation between the intelligence of the child population examined and the parental socio-economic status. The value found by the authors is $0{\cdot}25 \pm 0{\cdot}008$, a value which is, however, too small to be used diagnostically. This value compares favourably with the value 0·28 found by Duff and Thompson* in an investigation of the parallel problem in Northumberland ten years ago. As the authors state (but not only for the reasons quoted) it is unwarranted to assert, by reason of the existence of the positive correlation, that intelligence is causally related to parental socio-economic status.

Some of the results of the primary analysis deserve special reference:

(1) In all cases, the children of teachers of every kind exceed the mean of the social group of highest intelligence. This is, perhaps, not surprising in view of the construction of the test used to obtain differentiæ.

(2) The children of the 'larger business owners and higher executives group' are significantly inferior in mean intelligence to those of the professional classes. Nearly every other investigator has arrived at this conclusion.

(3) It is probable that children of manual workers engaged in the newer industries, where, for example, considerable mechanical ability is demanded, are superior in mean intelligence to those of all manual workers.

(4) The children of unskilled workers form a remarkably homogeneous group.

In the ultimate analysis of their material, the authors make a comparative study of the distribution among the various social orders of the opportunity for higher education and of the corresponding distribution of high ability, that is, ability to benefit from higher education, the lower level being taken at 130 *I.Q.* on the Otis scale or 120 *I.B.* (Index of Brightness) on the authors' scale. As a source of children of high ability, the 'manual workers group' is the largest numerically, although it contains the smallest percentage of able children within the group. Thus, 58 per cent of the children of the 'professional classes group' possess ability, and 23 per cent of the children of 'manual workers group' are equally able; but in terms of the ratio of able children in the group to the total of all able children, these figures are 5 per cent and 50 per cent.

The discrepancies between ability and opportunity are shown by the following figures: 95 per cent of the able children of the 'professional classes group' have the opportunity for higher education; 48 per cent of the able children of the 'clerical and commercial employees group' have the same opportunity; only 25 per cent of the able children of the 'manual workers group' receive the same facilities. Opportunity for higher education is wasted most by the children of the 'larger business owners and higher executives' and of the 'professional classes groups'. There are 49 per cent of the former and 35 per cent of the latter, in each group, with opportunity but

* *Brit. J. Psychol.*, **14**, Pt. 2; 1924.

without ability. In the case of children selected by competitive examination at the age of 11 plus, only 1·0 per cent have the opportunity for higher education without having the ability to benefit by it.

These figures reveal striking differences between the educational opportunities available for children of equal ability but of parents of different social status; and these differences are inherent in the present social system. That is to say, they belong to nurture and not to nature. It might be added, in comment, that the validity of these results depends on the extent to which the intelligence test measures the ability of the child to benefit from the higher education of the type provided in secondary schools. This is a matter which some educationists would be prepared to debate. W. F. FLOYD.

Tell el-Amarna, 1934-5

AN exhibition of finds from Tell el-Amarna, results of the Egypt Exploration Society's expedition during the season 1934–5, opened at the rooms of the Palestine Exploration Fund, 2, Hinde Street, London, W.1, on September 16, and will remain on view until October 12. Further progress has been made in the excavation of the Royal Palace. Its total length has not yet been ascertained, as exploration has not proceeded beyond the modern road, but it is expected that it will fall not far short of a kilometre.

Operations of the season concentrated on the great hall at the south end of the building, the harem quarter, and the state approach, paved with plaster, which runs on the western side of the harem to the 'Broad Hall'. Advantage was also taken of an opportunity to make a record in tracings and photographs of the sculptured reliefs in the Royal Tomb, which lies in a valley about four miles away. This is the burial place of the young Princess Maketaten, one of the daughters of Akhenaten (1387–70 B.C.), religious reformer and builder of Tell el-Amarna. No complete record of these reliefs has been made before, and owing to the fitting of a new doorway, the opportunity will not recur. The drawings from the tracings have not yet been completed; but the series of photographs, which show the representations of intimate scenes of mourning, including a visit of the Royal Family to the temple, forms part of the exhibit of plans and photographs, which illustrate the progress of the excavations and the character and extent of the building.

Although the finds of the season included several of striking interest, the total number of exhibits is not large. This is due to the fact that a large amount of the expedition's time was absorbed by the deep digging necessitated in the area of the approach way to the 'Broad Hall'. Here a large building, called the 'Shining of the Aten', and part of the approach had been demolished early in the reign of Akhenaten. The whole area had then been filled in with sand to a depth of ten feet and levelled to form a parade ground.

In this filling were found many fragments of the sculpture of the original building, which could not be used elsewhere. Hence the sculptures have preserved all their freshness. Among the selection shown are some singularly striking examples of graphic representation, such as, in particular, spirited horses, soldiers and servants bowing, a fine royal head, and two heads with arrogant expression, here labelled 'priests'. The approach way itself has yielded thousands of fragments of the rows of huge granite and quartzite statues with which it was adorned. These were systematically broken up at the time of the destruction of the city after the death of Akhenaten and the overthrow of his reformed religion.

In the harem quarter, with its garden surrounded by a colonnade carved with festoons of birds, one of the most notable finds was the model of a fish in gold plate, which may have formed a part of the decoration of a formal pond, or have been a royal toy. It is shown only by a photograph, the original remaining in Cairo. One of the most interesting portions of the Palace as yet explored is the great hall at the south end of the building. Its vast roof was supported by a forest of brick piers, and it was decorated with faience tiles. Complete examples of these are now shown for the first time. They show naturalistic flower designs with white daisies in faience inlaid. It is hoped that it may be possible to complete the excavation of the Palace in the coming season. This, however, must depend entirely upon the extent to which further financial assistance towards the cost of excavation can be obtained from subscription by the public.

The Bihar Earthquake of 1934

SOON after the occurrence of this great earthquake on January 15, Dr. J. A. Dunn and three assistants were sent to the areas chiefly affected. A preliminary report on the earthquake by Messrs. J. B. Auden and A. M. N. Ghosh has recently been published (*Rec. India Geol. Surv.*, **68**, 177–239; 1935). A brief report has also been written by Mr. N. Nasu (*Bull. Earthq. Res. Inst.*, **13**, 417–432; 1935), who spent seven weeks during the following summer in the central district.

Owing to the occurrence of the earthquake at about 2.13 p.m., the loss of life was much less than might have been expected from the damage to property. Including Nepal, more than 10,000 lives were lost, mainly in the crowded towns of Monghyr, Muzaffarpur and the Nepal valley. The isoseismal of highest

intensity (10, Mercalli scale) covers three tracts. The largest is bounded by an ellipse about 80 miles long from east of Motihari to Madhubani and about 20 miles wide. Two much smaller areas lie near Katmandu and at Monghyr, the total area enclosed within the isoseismal being 1,300 sq. miles. Important destruction to property was confined within an area of 31,000 sq. miles. The shock was felt near Madras, at Dharwar and, according to pilgrims, at Lhasa. At about the same time, a shock was felt in the extreme south-west of India, but this was not directly connected with the Bihar earthquake. The total disturbed area was about 1,900,000 sq. miles.

Surface undulations were seen by a great number of observers. It is difficult at such a time to estimate the dimensions of these waves, but, according to one observer at Muzaffarpur, the distance from crest to crest was about 5 ft. and the height of the waves about 6 in. The maximum acceleration was determined at several places by means of West's formula, the highest figure given being 3,270 mm. per sec. per sec. at Monghyr. The corresponding amount for the Mino-Owari earthquake of 1891 was 4,300 mm. per sec. per sec. The amplitude of the movement was 12 in. at Muzaffarpur and 5·2 in. at Katmandu.

One of the most remarkable features of the earthquake is the wide area over which sand and water were ejected from fissures and vents. Indeed, it is doubtful if the area has been equalled in any other known earthquake, for it amounted to about 18,000 sq. miles within the isoseismal 8. As a rule, the rise of sand and water seems to have taken place after the main shock had subsided, sometimes by as much as several minutes. The greatest height reached by the spurts of water was 6–8 ft. In places, the surface was so completely riddled with sand-vents that small areas might be compared with boiling porridge. The closeness of the vents and the wide area covered by the sand suggest that its origin was at no great depth below the surface. According to Mr. Nasu, the deposit of sand was in most places thin, the depth exceeding one foot within an area of not more than 300 square miles.

The ejection of sand attained its maximum within and near what has been termed the *slump belt*. This is a band within the isoseismal 9, covering about 4,700 sq. miles in Bihar and also including portions of Nepal, in which houses were tilted rather than crumbled and the subsidence of the ground was marked. Two lines were re-levelled by the Survey of India, and it was found that the area of subsidence of one foot or more coincides approximately with the slump belt. It may be a zone in which the alluvium was shaken down by the earthquake to a slightly lower level.

The epicentral area enclosed within the main portion of the isoseismal 10 lies about 50 miles to the south of the main boundary fault. Whatever movement, if any, occurred along this thrust plane below the surface, no signs of displacement were detected at its outcrop. It seems probable, therefore, that the movements responsible for the earthquake originated some distance to the south of the boundary fault and along thrust planes that are now concealed by the Gangetic alluvium. The two detached portions of the isoseismal 10 about Katmandu and Monghyr may be due to displacements relieving subsidiary zones of strains in these two areas.

C. D.

Science News a Century Ago

J. D. Forbes on the Puy de Dôme

On September 22, 1835, J. D. Forbes wrote to his sister: "Clermont seems to me the most pleasantly situated of all the large towns of France which I have seen. It is perched upon an eminence rising from an extensive and fertile plain, which forms a sort of bay amongst the hills which surround it for two-thirds of the horizon. These hills are, for the most part, connected with a plateau or table-land of granite, from which the volcanoes rise; and of these, the Puy de Dôme, the highest and most noted, is conspicuous from Clermont, being about the distance of the nearest Pentlands from Edinburgh, and greatly resembling some of them in shape. . . . The Puy de Dôme was the first mountain up which a barometer was carried, at the suggestion of the famous Pascal, and I ascended it fully as much in reverence for his memory as on any other account. He was a most remarkable man; and as he was a native of this place, I hoped to have obtained some new particulars about him, but in this I have failed".

Cost of University Education

In a letter to *The Times* dated September 22, 1825, "Justus" said: "I am a great admirer of our old Universities and consequently I am anxious that a misrepresentation which is abroad should no longer be unnoticed—I mean an impression relating to the expenses of education there. The charges for what actually constitutes the education are £2 10s. per term or £7 10s. per annum at Cambridge. This charge comprises all the fees, which at the London colleges amount to £21 at the least, to say nothing of the necessarily superior education which may be obtained at the former arising from greater competition, access to the libraries (in which advantage London is very deficient), and those incentives to study which a better situation and greater quiet naturally generate. The expense of board and lodging are very moderate indeed; and I do not hesitate to assert that any young man may secure every advantage which those noble institutions can bestow at an expense of, at the very utmost, £30 per term, or £90 a year".

Naval Architecture in Great Britain

In 1832 Captain (afterwards Rear-Admiral Sir) William Symonds (1782–1856) was appointed to succeed Sir Robert Seppings (1767–1840) as surveyor of the Navy. He held the post for sixteen years, but often was criticised for his actions. On September 23, 1835, *The Times* said: "We have much satisfaction in announcing to the nation that the present disgraceful state of English naval architecture is likely to become the subject of a formal, and we trust, serious and candid inquiry in the next session of Parliament. Mr. G. F. Young has placed upon the order-book of the House of Commons the following notice of motion:—'That a select committee be appointed to inquire into the system at present adopted in the construction of ships for His Majesty's navy; to report how far that system is calculated to insure for the public service the advantages of scientific and practical knowledge of naval architecture, and of improvements in naval construction; and to suggest the best means for submitting to the test of impartial examination and fair competition

the relative qualities of ships constructed on the plans of different naval architects'. Such an investigation is most imperiously demanded, and it will be as important as it will be beneficial to the nation, if properly conducted and carried on without reference to the interests of individuals in office, but on the contrary, with an entire disregard to everything but the attainment of the truth. . . ."

Death of Antide Janvier (1751–1835)

ON September 23, 1835, Antide Janvier, one of the cleverest horologists of the eighteenth century, died in the Hôtel-Dieu in Paris at the age of eighty-four years. He was born on July 1, 1751 at St. Claude (Jura). From an early age, he showed remarkable mechanical skill, and, when still a youth, made a model representing the motion of the moon which Berthoud referred to in his "Histoire de la mesure du temps". At twenty years of age he constructed a fine planetarium. After spending some years at Verdun, where he married, in 1784 he went to Paris where Lalande recommended him for the post of horologer to the king, and where he met with encouragement from the Academy of Sciences. He was deprived of his emoluments during the Revolution, but after the Terror, he was placed in charge of a school of horology, and was well known as a successful teacher. In 1802, he was awarded a gold medal for an astronomical model declared to be the cleverest made during the eighteenth century. Devoted more to his art than to the making of money, his last days were passed in poverty. He published several works including a "Manuel chronométrique", 1810, and his "Recueil des machines composées et exécutées par Ant. Janvier", 1827. After his death, a subscription was opened to raise a monument to his memory.

Societies and Academies

PARIS

Academy of Sciences, July 29 (*C.R.*, 201, 309–368). GABRIEL BERTRAND: Observations concerning the contributions by the atmosphere of sulphur to arable soils. Results of a series of determinations of sulphur as sulphate in rain water collected at Paris, 1931–1932, and of one year at Grignon, 1934–1935. The latter figure, although small, is sufficient to meet the requirements in sulphur of most cultivated plants. CHARLES NICOLLE and J. LAIGRET: Vaccination against yellow fever by the living amaril bacillus, dried and coated. The dried material was coated with either yolk of egg or olive oil before inoculation. Ninety-one persons were inoculated: there was no local reaction and no anaphylactic trouble. A single vaccination by this method replaces three inoculations by the current method. EMILE MATHIAS: Dauzère's theory on the conductivity of the air in regions exposed to lightning. E. J. GUMBEL: The greatest age, distribution and series. Statistical study of tables of survival. ALFRED LIÉNARD: The problem of the oblique derivative in the theory of potential. PAUL MONTEL: A formula of Weierstrass. PAUL BOURGEOIS and J. F. COX: The origin of comets. BASILE FESSENKOFF: A method of evaluation of the absorption in galactic nebulæ. FERNAND BALDET: The resolution of Nova Herculis, 1934. According to an observation made at the Lick Observatory on July 4, Nova Herculis is double, with two components with 0·2 in. apparent distance. This is confirmed by observations made at Meudon on July 23 and 24. FRANÇOIS CANAC: The study of intercrystalline corrosion by the method of luminous diffusion. D. G. DERVICHIAN: The interfacial tension between two liquids. ARCADIUS PIEKARA and MAURICE SCHÉRER: New experiments on the magnetic change of the dielectric constant of liquids. The large Bellevue electromagnet has been utilised in the study of the effect of the magnetic field on the dielectric constant as a function of the intensity of the magnetic field, the wave-length, and the angle between the electric and magnetic fields. E. FRIEDLANDER: The absence of natural β-radioactivity of beryllium. All commercial beryllium salts possess a marked radioactivity, but this is removed by careful purification, and it would appear that the pure products possess neither β- nor γ-radioactivity. MLLE. NIUTA KLEIN: The variation of the refractive index of non-annealed glass as a function of the time. The experimental results described appear to indicate that the variation of the refractive index with time is due to the transformation of the β variety into the α variety of the glass, a transformation prevented by rapid cooling. MLLE. MARIE LOUISE DELWAULLE: The system bismuth iodide – ammonium iodide – water. ANDRÉ DE PASSILLÉ: The existence of a series of ammonium orthophosphates and orthoarsenates. G. DEDEBANT, PH. SCHERESCHEWSKY and PH. WEHRLÉ: The theory of the general circulation of the atmosphere. The average field of temperature. MME. ODETTE THELLIER: Condensation nuclei and particles in suspension in the atmosphere. PAUL CHABANAUD: The vomer, the ethmoidian complex and the peripheral path of the olfactory nerves of the soleiform Teleosteans. TIFFENEAU and BROUN: The microdetermination of ethyl, propyl and isopropyl bromides in the tissues of animals anæsthetised by these substances. OLIVIER GAUDIN: The comparative toxicity of the pyrethrines towards different classes of animals. Pyrethrines are highly toxic to Crustacea; with other animals, the toxic action is variable. MAURICE ROSE and HENRI BERRIER: The appearance of substances functioning as plant auxins, in the course of the development of *Discoglossus pictus*. JACQUES BENOIT: New experiments relating to the stimulation by light of the testicular development in the duck. CLÉMENT COURTY: The magnetic micro-estimation of iron in the blood. MAURICE PIETTRE: The physico-chemical action of some electrolytes on the myxoproteid of the blood serum. SERGE METALNIKOV and L. Y. MENG: The utilisation of micro-organisms against mole-crickets (*Gryllotalpa vulgaris*).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 413–506, July 15). FRANZ BOAS: The tempo of growth of fraternities. Data from the Hebrew Orphan Asylum in New York show that the brothers and sisters of children classified as tall, medium or short at a given age fall also into these groups, indicating inheritance of tempo of growth. Jewish immigrants into the United States measured in 1910 and born between 1850 and 1890 do not show the increase of stature generally characteristic of European populations during the past century, but their children often living under poor conditions in New York, show progressive increase in stature, indicating that environment is also a factor in determining bodily

form. P. VAN DE KAMP and A. N. VYSSOTSKY: Analysis of 18,000 proper motions derived at the Leander McCormick Observatory. Some general results obtained from this survey of stars between magnitudes $7\frac{1}{2}$ and 14 are that the solar apex differs by 15° from that derived with respect to the bright stars, due possibly to a higher percentage of high velocity stars among the apparently faint stars, that the secular parallaxes are somewhat larger in northern than southern galactic latitudes and that parallaxes of groups of fainter stars in the Milky Way are larger than previously supposed, indicating heavy obscuration near the plane of the Milky Way. FRED M. UBER and T. H. GOODSPEED: Micro-incineration studies. (1) Localisation of inorganic elements in plant cell-walls. A special electric furnace for micro-incineration is described. Sections of tissues are held in position by a gelatin smear hardened by formaldehyde vapour. Photomicrographs of sections before and after incineration are given. They show absence of ash in intercellular substance, and limitation of mineral elements to the 'middle lamella' of the cell-wall. H. C. SHERMAN and H. L. CAMPBELL: Relation of food to regularity of nutritional response. Rats reared on a diet better than 'adequate' show more rapid growth, more successful reproduction and extension of the adult life-cycle; these responses occur with less variability than the responses of rats on an 'adequate' diet. M. A. BIOT: Quadratic wave equation: flood waves in a channel with quadratic friction. A mathematical investigation of the type of flood wave caused by the bursting of a dam. An exact solution of the equation of propagation of waves with quadratic damping is found. High amplitude waves are more quickly damped, and the damping effect depends on the volume of the wave and the friction coefficient of the channel. TH. DOBZHANSKY: Maternal effect as a cause of the difference between the reciprocal crosses in *Drosophila pseudo-obscura*. GEORGE D. SNELL: The determination of sex in *Habrobracon*. In this parasitic wasp, as in other Hymenoptera, the males normally arise from unfertilised eggs (a haploid generation). After inbreeding, however, males may arise from fertilised eggs (diploid) and are commonly sterile. The hypothesis is advanced that there are a number of pairs of factors, probably on different chromosomes, which when heterozygous cause diploid zygotes to become females. ALAN L. MITCHELL: The inheritance and linkage relations of kinky coat, a new mutation in the Norway rat. This character is inherited as a simple Mendelian recessive, and since it is not linked with other known characters, its gene appears to lie in a seventh chromosome. CHESTER STOCK: Titanotherе remains from the Sespe of California. The remains were found in the uppermost Eocene horizon at one particular locality alone. HASSLER WHITNEY: (1) Differentiable manifolds in Euclidean space. (2) Sphere-spaces. G. A. MILLER: (1) Groups which are the products of two permutable proper sub-groups. (2) Largest groups determined by the squares of their operators. SAUNDERS MACLANE: Abstract absolute values which give new irreducibility criteria. W. SEIDEL: On a metric property of Fuchsian groups. NORMAN E. STERNROD: On universal homology groups. OSWALD VEBLEN: A conformal wave equation. A differential equation in generalised four-dimensional conformal geometry, somewhat analogous to the Dirac equation for the electron in classical relativity. A. G. JACQUES: The kinetics of penetration. (10) Guanidine. Plotting the rate of entry of guanidine into cells of *Valonia* against external concentration of guanidine suggests that entrance is preceded by a reversible action between this base and an acidic constituent of the protoplasm. HENRY BORSOOK: The correlation between excess calories and excess urinary nitrogen in the specific dynamic action of protein in animals. Further data are quoted in support of the view that a steady state is attained between the increase in energy metabolism and urinary nitrogen within four hours after the ingestion of protein. DICKINSON W. RICHARDS, JR., ANDRÉ COURNAND and ISRAEL RAPPAPORT: Relation of the regulatory mechanism of respiration to clinical dyspnea. Dyspnea, or distress, referred to the act of breathing, whether due to physical exertion or pathological conditions, is due to disturbance in the mechanical functioning of the organ of breathing. It is associated exclusively with sensory impulses from chest and lungs; and separated from the physical chemistry of respiration. CHARLES A. KOFOID: On two remarkable ciliate Protozoa from the cæcum of the Indian elephant. Two new genera of relatively large ciliate Protozoa are described. Both have several spirally curved ciliary zones arranged in a secondary bilateral grouping instead of the single dorsal zone in other members of the family, and show other advanced characters. The evolution of structural complexity in the protozoan parasites of herbivorous animals seems to have proceeded parallel to that of their hosts.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*

Sunday, September 22

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Gem Stones".*

FARADAY SOCIETY, September 26–28.—General Discussion on: "Phenomena of Polymerisation and Condensation", to be held in the Zoology Theatre, University of Cambridge.

Official Publications Received

Great Britain and Ireland

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vol. 16, 1934. Pp. 125. (London: Chemical Engineering Group.) 10*s.* 6*d.*

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1935–36. Pp. 403. (Manchester: College of Technology.)

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