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In Africa—the Next Step?

IN the spate of problems let loose by the Italian adventure in Abyssinia, a long view will not be blind to the intense gravity of the issue raised by the attempt to re-open the question of the distribution of authority in Africa among the European powers. Not the least disturbing factor in the situation is that the form in which this question has arisen carries with it an implication of the necessity for some change in the principles of administration under which that authority is exercised.

No good purpose is served by any attempt to disguise the fact that the thrust of Italy towards the acquisition of a sphere of exclusive or preferential economic advantage in Abyssinia has paved the way to a demand for a revision and readjustment of conditions in other parts of Africa outside the zone of contention. Even now it is suggested that the position in territory formerly in the possession of Germany should be reviewed. The natural regret of Germany for her lost colonies, and the desire for their restoration, are made to assume an appearance of 'sweet reasonableness'. They no longer stand naked on national prestige, but are clothed in a garment of economic necessity.

The issue has been forced by the policy of the 'closed door', adopted as a measure of relief in a time of economic stress. Some would now wish to see that policy modified or reversed as a matter of expediency and as a compromise. It is, however, the privilege—as indeed it is the duty—of science to view such questions as this, not merely as matters of immediate expediency, but *sub specie æternitatis*—in the light of general principles, in so far as these can be applied to the circumstances of time and place. Expediency must be submitted to the touchstone of its approximation to principle.

The mandatory system applied by the League of Nations to the government of certain territories —we are concerned here only with those in Africa —by adopting the benefit of the native as the end and the criterion of a delegated authority, has at least afforded a medium in which the results of scientific study of native character and institutions may be applied most effectively to solving problems in the administration of the affairs of a backward people and to mitigating the dislocations which arise out of the contacts of diverse and in some ways incompatible cultures. The purpose of the mandate was not to promote the aggrandisement or the economic advantage of those who accepted it—in some, if not most, instances it has proved a burden—but to provide a system of tutelage for the mandated peoples. An authority accepted on the conditions laid down in the mandates of the League of Nations constitutes a trust; but a rule allowed to pass to an extraneous power in virtue of the desire of that power for political prestige or territorial enlargement to relieve pressure of population, or in response to the claims of its economic necessity, would entail no inevitable obligation, or intention, to do more than exploit land and people.

When the implications are thus baldly stated, the argument ceases even to be plausible. It cannot be recognised too clearly that, however much it may be asserted that the requirements of the general principle have not been overlooked, any action, any policy, which has not for its primary object the advantage of the governed—or it might be added in matters of such moment as the supreme control of territory, which does not command the assent of the inhabitants—at best will involve a change in principle and in the graver issue will be an infringement of a recognised right.

In these circumstances, it is more than a mere matter of interest to inquire in what manner the mandatory powers have discharged their trust. France and Great Britain, at the time the mandated territories were entrusted to their care, had behind them a considerable and varied experience of the administration of the affairs of native peoples in Africa. This experience was such as to qualify them to enter upon their responsibilities with a sympathetic understanding of the end in view. In certain of the British dependencies, 'indirect rule' had long passed beyond the experimental stage; and in others outside its original sphere it had been already, or was about to be, applied. In the French colonial possessions, notwithstanding differences of method involved in the greater integration of their administrative organisation as part of the political system of the Republic, in practice, when once the claims of military service and taxation had been satisfied, native institutions were almost equally free from disturbance.

An opportunity to test the interpretation which these two powers respectively have placed upon their obligations, and to contrast their methods of administration, is afforded in the present discussion by the reports on the mandated territories of Togoland and the Cameruns, now allotted in part to France and in part to Great Britain, which have been made recently to the Mandates Committee of the League of Nations, and of which a summary is given in *The Times* of January 31 by its League of Nations correspondent.

It is interesting to note how the difference in outlook in colonial policy of the two powers is reflected in their respective constructive interpretations of an administrative policy which will best conduce to the advancement and well-being of the native. France, precluded by the terms of the mandate from imposing on the mandated territory what she regards as the first duty of her dependencies, namely, military service, has turned to their economic advancement, developing resources and promoting trade. The number and character of the administrative officials in French colonial possessions has on more than one occasion been the subject of criticism by observers; and it is admitted that in the mandated territories, owing to considerations of economy, it has been inadequate. A partial remedy has been found in a 'school for chiefs', while the officials, whose principal duties are to act as arbitrators and supervise discussion in matters in dispute, have the assistance of expert native assessors who ensure the observance of custom. The most considerable undertaking, however, upon which the Government has entered in the interests of the native is the compilation of a comprehensive 'code' of native custom, which, it is anticipated, it will take some years to complete.

In the mandated territory in Togoland and in the Cameruns assigned to Britain and administered under the jurisdiction of the Gold Coast and Nigeria respectively, attention has been devoted primarily to the development of native institutions as instruments of administration, rather than to the material development of the country. Modifications, mainly in two directions, have been introduced. These have been based, it may be mentioned incidentally, on a necessary, if somewhat hurried, preliminary ethnographic survey. Where tribal affinities have made it possible, administrative units have been built up by amalgamation of smaller social groups; and the introduction of paid headmen—a measure which has proved highly successful in other parts of Africa—has increased the efficiency of taxation and local government, as well as made possible the abolition of the system of compulsory tributory labour. Their administrative duties have enhanced the interest of the chiefs in education, to which a distinct trade bias has been given.

Without entering into a detailed consideration of the differences in method revealed in the reports of the French and English authorities, it may be pointed out that, while there is in each an equal regard for native interests and institutions as a basis of administration, France aims at the amelioration of material conditions, Great Britain at the development of personal capacity for social and economic efficiency. Further, the codification of custom, to which France is applying the resources of her ethnographers, is purely static in effect, whereas Africa, as all observers are agreed, is changing rapidly. Under British rule, on the other hand, an elastic system is being built up, capable of modification as conditions change; but at present, except in so far as concerns efficiency of administration, it shows too few signs of any attempt to determine the line which future development should take. Is not the time at hand when the powers interested in Africa must make up their minds where the future of her native peoples is to be sought?

Physiology of Development

How Animals Develop

By C. H. Waddington. Pp. 128+7 plates. (London: George Allen and Unwin, Ltd., 1935.) Paper, 3*s*. 6*d*. net; cloth, 4*s*. 6*d*. net.

EMBRYOLOGY until very recently was almost entirely a descriptive science—a branch of morphology. It dealt with change of form during the progress of development. As is well known, the study received a great impetus from the theory of organic evolution, for it was in the light of that theory that many of the characteristics of the developmental processes began to become intelligible. Knowledge of embryology in pre-Darwinian days was fragmentary, but it grew enormously as a result of the compelling interest awakened in it by the application of the biogenetic law of development enunciated in slightly different forms by von Baer, Haeckel and others. Stated in its more extravagant and picturesque form, as Milnes Marshall stated it—that an animal in the progress of its development climbs up its own genealogical tree—the 'law of recapitulation' is pretty generally rejected by biologists. But to say that an animal during its growth passes through stages which are similar to those which its ancestors passed through in individual development is a statement which no modern biologist would deny. In the light of this law, the theory of organic evolution has given an intelligibility to the facts of development just as it has to many other facts of morphology. But the recapitulation theory does nothing to elucidate the causes of development or of the differentiation which accompanies it. Similarly, until embryology began to be studied experimentally it tended to remain at the descriptive level, like the comparative accounts of the œstrous cycle before the discovery of the chemical substances which are now known to initiate and regulate it.

In the last few years, however, largely owing to the researches of Spemann and the group of workers to which the author of the book before us belongs, the science of embryology has entered a new phase and developed a physiological side which deals with the causes responsible for embryonic growth and differentiation, and like other branches of physiology it is based upon experiment. Mr. Waddington in his work on "How Animals Develop" does not neglect the morphological side; on the other hand, he gives a sketch of the general pattern on which all animals are built and the more important differences in the various groups, but his book differs from previous elementary treatises in giving an account of the factors which promote the development of the parts and bring them into correct relations with one another.

As was to be expected, the book possesses a good deal of originality, for the subject is new and it is one of which Mr. Waddington has made himself a master. It begins by stating the main facts of embryonic growth, and then proceeds to discuss the organisers which control it. 'Organiser' was the name originally given by Spemann to the piece of tissue which determines what a given part of the ovum will become. More recently it has been found that in some animals, like the rat and the chick, the stimulus provided by the organiser is still effective after the death of the tissue. Moreover, this stimulus, which the author calls the evocator, is a chemical substance and is not specific for a particular kind of animal. But the tissue acted upon must be in a 'competent state' for the evocator to work. Further, something else is present in the living organiser in order to determine the part or parts of the embryo which are to develop, and this 'something else' is called the individuation field. Thus, some of the ectoderm in the gastrula becomes neural plate because it is acted on by the evocator while it is in a competent state for the process to be effective, and it becomes a particular part of the neural plate because it is within the individuation field. The evidence on which these and the other main conclusions reached in this book, starting from Spemann's beautiful experiment in making artificial twins, is admirably presented, and the only criticism that can be made is that the proofs for some of the later deductions, in particular those relating to the action of the secondary organisers, are not fully stated. On the other hand, to have given an adequate account of the experimental evidence would probably have involved the writing of a far larger work.

The book concludes with a chapter on the 'final adjustments'. Herein we find sections on nutrition, growth, the influence of function, the nervous system, the hormones, sex and the part played by the genes in development. In referring to the œstrus-producing hormones, it seems rather odd that the author should allude specially to their chemical dissimilarity, since the fact that they are based on a common molecular skeleton is what is usually stressed. The series of substances possessing œstrus-producing properties of a different degree of potency must be regarded as metabolic

products to the presence of which the accessory sexual organs have come to respond in the course of evolution. Exception may be taken also to the author's unqualified condemnation of Driesch's entelechy as a defeatist hypothesis. It may be so, but it must be remembered that the main justification of a scientific theory or 'law of Nature' is its usefulness for purposes of generalisation and prediction. For example, the physiological conception of 'compensatory hypertrophy' is teleological, and at the same time has been found definitely useful in the interpretation of organic function. As Woodger has remarked, there was a great deal to be learnt from the writings of Driesch because they dealt with those aspects of the organism which most other writers omitted.

The book is well illustrated, and we like the inclusion of the figure of the railway sorting yard which serves as a mechanical picture of the manner in which the development of the bodily structures is directed. The diagrams of the placenta, however, are not so clear, and in one of them, what looks like a large blood sinus is mysteriously labelled 'embryonic membrane'. Taken as a whole, the book may be confidently recommended to medical and scientific students as well as to the general reader who wishes to obtain an up-to-date survey of the modern science of experimental embryology. It is the first book of its kind, at any rate in English, to present authoritatively in simple elementary language an outline of the way in which animals develop and the causes which underlie the processes of embryonic differentiation.

F. H. A. MARSHALL.

The Significance of Experiments

The Design of Experiments

By Prof. R. A. Fisher. Pp. x+252. (Edinburgh and London: Oliver and Boyd, 1935.) 12*s*. 6*d*. net.

READERS of "Statistical Methods for Research Workers" will welcome Prof. Fisher's new book, which is partly devoted to a development of the logical ideas underlying the earlier volume and partly to an extension of the application of these ideas. At one time it was fashionable to say that Nature would only reply to one question at a time; the author, however, believes that her responses to a well thought out questionnaire will be more satisfactory.

The objects of an experiment are, broadly speaking, twofold: first, to demonstrate the existence of some effect; secondly, if it exists, to measure it. Thus we are faced with two different problems in the interpretation of the numerical data provided by an experiment; we have to carry out tests of significance and at a later stage we may have to consider methods of estimating the magnitude of the effects which have been shown to be significant. The two problems are quite distinct, though they have sometimes been confused in the past.

The first nine chapters of this book are concerned, broadly speaking, with tests of significance. The fundamental principle, on the view put forward, is that the significance of effects is demonstrated by disproving their absence, or, more precisely, showing that the probability of the observed result arising on the hypothesis of the absence of the effect in question is so small that the hypothesis may be rejected. By 'so small' is meant, of course, less than a definite amount, such as 0·05 or 0·01, decided on in advance. Such hypotheses the author calls 'null hypotheses', and these should be explicitly formulated when the experiment is designed. Given a null hypothesis it is always possible in theory, though the mathematical difficulties may sometimes be very great, to deduce the frequency distribution of the possible results of the experiment and so arrive at a test of significance. Though disproving a null hypothesis may be said to prove its opposite, yet its opposite will not in general provide an exact hypothesis to test. That there is no difference, for example, between the average growth of two groups of rats on two different diets provides a null hypothesis. But the opposite hypothesis that there *is* a difference is inexact. If it be made exact by postulating that the difference is a definite amount '*d*', this provides a null hypothesis; for we are testing that the average growth in one group does not differ from '*d*' added to the other.

Experiments are concerned, as a rule, with the ascertainment of one or more measurements or qualitative attributes among groups of individual objects, the groups receiving different treatments but the members of any one group being treated alike. The interest of the experiment consists in the comparison of the average measurements of the groups treated differently, and ideally

individuals should be alike except in respect of the treatments given and the measurements under test. This is, of course, an impossible requirement in practice, however much it is possible to reduce the uncontrolled causes of variation. A safeguard is therefore needed if the frequency distribution, on the null hypothesis, of possible results of the experiment is not to be disturbed by such uncontrolled variation. The safeguard consists in the physical process of *randomisation* by which it is ensured that every individual object has an equal chance of receiving any treatment. Further, the fact that individual objects treated alike vary in the measurement under test makes it necessary to compare the variation from group to group with that among individuals in the same group; thus more than one individual must receive each treatment. Hence treatments must be *replicated*.

It is with applications of the principle of testing null hypotheses by means of *randomised and replicated* experiments that the first nine chapters of this book deal. In the second and third chapters the principle is illustrated by two especially simple experiments, a psycho-physical experiment designed to test whether a person can discriminate cups of tea in which the milk or the tea has been added first, and an experiment of Darwin's on the difference between the heights of self- and cross-fertilised plants. The fourth and fifth chapters deal with the simplest types of agricultural experiment, randomised blocks and Latin Squares. The sixth considers *factorial design* in which every combination of one of two levels of each of the factors used constitutes a treatment and the whole system is, as a rule, replicated. Such arrangements are shown to possess three advantages over experiments involving only single factors; namely, greater efficiency in the use of experimental material, greater comprehensiveness because the interactions of the different factors may also be evaluated, and a wider inductive basis.

The seventh and eighth chapters deal with *confounding*. In confounding, absolute replication is dispensed with, in order to obtain greater precision by the use of smaller and therefore more homogeneous blocks. Higher order interactions, the magnitude of which is likely to be small, or the effect of which is unimportant in practice, are incorporated in block differences, and information about these is sacrificed, the remaining comparisons being unaffected. In some arrangements the interactions are only *partially confounded*, when some information about them may be regained. If the estimate of error has been materially reduced by the use of more homogeneous blocks than would have been possible without confounding, these partially confounded interactions may actually be estimated more precisely than if confounding had not been used.

The ninth chapter deals with allowances for uncontrolled variation which it is impossible to equalise. An example of such a situation arises if a series of different diets are given to groups of animals and their responses, as measured by increase in weight, are obtained. If the average ages of the groups are not equal and cannot be equalised, the regression of response on age among animals treated alike may be obtained and used to correct the observed responses. The significance of the difference between the corrected averages for the different groups may then be tested by means of a technique involving the analysis of covariance.

The remaining two chapters are concerned with certain aspects of the problem of estimation, the problem which naturally arises when it is wished to ascertain the magnitude of effects which have been shown to be significant. The principles of efficient estimation were dealt with in "Statistical Methods for Research Workers"; here the author is mainly concerned with the evaluation of the amount of information relative to some parameter contained in a sample of data. In large samples for which there exists a corresponding statistic, normally distributed with the minimum possible sampling variance, the amount of information in the data is the reciprocal of this variance; in small samples it may be shown to be

$$-E\left(\frac{\partial^2 L}{\partial \theta^2}\right) = S\left\{\frac{1}{m}\left(\frac{\partial m}{\partial \theta}\right)^2\right\}$$

where θ is the parameter in question, L the logarithm of its likelihood calculated from a sample, m the expected frequency in any one of the groups into which the data are subdivided, the summation on the right-hand side being extended to all groups. The examples given are concerned with the estimation of linkage in genetics, with the estimation of bacterial counts from the observed proportion of sterile plates and with the principles of biological assay.

The experimental designs originated by Prof. Fisher have been most extensively explored in agriculture, where they are being used all over the world. It seems likely that in the next few years they will be increasingly applied in other fields. Indeed, this is already the case. They have been used, to mention a few examples, in industrial research in examining the properties of cotton yarn, in the study of ultra-violet absorption spectra in biochemical research, and a beginning has been made in nutrition studies. Prof. Fisher

evidently wishes to induce vital statisticians to examine them, for he says:

"The supposition that rates, based on the registration of individuals, possess the precision which would be appropriate if all the individuals could be regarded as independent in their sociological reactions, is clearly inappropriate when we are interested in the effects on these reactions of economic or legislative causes, or other agencies derived from social organisation, liable to affect large numbers of individuals in a similar manner. The effective samples available for administrative decisions, even though based ultimately on millions of individual persons, are often much smaller than those available in biological experimentation and, for this reason, require even more than the latter, the accurate methods by which small samples may be interpreted."

J. O. I.

A Pioneer in Illumination

Auer von Welsbach

Von Dr. Franz Sedlacek. (Österreichisches Forschungsinstitut für Geschichte der Technik in Wien: Blätter für Geschichte der Technik, Heft 2.) Pp. viii+85. (Wien: Julius Springer, 1934.) 3.60 gold marks.

ALL interested in the advance, during the last fifty years, of the industry of illumination, will read with pleasure this short biography of Auer von Welsbach, the well-known pioneer in this field, issued by the "Austrian Institute for Research on the History of Technology". The development of the three important discoveries of Auer, the 'Welsbach mantle' for gas light, the osmium wire electric lamp, and the cerium-iron-alloy gas-lighter, is ably traced, and includes valuable chapters on the historical background.

Comparatively little space is devoted to the personality of Auer, but sufficient to give an impression of his originality. That so few people had an opportunity of meeting him—the author does not seem to have been amongst them—was largely due to Auer's deafness, which induced him to spend his later years almost exclusively at his home in Caranthia; here, amidst the forests of the Alps, in a well-equipped laboratory, he devoted his time literally up to the last days of his life to the study of the rare earths, a field in which his scientific achievements were not less outstanding than his practical discoveries in the technique of illumination. It is sufficient to mention here his separation of didymium into praseodymium (element 59) and neodymium (element 60), and his discovery of cassiopeium (element 71), two years before the same element was called lutecium. Science is indebted to him also for the generosity with which he put the rarest of the rare earths, prepared by him in painstaking crystallisations lasting over years, at the disposal of other workers. Even nowadays, six years after his death, the superior purity of his material as compared with rare earths from other sources has proved to be a decisive factor in studies on the effects of neutron bombardment (NATURE, 136, 102 and 103; 1935).

The author mentions that in England and in the United States the name 'Welsbach' is preferred to 'Auer' on account of the difficulty of pronouncing the latter. But surely only the orthography and not the sound proves the stumbling block, for the simple English word 'hour' is pronounced in precisely identical fashion. (Actually it is much more difficult for Englishmen to say 'Welsbach' correctly.) After all, Auer is the family name, von Welsbach only a titular territorial distinction, used in Austria as a formal address in combination with Auer (cf. Rutherford of Nelson), but never as an independent name.

F. A. P.

Antoine Lavoisier: the Father of Modern Chemistry

By Dr. Douglas McKie. Pp. 303+3 plates. (London: Victor Gollancz, Ltd., 1935.) 10*s.* 6*d.* net.

DR. MCKIE has put together the already known chief data of Lavoisier's life and researches, and has duly taken advantage of the recent additions to our understanding which are due to the late Dr. A. N. Meldrum. It is very convenient to have so much material brought systematically into one volume, and Dr. McKie's framework and running comments are serviceable and judicious. He expands interestingly some of the less familiar investigations. His many quotations from the source-books are well balanced; they are translations into English, which is probably an advantage here, as it will ensure that the reader and the author are considering identical data; and the references are given. Trouble is taken to display for the uninitiated a background of chemistry as Lavoisier found it, and to portray concurrent advances.

I. M.

The Invertebrata: a Manual for the Use of Students

By L. A. Borradaile and F. A. Potts. With Chapters by Prof. L. E. S. Eastham and J. T. Saunders. Second edition. Pp. xv+725. (Cambridge: At the University Press, 1935.) 25*s*. net.

LESS than three years ago (NATURE, **131**, 76) we noticed the first edition of this carefully planned volume, each chapter of which has undergone revision by its writer. This edition is eighty pages longer than the first edition, which is largely due to expansion of the general introduction to certain of the sections, and to the insertion of short accounts of animals omitted in the first edition, for example, *Piroplasma* (*Babesia*), Gastrotricha, Nematomorpha and Acanthocephala. Other examples of additions which greatly improve the usefulness of the volume are: general observations on the importance to animals of the environment and of the internal medium; the anatomy and biology of the Metazoa; the general introduction to the Accelomata; the fuller consideration of feeding and respiration and of the embryology of insects; the extension of the accounts of the Lepidoptera, Hymenoptera and Diptera, and the short summary of digestion in the Cephalopoda. Twenty-nine new illustrations are provided, and, as in the first edition, the chapters on Protozoa, Crustacea and insects are particularly noteworthy for excellence of treatment.

A few of the sections are still unduly short, for example, on the Phoronidea; only one page, half of which is occupied by illustrations, is allotted to this group. There was room on p. 514 to add a brief statement on the parasitic castration produced by the parasite *Stylops* in its host—the bee.

The assertion that no special sense-organs are known in Brachiopoda is incorrect; statocysts occur in *Lingula* and at least two other genera. The funnels of the excretory organs in this group and in *Arenicola* are not regarded as nephrostomes.

The volume, like its predecessor, is a compendium of the most significant knowledge on invertebrates, and the authors well deserve renewed commendation for their clear and concise presentation of the subject.

The Nature of the Physical World

By Sir Arthur Eddington. (Everyman's Library, No. 922.) Pp. xii+345. (London: J. M. Dent and Sons, Ltd., 1935.) 2*s*. net.

THIS book is a very welcome and appropriate addition to the modern volumes which have lately been added to the well-known "Everyman's Library". Comment on the work itself is unnecessary: no modern book on scientific philosophy is better known, nor is any collection of standard literature more familiar to the English-speaking public or better appreciated by them.

The introduction, by E. F. Bozman, gives a few comments on the author's life and work which will be helpful to many, but we hope that "Everyman" will read the earlier volumes of his Library in order not to be misled by the reference to "the recent emancipation of thought from the shackles of classical science". In this connexion we cannot refrain from commenting on a remarkable omission from the Library. In the Science section, containing more than twenty volumes, every science appears to be represented except the oldest—and historically the most influential of all—astronomy; and even now that an astronomer has been selected as an author, it is a non-astronomical work that is chosen. This can scarcely be due to lack of literature. Among the great books of the world there is probably none which, by its combination of historical as well as present-day importance, clarity and cogency of argument, literary merit and intrinsic 'readableness', is more essentially suitable for "Everyman" than Galileo's "Dialogues Concerning the Two Systems of the World". This book is now available to English readers only through Salusbury's original seventeenth-century translation, of which copies are rare and generally unattainable to most of those to whom the book would bring pleasure and profit (and perhaps also emancipation from the shackles of modern paradox). We would suggest that the publishers might consider the possibility of adding this immortal work to the collection.

H. D.

A Dictionary of the Economic Products of the Malay Peninsula

By I. H. Burkill, with Contributions by William Birtwistle, Dr. Frederick W. Foxworthy, J. B. Scrivenor and J. G. Watson. (Published on behalf of the Governments of the Straits Settlements and Federated Malay States.) Vol. 1: A–H. Pp. xi+1220. Vol. 2: I–Z. Pp. iii+1221–2402. (London: Crown Agents for the Colonies, 1935.) 2 vols., 30*s*.

THIS useful and comprehensive work may well be compared with Sir George Watt's classic "Dictionary of the Economic Products of India", and should stimulate research on Malayan economic products in the same manner that Sir George Watt's well-known work has undoubtedly done for those of India. It is arranged on somewhat similar lines, but is naturally smaller. The author, a well-known botanist, has had a long and varied experience in the Eastern tropics and possesses a first-hand experience of the numerous natural products of these regions. He has been responsible for almost all of what appears in regard to vegetable products in the work—more than ninety per cent of the total. Well-known authorities on mineral, animal, fishery and forest products in Malaya have contributed to the remainder of the subject matter.

The arrangement throughout is alphabetical, vegetable products being placed under the genera to which they belong, while mineral and animal products appear for the most part under their common names. Marginal notes indicating the contents of the text and a good general index, replete with native names, render the work easy of reference. Throughout the text, references to literature are freely quoted.

The author has brought together in convenient and orderly form all the existing information on the uses of the multiplicity of natural products throughout Malaysia. He has also supplied a good deal of information that is new or hitherto unpublished, and is to be congratulated on having performed a great task.

The Gases of War

By Arthur Marshall

THE word 'gas' has come to stay as the name of the atmospheric poisons that are used in warfare, but it is an unfortunate one as most of them are liquids and not very volatile, and some are non-volatile solids that are used in the form of aerosols. It is generally assumed that if air raids are perpetrated in a future war, the bombs will mostly be charged with 'gas', but this is by no means certain. High explosive bombs would not only destroy more property, but would also probably inflict far more casualties than chemical bombs. On the other hand, bombing or spraying with a persistent substance, such as mustard gas, would greatly disorganise the life of a big city, as it would force the majority of the population to keep indoors until the contamination had been cleared away by the special squads. It is likely, then, that the raiders would use a mixture of high explosive, gas and incendiary bombs, and of course the raids would be on a vastly bigger scale than in 1917–18, because the aeroplanes available would be far larger and more numerous.

Atmospheric poisons can be classified in various ways, according to their persistence (depending principally on their vapour pressure), or according to their chemical composition, or their physiological action or their use in warfare. The last two ways lead to much the same result, and form the basis of the classification that is generally adopted. There are four main classes, which have been given various names.

Class A. Choking Gases (Lethal)

French: *Suffocants*. German: Green Cross or *Lungenreizstoffe*.

Chlorine, Cl_2, the first substance to be used effectively (in April 1915) belongs to this class. It was discharged from cylinders in the form of a cloud. Its characteristics are sufficiently well known.

Phosgene, $COCl_2$, replaced chlorine to a large extent, but as it liquefies under atmospheric pressure at 8·2°, it was necessary to mix chlorine with it in the cylinders. It was used in this way right up to the end of the War, especially by the British; alone or mixed with other poisons, it formed the charge of shells and large bombs thrown by projectors. In the British service it was called CG, from the French 'collongite'. It is much more toxic than chlorine, and has a delayed action, which renders it especially dangerous; it affects the eyes to some extent as well as the throat.

Trichloromethylchloroformate, $CClO.OCCl_3$, is very similar in its action to phosgene, but has a boiling point of 127° and consequently has a certain amount of persistence. It was used largely by the Germans in their shells and was called by them 'Perstoff', whereas the British named it 'diphosgene' and the French 'surpalite'.

Class B. Nose Gases or Sternutators

French: *Irritants respiratoirs*. German: Blue Cross or *Hustenreizstoffe*.

These substances were used on a large scale by the Germans during the last year of the War. They are all solid arsenical compounds practically non-volatile at the ordinary temperature. The Germans fired them in shells charged also with high explosive, which reduced them to a very fine state of division so that they should penetrate the gas masks. By causing the wearer to cough and sneeze violently and vomit, they forced him to remove the mask and expose himself to some other more toxic gas. Other symptoms produced are running at the eyes, pains in the gums, intense headache and general depression; but the sufferer makes a complete recovery in a comparatively short time. According to General Foulkes ("Gas, the Story of the Special Brigade", Blackwood, 1934, pp. 249 *et seq.*), they were not very effective as used by the Germans, since the particles were not sufficiently minute to penetrate our gas masks; but it was found in the British service that they produced far more powerful effects if released as a smoke by vapourising them in a special form of thermo-generator or 'candle'. At the time of the Armistice, active preparations were being made to supply these in large quantities, and thereby it was hoped to obtain a decided military effect.

Diphenylarsine chloride, $(C_6H_5)_2AsCl$, was the first of these substances to be used (July 1917). The Germans called it 'Clark I' and the British 'DA'.

Diphenylarsine cyanide, $(C_6H_5)_2AsCN$, is even more violent in its action, and for this reason was introduced by the Germans in May 1918. The German name is 'Clark II' and the English 'DC'.

Diphenylaminearsine chloride, $NH(C_6H_5)_2AsCl$, unlike the atmospheric poisons already mentioned, had not been prepared before the War. It is said to have been discovered by Wieland in Germany in 1915, and by Adams in the United States in January 1918. This was the substance which the

Allies were to have used in the thermo-generators, but it was never actually tried at the front. It is called 'adamsite' or 'DM', and is reputed to be even more potent than 'DC'.

Class C. Tear Gases or Lachrymators

French: *Lachrymogènes*. German: White Cross or *Augenreizstoffe*.

These were used extensively in the earlier stages of the War, but did not cause many serious casualties; they make the eyes run and consequently compel the wearing of gas masks and so reduce the military value of the enemy. In future wars they are likely to be replaced to a considerable extent by nose gases. Tear gas bombs have been used in America and other countries for dispersing riots, because they incapacitate the rioters without inflicting permanent injury on them.

Benzyl bromide, $C_6H_5.CH_2Br$, and xylyl bromide, $CH_3.C_6H_4.CH_2Br$, were among the first poisons used for charging shells, but were afterwards replaced by more pungent lachrymators. The Germans called them 'T-Stoff'; the French referred to benzyl bromide as 'cyclite'.

Bromoacetone, $CH_3.CO.CH_2Br$, has a considerably stronger action and was introduced by the Germans in July 1915 as a filling for shells and hand-grenades under the name of 'B-Stoff'. The French call it 'martonite'. It is less persistent than the above, as it boils at 135°, whereas benzyl and xylyl bromides boil at 198° and 215°. It does not keep well.

Chloropicrin, CCl_3NO_2, is still more volatile (b.p. 26·5°), and was sometimes mixed with chlorine in cloud attacks, and with phosgene in projector and trench mortar bombs. It affected not only the eyes, but also caused coughing, vomiting and even death, so that it forced the enemy to remove his gas mask. In the British service it was called 'PS'; the French name is 'aquinite' and the German 'Klop'.

Chloroacetophenone, $C_6H_5.CO.CH_2Cl$, is an effective lachrymator which might have been used on a considerable scale if the War had lasted longer. It is a solid of low volatility which can be distilled unchanged (b.p. 246°), and consequently can be dispersed as an aerosol by means of a thermo-generator (see Héderer and Istin, "L'Arme chimique et ses Blessures", 1935, p. 140).

Class D. Blister Gases or Vesicants

French: *Vésicants*. German: Yellow Cross or *Hautreizstoffe*.

These substances attack the skin even in the form of vapour, but much more when the liquid comes in contact with it, raising blisters which are slow to heal and are liable to lead to secondary infection. They also attack the eyes and lungs, and in severe cases affect the digestion and nerves and in fact upset the whole system.

Dichlorodiethyl sulphide, $S(C_2H_4Cl)_2$, or mustard gas (French, 'yperite'; German, 'Lost'), has been known since 1822. It was one of the substances which was examined in the laboratories of the Allies soon after the Germans introduced gas warfare, but its high military value was not perceived until the Germans commenced to use it at the front in July 1917. It was then recognised at once, and attempts were made to work out a method of manufacture. This was found to be far from easy, and no mustard gas of British or American manufacture was actually fired in the War. The French were more successful, and in the last months before the Armistice their 'yperite' was used both by them and the British, causing severe casualties to the enemy.

Full protection against mustard gas requires not only a gas mask but also a complete suit of special clothing. As the vapour has no pronounced smell and produces no immediate effect, it is liable to escape detection until it has had time to cause serious injuries which only develop some hours later. In a future war, it might be used not only as a filling for aerial bombs but also as a spray from aeroplanes.

Chlorovinylarsine dichloride, $ClCH{:}CH.AsCl_2$, known as lewisite, was first made by Lewis in 1904. The Americans, English and Germans were all investigating its possibilities as a poison gas at the time of the Armistice, and the Americans were preparing to manufacture it on a large scale. As it was not actually used, its military value can only be estimated. It has been called the 'dew of death', and most exaggerated claims have been made as to its power of killing off the whole population of a city; but the British chemists who examined it came to the conclusion that it is less dangerous than mustard gas. Others who have made a careful study of the matter consider, however, that lewisite is slightly the more effective. It acts more quickly than mustard gas, but the lesions also heal in a shorter time; it is more volatile and consequently less persistent (b.p. 190° as compared with 217·5°). It has a more pronounced smell, and therefore is more easily guarded against.

These are the principal substances which were used in 1915–18, or were about to be used on a considerable scale in 1919. Since then, the 'chemical defence' departments in the various countries have been searching for worse poisons; their results have been kept secret, but there is no evidence that they have been successful. They are heavily handicapped by the want of any reliable method

of testing their gases in peace time; experiments on animals are liable to be fallacious, as different species vary greatly in their susceptibility to poisons, as indeed do different individuals of the same species. Moreover, when used in large quantities over extensive areas, the effects are often quite different from those obtained in small-scale experiments on a few individuals. Some indication of these difficulties may be gathered from what has been said about mustard gas and lewisite.

It is important to emphasise that practically all these substances were known before the War and were discovered in the course of purely scientific researches conducted without anticipation of the possible uses of the results in warfare. Chlorine is, of course, one of the commonest reagents of the laboratory and works, and was first made by Scheele in 1774. Phosgene was discovered by Davy in 1812. Benzyl bromide, chloropicrin and 'DA' can be obtained from the dealers in chemicals, and 'DC' can be made from 'DA' by a simple interchange. Diphosgene was discovered so long ago as 1847, and mustard gas in 1822, and bromoacetone in 1863. Although it was not actually used in the War, chloroacetophenone had been discovered by Graebe in 1871, and even lewisite, although it was the result of investigations carried out specially during the War, was discovered in researches started in America in 1904 for purely scientific purposes.

A Recent Discovery in Sixteenth Century Botany

By Dr. Agnes Arber

WHEN, a few years ago, Prof. Walther Rytz of the University of Bern was reviewing the collections in the Botanical Institute, he brought to light a herbarium in nine folios, the existence of which had been forgotten for more than a century. The history of these volumes, so far as it could then be traced, was that in 1806 they had been received by a bookseller in Bern from an antiquary in Zurich who owed him four *louis d'or* which he was unable to pay; six years later, the Bern dealer sold the nine folios for a single *louis d'or* to a botanist, through whom they came into the possession of the Institute. Since the collection was obviously a remarkable one, and appeared to be of early date, Dr. Rytz examined it minutely. His researches and their results make a fascinating story, which is now set out in fully illustrated form*.

Of the nine folios, the herbarium occupies eight, while the ninth contains illustrations alone. The herbarium is far from complete; there is reason for believing that about ten more volumes may await some future happy discovery. Even in its incomplete form the collection contains 813 species drawn from a wide geographical area—Switzerland, Italy, France, Spain and Egypt. It also indicates activity of an adventurous kind, for there are specimens from Pilatus, Monte Baldo and the mountains of Savoy—peaks arousing little emotion among the alpinists of to-day, but most formidable in the eyes of the men of earlier centuries.

The dried plants are well preserved and arranged, and some of them have retained their colour admirably; this point must have been regarded as of special importance, for, in some species of *Campanula*, the difficulty that the corollas turn brown on drying has been met by replacing them by imitations cut out of larkspur flowers! There are numerous inscriptions on the sheets, and all the information which could be gleaned from these has been brought together and analysed by Dr. Rytz, who has also made an exhaustive study of the paper used for mounting—a study which reveals no less than forty more or less different watermarks. All this research leads directly to the conclusion that the collection was formed in the second half of the sixteenth century by a botanist who was in relation with Charles de l'Écluse (1525–1609), Conrad Gesner (1516–65) and Joachim Camerarius (1534–98), from all three of whom he received specimens. After a process of delicate detective work, too complex and detailed to be summarised here, Dr. Rytz has decided that the herbarium was undoubtedly the work of Felix Platter, an eminent physician of Basle, who lived from 1536 until 1614. Fortunately, the facts of his life have been fully recorded and a fine contemporary portrait was available for reproduction in Dr. Rytz's first memoir.

From 1552 until 1557, Platter is known to have studied medicine at Montpellier, like so many botanists of his day, for example, Conrad Gesner, Jaques Dalechamps, Charles de l'Écluse, Jean Bauhin, Pierre Pena and Jean de l'Obel. In his diary of 1554, Platter speaks of collecting "viler kreuter, die ich in papier zierlich inmacht", so it is clear that he had already begun a herbarium

* Das Herbarium Felix Platters. Ein Beitrag zur Geschichte der Botanik des XVI. Jahrhunderts. By Prof. Walther Rytz. (*Verhandl. Naturforsch. Gesellsch. Basel*, **44**, pt. 1), 222 pp., 22 figures. (Basel: Naturforsch. Gesellsch., 1933.) 5 Sw. fr.

Pflanzenaquerelle des Hans Weiditz aus dem Jahre 1529: die Originale zu den Holzschnitten im Brunfels'schen Kräuterbuch. By Prof. Walther Rytz. 44 pp., 15 coloured plates. (Bern: Paul Haupt, 1936.) 60 Sw. fr.

soon after the middle of the sixteenth century. There is evidence that all European herbaria can be traced back to the influence of Luca Ghini, the Italian man of science, from whom William Turner, the 'father of British botany', learned to dry plants. Rondelet also, Felix Platter's teacher at Montpellier, was probably instructed in the art of herbarium-making by Ghini, and then disseminated this art among his pupils. The interchange of dried plants between savants played a very important part in the beginning of scientific systematics, and illustrations often seem to have been drawn from them. This is shown by the fact that in August 1563 Conrad Gesner wrote to Jean Bauhin: "At this time I cannot occupy the artist with dried plants: he can scarcely now paint all the fresh and green examples: I put off the dried specimens to the winter, when there will be no opportunity of getting the living".

The oldest herbaria usually consisted of dried plants alone, but the collections of Gaspard Bauhin and Felix Platter were exceptions in including figures as well as actual specimens. In the Platter herbarium there are 650 woodcuts; most of them are from well-known herbals of the period, but there is also a rough though specially interesting set of pictures, which appear to be proofs taken from the blocks prepared by Leonhard Fuchs for a projected new edition of his herbal, which was destined to remain unpublished.

Felix Platter did not confine himself to botany: he was a renowned collector of natural and artistic treasures of all kinds, and various foreigners who visited his 'cabinet' have left records of their impressions. Among them was Michel, Seigneur de Montaigne, who was amused at the 'mignardise' of Platter's house, but took pleasure in the herbarium, when he passed through Basle on his way to Italy in 1580—the very year in which the first edition of the "Essais" was published. A collection of dried plants was evidently a new toy to him. He writes of "un livre de simples . . . au lieu que les autres font pindre les herbes selon leurs couleurs, lui a trouvé l'art de les coler toutes naturelles . . . sur le papier". He notes with surprise that the pages could be turned over without the plants dropping out, and that some of these were actually more than twenty years old.

The ninth folio, which is of illustrations alone, seems to be the last survivor out of a set of similar volumes, of which no less than twenty-three have disappeared—perhaps to be redeemed by future search. The surviving volume contains 667 woodcuts mostly derived from printed herbals, and a few copperplate etchings. There are also water-colour drawings, which are of peculiar interest, since they include a number which Dr. Rytz recognised at once as corresponding closely to the woodcuts by Hans Weiditz in the great "Herbarum Vivæ Eicones" of Otto Brunfels (1530). This book marks the beginning of an epoch in plant illustration; it has been elucidated from the botanical point of view by the authoritative work of Dr. T. A. Sprague of the Kew Herbarium (*J. Linn. Soc., Bot.*, 48 (1928)). Critical comparison of the newly-discovered paintings with the woodcuts leaves no doubt that these drawings, which are water-colours with a bistre outline, are the actual originals from which the blocks in the herbal were made. In the second of Dr. Rytz's two memoirs, there are admirable colour reproductions of thirty of these paintings; botanists thus have the opportunity of themselves comparing them with the cuts in Brunfels' herbal.

It may seem surprising that Weiditz should have taken the trouble to colour the drawings, when they were to be reproduced as woodcuts, but Dr. Rytz has shown convincingly that the colour was chiefly intended to assist the man who would copy the outline on to the block, and also the woodcutter who would complete the process. The colouring is not used for its own sake, as in Albrecht Dürer's plant studies, but is employed with the definite object of heightening the comprehension of the form, and thus giving confidence to the copyist and enabling him to achieve a free and virile outline.

Weiditz worked on both sides of the paper—a luckless economy which led Platter, who was a man of method, to mangle the drawings cruelly in cutting out as many as possible in order to stick them into the appropriate places in his collection. On the backs of some of them, which have now been unstuck for examination, fragmentary inscriptions in the handwriting of Weiditz have been detected. They include directions to the craftsmen, and, on one fortunate page, the date "1529" has escaped Platter's scissors.

In a brief summary such as this, it is impossible to do justice to the indefatigable scholarship with which Prof. Rytz has extracted and evaluated every particle of ore from the rich vein which he has struck. His study has many interesting aspects which cannot be indicated here, but a parallel which he suggests may be cited in conclusion. He shows that there is a certain correspondence between the history of botany and the history of human anatomy. He compares the importance to botany of Hans Weiditz's paintings, with the importance to anatomy of the drawings of Leonardo da Vinci and Vesalius. One of the results of reading Dr. Rytz's work is, indeed, an enhanced sense of the significance of the role of artists in the biological renaissance of the sixteenth century.

Relationships in the Sex Hormone Groups

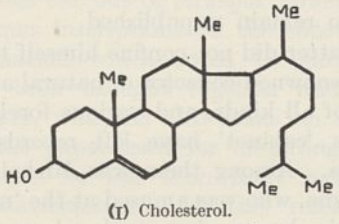
By Prof. L. Ruzicka, Technische Hochschule, Zürich

THE sex hormones may be divided into two main classes. One class comprises the gonadotropic hormones, the chemical structure of which is still unknown, and which stimulate the gonads to the production of the real sex hormones. It is possible that the gonadotropic hormones are identical in both sexes. However, the occurrence of the real male and female hormones, which form the subject of this article, is also not specific for the sexes, since it has been proved by their action that hormones of the other sex can exist in the male as well as in the female organism. A female hormone has been successfully isolated in a pure state even from the urine of stallions[1]. The specific action of the male and female hormones is confined only to the development and maintenance of the functions of the sex organs and glands and the secondary characteristics of the sex under consideration. This, however, by no means excludes the possibility that both groups of hormones can play a definite biological part in both sexes. Lately, a substance, androstene-3,17-diol, was prepared artificially[11], which showed even male and female hormone activities[2].

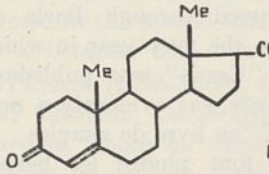
The sex hormones afford one of the best examples of how Nature, in using a fundamental principle, can produce not only different but even contrary actions by an alteration in the details of this fundamental principle. The common characteristic of all sex hormones is that they can be derived from cholesterol (I) by splitting off a part of the side-chains, and thus they all contain a ring system consisting of four carbon rings. The difference between the individual hormones depends upon which part of the side-chains has been split off, and is, moreover, essentially due to the variation in hydrogen content.

On account of their schematic structure, the work of determining the constitution of the sex hormones has been very considerably facilitated. Once the empirical formula has been determined and the groups present in the molecule identified, the correct molecular structure of a newly isolated hormone could be guessed by considering how such a compound could be most simply derived from cholesterol. It will be of interest to trace briefly these relationships in the individual groups of sex hormones[3].

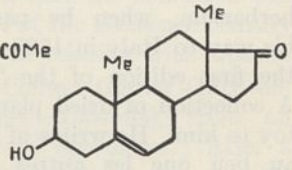
The œstrane group (VII–XI) comprises the female sex hormones, with the exception of progesterone (II), and is characterised by the presence of 18 carbon atoms in the molecule. One of the most important points in the elucidation of the constitution of this group was the conversion into a phenolic dicarboxylic acid, and from this it could be supposed that the hydroxylated ring in œstrone (VII) is a benzene ring, the presence of which also affords an explanation for the splitting of one methyl group from cholesterol in the formation of this hormone group. Œstradiol (IX) could be obtained by reduction from œstrone, and œstriol (XI) may be transformed into œstrone by the removal of water. Formula (X) for equilenin is the simplest expression for a naphthol derivative in this group, and except for the position of the fourth double bond, the constitution of equilin (VIII) is established. In addition, all the details of the structure of the œstrane group are established by chemical reactions[4] and only the steric structure remains in doubt, although this is very probably identical with that of cholesterol.



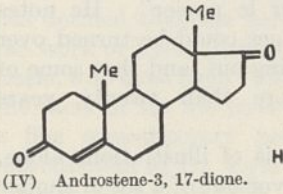
(I) Cholesterol.



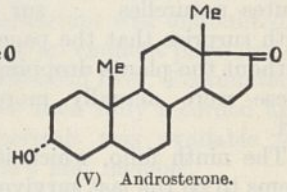
(II) Progesterone.



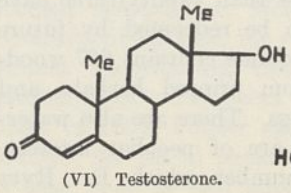
(III) Androstene-3-ol-17-one.



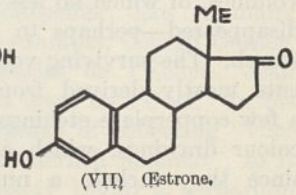
(IV) Androstene-3, 17-dione.



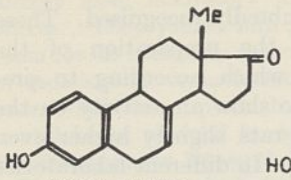
(V) Androsterone.



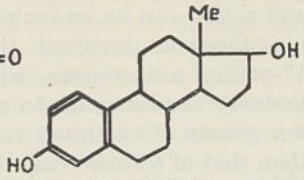
(VI) Testosterone.



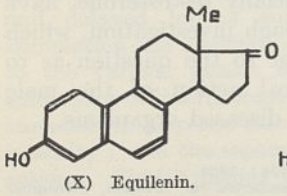
(VII) Œstrone.



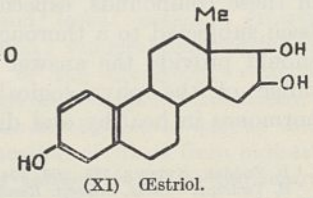
(VIII) Equilin.



(IX) Œstradiol.



(X) Equilenin.



(XI) Œstriol.

The fact that progesterone is an unsaturated diketone with the empirical formula $C_{21}H_{30}O_2$ led to the proposal of formula (II), which could be verified by an artificial preparation of progesterone which had stigmasterol as its starting material[3].

A similar relationship was found to exist in the first two male sex hormones, which were isolated by A. Butenandt in a pure state from urine, and are characterised by the presence of 19 carbon atoms. From the empirical formula of androsterone it was supposed that it is related to a hydrogenated sterol. The details of the structure of this hormone (V) were definitely settled by its artificial production from epicholestanol. The similar preparation from cholesterol of the other male hormone present in urine showed it to be androstene–3–ol–17–one (III)[5].

The ready accessibility of androsterone rendered possible thorough physiological investigations[6], which soon proved that androsterone could not be identical with the male hormone from testes. In the first place, the highly purified testicular extract was considerably superior to androsterone in its action on the sexual glands of castrated rats[7]; secondly, definite chemical properties of the active substance from testes pointed to a different molecular structure from that of androsterone. The physiological action of the testicular extract was destroyed by alkali and by potassium permanganate[7] under the very conditions which left androsterone unattacked. This fact led to the correct view as to the structure of the testicular hormone even before the hormone itself had been isolated in a pure state[5]. The instability towards alkalis was the chief reason for our view that an α, β-unsaturated ketonic group is present in the testicular hormone, since such compounds are, as a rule, less stable towards alkalis than the corresponding saturated ketones. In the androstane group, the simplest α, β-unsaturated ketonic compounds which can be derived from cholesterol are androstene–3, 17–dione (IV), and androstene–3–one–17–ol (VI), and accordingly these suggest themselves as possible formulæ for the testicular hormone.

The first test of this hypothesis was made possible by the physiological examination[9] of the androstene–dione prepared from cholesterol. The properties of this diketone corresponded, although not completely, yet in essential features with those of testicular extract, and therefore as a further test it was necessary to carry out the artificial preparation of compound (VI). At this point our synthetic method for the elucidation of the testicular hormone happened to coincide with the analytical method of Laqueur and his co-workers. These workers had meanwhile succeeded in isolating the pure hormone from testes[10]; it was named testosterone, and was different from our diketone (IV). The similarity in physiological action between the diketone and testosterone, however, afforded a means of testing whether the second of the two formulæ proposed for the testicular hormone, that of androstene–3–on–17–ol, should not be given consideration. Indeed, testosterone yielded androstene–dione on oxidation[11] and the androstene–3–one–17–ol prepared from cholesterol by suitable methods was identical in all its properties with natural testosterone[12]. This hormone is about 20–25 times more powerful than androsterone in its action on the sexual glands, for example, the seminal vesicles, the prostate and Cowper's glands: its male hormone action exceeds that of any compound as yet isolated from an organism.

However, in spite of this, the whole problem of the male hormone action of testicular extract is not yet completely solved, since according to Laqueur and his co-workers[10] testicular extract contains as well as the hormone a constituent—the so-called *X* substance—which is by itself inactive but the presence of which markedly increases the characteristic action of testosterone.

The recognition of the fact that α, β-unsaturated ketonic compounds are responsible for male hormone action offers a plausible explanation for the origin from cholesterol of the sexual hormones of the œstrane and androstane groups present in organisms. Androstene–3, 17–dione may be assumed to act as an intermediate product[5], although it has not yet been detected in Nature, as by hydrogenation of the double bond and one ketonic group it could be converted into androsterone; in this way it also provides an explanation for the epi-position of the hydroxyl group in the latter. Moreover, œstrone might be produced by the removal of methane from androstene-dione. In the same manner œstradiol, the most powerful female hormone which was isolated by E. A. Doisy from the ovary, could be derived from testosterone, the most powerful male hormone. Finally, the testo-

sterone in organisms might also have its origin in a partial hydrogenation of androstene-dione. Thus a possible explanation is obtained for the simultaneous occurrence of the male and female hormones in one organism.

The appearance of different hormones with similar action in organisms leads to the question of the relationship between their constitution and physiological action, and, furthermore, to the question of the chemical specificity of hormone action. The specificity is most evident in progesterone, which as yet is the only compound possessing the complete characteristic corpus luteum hormone action. The specificity of the hormones in the œstrane group (VII–XI) is no doubt considerably smaller, as they all show approximately the same qualitative action, the main point of difference being merely a quantitative one. In all the hormones of the œstrane group the phenolic ring is present unchanged, whereas in contrast, this ring in the androstane group (III–VI) is variable, and this group of hormones is accordingly characterised by the largest number of compounds which, in spite of differences in chemical structure, yet show very similar physiological action.

The formulæ (III–VI) give only a partial indication of the possible variations in the androstane group. We have recently discussed[13] more than twenty physiologically active androstane derivatives in which relationships between constitution and action can be undoubtedly recognised. These investigations involved the preparation of the 17-methyl-testosterone, which according to preliminary results seems to show an activity on the sex glands of castrated rats slightly higher even than that of testosterone. In different laboratories and medical research institutes, the most powerful of these compounds, especially testosterone, have been subjected to a thorough investigation, which should provide the answer to the question as to range of the physiological action of the male hormones in healthy and diseased organisms.

[1] B. Zondek, NATURE, **133**, 209, 494; 1934.
[2] E. Tschopp, *Praxis, Schweiz. Rundschau für Medizin*, December 12, 1935, and *Arch. internat. Pharmacodyn. et Thérapie*, January, 1936.
[3] Cf., for more details, an article by J. W. Cook, NATURE, **134**, 758; 1934.
[4] Cf. the latest paper in this field by A. Cohen, J. W. Cook and C. L. Hewett, *J. Chem. Soc.*, 445; 1935.
[5] L. Ruzicka and A. Wettstein, *Helv. Chim. Acta*, **18**, 986; 1935. R. V. Oppenauer, NATURE, **135**, 1039; 1935. W. Schoeller, A. Serini and M. Gehrke, *Naturwiss.*, **23**, 337; 1935.
[6] Only the latest papers are mentioned: R. K. Callow and R. Deanesly, *Biochem. J.*, **29**, 1424; 1935. *Lancet*, ii, 77; 1935. A. S. Parkes, *Chem. and Ind.*, 928; 1935. V. Korenchevsky, M. Dennison and S. L. Simpson, *Biochem. J.*, **29**, 2131; 1935. V. Korenchevsky, NATURE, **135**, 434; 1935. E. Tschopp, a paper in press in *Arch. internat. Pharmacodyn. Thérapie*.
[7] See also E. Dingemanse, J. Freud and E. Laqueur, NATURE, **135**, 184; 1935.
[8] E. Laqueur, P. de Fremery, J. Freud, S. E. de Jongh, S. Kober, A. Luchs and A. P. Münch, *Berichte über die gesammte Physiologie*, **61**; 1931. T. F. Gallagher and F. C. Koch, *Endocrinology*, **18**, 107; 1934. Matsuzaki Kwanji, *Jap. J. Med. Sci.*, **7**, 1515; 1934.
[9] E. Tschopp, NATURE, **136**, 258; 1935.
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[11] K. David, *Acta brev. Neérland.*, **5**, 85, 108; 1935.
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Obituary

Dr. R. G. Canti

BY the death of Dr. Ronald George Canti on January 8 at the early age of fifty-two years, the medical profession loses not only a distinguished consulting pathologist but also a brilliant experimental investigator.

Born in 1883, Canti was educated at Charterhouse, King's College, Cambridge, and St. Bartholomew's Hospital, London. After graduating in medicine he became house physician to the late Dr. Samuel West, and in 1915 joined the teaching staff of St. Bartholomew's Hospital as a demonstrator of pathology. He remained a member of the Pathological Department until his death, being successively senior demonstrator of pathology, bacteriologist to the hospital, and ultimately clinical pathologist and medical officer of health to the hospital. In addition to his hospital work, he carried on a large private consulting practice as a pathologist. In all matters relating to his profession he was an acknowledged master. The late Sir Frederick Andrewes, whose senior assistant he had been for many years, was wont to declare that Canti was the finest clinical pathologist he had ever known.

The heavy demands of private practice, and the routine work connected with his hospital appointments, would have taxed the energies of any ordinary person. But Canti was no ordinary person. He was indefatigable. His quick intelligence, vivid imagination, wide knowledge and superlative technical skill, were always at the disposal of his colleagues and friends, and continually being used by them.

Canti's chief claim to public recognition, however, is the brilliant scientific work which he carried out during the past dozen years on the development of normal and malignant cells and their response to radiation. Active participation in the intensive clinical research on the effects of X- and radium rays on cancer, which was carried out by the staff of St. Bartholomew's Hospital immediately after the close of the Great War, convinced him that progress was greatly retarded by the prevailing ignorance of the fundamental action of these agents on living cells.

Further consideration led Canti and one or two other Bart's men to recognise that the late Dr. T. S. P. Strangeways had so perfected the art of cultivating living tissues *in vitro* as to afford an

almost ideal laboratory method of studying such effects. They joined him to form the Strangeways team for an attack on these problems. A programme of radiological research extending over a number of years was drawn up which, with some modifications, is still being pursued by several of the members of the Strangeways Research Laboratory.

The programme included the investigation of the earliest observable effects of irradiation; immediate and delayed lesions and lethal action; growth stimulation and retardation; vulnerability in relation to the various phases of the life-cycle; relative efficiencies of intermittent and continued irradiation; variation in response due to changes of quality and intensity; and the separation of direct from indirect actions. Canti's genius showed itself in the many new instruments, appliances and techniques which he evolved to elucidate these problems and in the valuable results obtained by him and his collaborators which are published in numerous papers in various radiological and biological journals. Special reference must be made to the now world-famous cinema photomicrographic study which he made on the effects of gamma rays on normal and malignant cells grown *in vitro*. The first apparatus used by Canti for this purpose was constructed from Meccano parts and erected by him in his private house. With it he secured the superb photomicrographs which are now shown in all the continents of the world, and have probably been the means of convincing more people of the efficacy of the radiation treatment of cancer than any other form of publication. For this work Canti received the Röntgen award of the British Institute of Radiology and shared with other members of the Strangeways Research Laboratory the Garton prize of the British Empire Cancer Campaign.

At the time of his death Canti was honorary secretary to the Scientific Advisory Committee of the British Empire Cancer Campaign, to the Cancer Research Committee of St. Bartholomew's Hospital, and scientific adviser to the British Red Cross Blood Transfusion Service. His distinguished appearance, his modesty and great personal charm impressed everyone with whom he came in contact. His loss will be deeply felt by a very wide circle.

In 1912 Canti married Clare Eyles, who nursed him through his last long illness which terminated in pneumonia. He leaves four children, of whom the youngest son is at present a student at St. Bartholomew's Hospital. F. L. H.

Dr. Herbert Bolton

DR. HERBERT BOLTON, director of the Bristol Museum and Art Gallery from 1898 until 1930, died on January 18 at Reading, whence he retired in 1931. Dr. Bolton was born at Bacup, Lancashire, in 1863 and started life as a boy in the mills. He applied himself to the rigid discipline of self-education through the medium of the old-fashioned night schools, and eventually proceeded to the Royal College of Science, South Kensington, where he was a fellow student with H. G. Wells and Morley Davies. He afterwards went to Owens College, Manchester, and in 1890 was appointed to an assistant keepership in the Manchester Museum.

During this period, Bolton pursued several lines of geological research, but even in these early days he was chiefly attracted by the stratigraphy and palæontology of the Coal Measures. His most important contributions to science at this stage include the publication in 1898 of a critical survey of the nomenclature of the seams in the Lower Coal Measures of Lancashire, and the palæontology of the Manx Slates, Isle of Man, in 1899. He was elected a fellow of the Royal Society of Edinburgh in 1894.

Dr. Bolton's real life-work and interest began when he was appointed curator of the Bristol Museum in 1898. He became the first director of the Museum and Art Gallery in 1911 and ably served the city of his adoption for thirty-two years. During this period the exhibition area was increased three-fold and the whole of the material was entirely recased. He always tried to visualise the visitors' point of view, and formulated many museum principles which are to-day universally accepted. Indeed many of the so-called new themes in museology expounded at the present time are to be found in his presidential address at the Wembley Conference of the Museums Association in 1924. Several of the younger generation of museum curators can testify to the intensive and extensive methods of his training. A strict disciplinarian, a ruthless but honest critic, he would first destroy the theme put forward by the budding curator and then by constructive and suggestive means gradually evolve the true solution of any museum problem. A hard and severe training it was, although many have had reason to be thankful for contact with such an inspiring and vitalising personality.

Pre-eminence in the museum world was acknowledged by Dr. Bolton's membership of the Advisory Council of the Victoria and Albert Museum in 1920–33 and by the invitation to give evidence before the Royal Commission on National Museums. At various times he had the opportunity and privilege of visiting the most important museums in Europe, Australia, Canada and America.

Throughout his life, Dr. Bolton always stressed the idea that curatorial work and research were complementary, and reacted both to the benefit of the curator and the institution. He put this theory into practice, and considering that throughout his time at Bristol administrative duties were continually increasing, the amount of original research that he published must be regarded as remarkable. For many years he was reader in palæontology and a member of the Court of the University of Bristol.

In 1907 and 1911 Dr. Bolton published papers on the faunal horizons in the Coal Measures of the Bristol district. In view of the fact that several of these collieries are now closed, the evidence he recorded and the specimens he collected are important. Afterwards, he became interested in several other local geological questions, but finally was inevitably drawn to the small compact group of Carboniferous insects. With Mr. J. W. Tutcher as collaborator in photography, he wrote several papers on these hitherto neglected forms. The paper in which he graphically

described a giant dragon-fly, *Boltonites* [*Meganeura*] *radstockensis*, Bolton, will always have an irresistible appeal to the imagination. Eventually as a *magnum opus*, the Palæontographical Society published in 1921–22 a comprehensive monograph, which is now, and will probably remain for many years, the standard work of reference on this group of fossils. This work was recognised by the award of the Murchison Fund of the Geological Society of London in 1922 and the D.Sc. degree of the University of Bristol in the same year. He was elected a fellow of the Geological Society in 1906 and of the Zoological Society in the preceding year.

In all, Dr. Bolton published sixteen geological papers, but he will be chiefly remembered for his pioneer work in the elucidation of the Coal Measure insects. Although the genetic relationships that he suggested are admittedly tentative, they are founded on observed facts and will form the basis for future investigation on this group. F. S. WALLIS.

PROF. WILLIAM BLAIR-BELL, whose death on January 25 at the age of sixty-four years has been announced, held a high place among modern British physicians. He combined experimental methods of research with clinical observation, and did much to elucidate the control which the pituitary and other glands of internal secretion exert on the ovaries and uterus. He was gynæcologist and obstetrician to the Royal Infirmary, Liverpool, and held the chair relating to those subjects in the University of Liverpool. In the later phase of his professional life, he sought to arrest the growth of malignant tumours by injection of a colloidal salt of lead into the veins of patients, but his results did not inspire others to adopt this mode of treatment. His best-known books are "The Sex Complex" (1916), "The Pituitary" (1919), "Some Aspects of the Cancer Problem" (1930), and "Principles of Gynæcology" (fourth edition, 1933). He received honorary degrees from the Universities of Glasgow and of Liverpool, and was elected an honorary fellow of the American College of Surgeons.

WE regret to announce the following deaths :

Sir Charles Ballance, K.C.M.G., C.B., M.V.O., formerly president of the Medical Society of London, on February 8, aged seventy-nine years.

Prof. K. C. Browning, professor of chemistry in the Military College of Science, Woolwich, on January 25, aged sixty years.

Mrs. M. French Sheldon, who made a remarkable journey from Mombasa to Mount Kilimanjaro in 1890–91 and explored the curious crater lake Chala at the south-east foot of the mountain, on February 10, aged eighty-eight years.

Mrs. Henry Sidgwick, principal in 1892–1910 of Newnham College, Cambridge, and president in 1915 of Section L (Educational Science) of the British Association, on February 10, aged ninety years.

News and Views

State Control of the Chemical Industry

EVIDENCE relating to the State control of chemical industry and its bearing on the armaments traffic and its control was submitted to the Royal Commission on the Manufacture of and Trading in Arms at the Middlesex Guildhall on February 5–6. In a written statement of evidence which covered the whole range of its enterprise from the manufacture of explosives to fertilisers, dyes, paints and lightning fasteners, Imperial Chemical Industries, Ltd., denied that it is in any way party to any "International Armaments Ring". Military products formed only 1·8 per cent of total sales during the last five years and only 0·9 per cent of foreign sales. While not engaged in the manufacture of military products to any extent, its plant, designed for commercial products, can readily be converted to other uses should it ever become necessary. Nitric acid, which is produced in considerable quantities, is a raw material for practically all high explosives, and by-products from the hydrogenation of coal could afford intermediates used in the manufacture of high explosives. The manufacture of nitrocellulose for industrial purposes could easily be switched over to manufacture for high explosives.

THE statement by I.C.I. stressed the necessity of a well-organised chemical industry in any highly industrialised country, and particularly in one with great textile industries. The trained personnel of the dyestuffs industry and its varied and flexible plant is a definite national asset, and is not directed towards the production of mustard gas or other poison gas. The large staff of organic chemists available might be expected to make contributions in the development of pharmaceutical products comparable with those of German chemists in this field. In relation to chlorine, the statement pointed out that chlorine in the form of bleaching powder, etc., is one of the most useful and important servants of the community, and provides the only efficient means of decontamination after a mustard gas attack. In a personal statement, Sir Harry McGowan urged that nationalisation proposals are economically unsound, and suggested the establishment of a permanent supervisory body which would with due financial safeguards co-ordinate private manufacture and provide the auxiliary help necessary when the demand is in excess of the capacity of private concerns. This body would be a shadow of the Ministry of Munitions ; but should be appointed by the industry itself.

Public Health and Agriculture

IN his address to the Farmers' Club on February 3, Sir John Orr further expounded his views on the necessity for a national food policy (see NATURE of November 16, p. 771). The powers now given to marketing boards carry grave responsibilities; if fully used, 7 per cent of the population would control the remaining 93 per cent; therefore those exercising control must think not only of the wholesale price that will make farming remunerative, but also of the retail price within the reach of consumers. The Market Supply Commission is considering food supplies from all three points of view—consumers', exporters' and producers'. The food question has been affected by new scientific discoveries, by our greatly increased productive capacity, and by the world economic crisis. Under-consumption by the poorer classes, with its *sequelæ*, stunted growth, ill-health and poor physique, must be rectified by increases in their dietary of at least 12–25 per cent for dairy produce, vegetables, fruit and meat. Low consumption is due both to poverty and to ignorance. Ten per cent (4½ millions) of our population spend on an average only 4*s*. a head a week on food, and the total income of these families is only 10*s*. a head a week. To meet the extra consumption required, the necessary foodstuffs must be made available to the poor at prices lower than the present retail prices. But the farmers are justly asking for higher prices for their produce. How can both of these opposing needs be satisfied?

SIR JOHN ORR thinks there are two ways of dealing with the problem. Distribution costs must be lowered, and the Treasury, after partly recouping itself from ear-marked tariff revenues, must find the difference. Opposition to State expenditure on great schemes of social welfare, like sanitation and water-supplies, housing and unemployment, has always been strong when the reformative measures were proposed; but in all cases the subsidies given have been justified by results. Both health and a prosperous countryside can be bought by spending money on a national food policy. The discussion on Sir John Orr's address evoked much sympathy from his audience, although it failed to elicit any constructive suggestions. Lord Bledisloe stated that, during his tenure of office as Governor-General of New Zealand, he had ascertained that about 60 per cent of the inmates of public hospitals and similar institutions had suffered from under-nutrition. Several speakers disapproved of a State subsidy as part of a permanent policy, but only one voice—that of a milk-distributor—was raised against the proposal to reduce distribution costs. Lord Radnor, however, pointed out that hitherto no courage had been shown in tackling this important problem. He suggested, as a *tertium quid*, a general increase in the purchasing power of the nation, but no one supported him. It looks, therefore, as if considerable difficulty will be found in arranging a satisfactory 'marriage allowance' for the projected union of public health and agriculture.

Dangers of Modern Civilisation

CIVILISATION and its dangers formed the subject of a recent address by Prof. H. E. Armstrong to the Lancaster Society, the occasion being the delivery of the third Frankland Lecture. Reviewing the chemical foundations of the Industrial Revolution, he laid emphasis on the part played hitherto by coal, and on the necessity of preparation for the coming exhaustion of coal supplies, possibly not more than two centuries hence. Few to-day realise what coal means to them, or they would not use it thoughtlessly; they must take care for the morrow, and efforts should be directed not to employing more miners but to economising the use of coal. The 1851 Exhibition was the first witness to other nations of the fruits of the use of coal; but thereby the jealousy of other countries was excited, and then the engineers began to sell their machines abroad for others to copy, if not improve. They could not both have their cake and eat it unless in some way more cake were provided. Commercial war reigns everywhere; and this, the main problem of to-day, is brought upon them by the advance and spread of knowledge, especially by their power to use it. Insular conservatism is still a hindrance to progress; too often knowledge is ignorantly put aside, and management placed in uninformed hands. "Probably we are at the most perilous period in the history of our country, if not of the world," said Prof. Armstrong, "with little time to look around and put our house in order." Civilisation is fast becoming developed, if not organised, to promote the survival of the unfit. We are already in the position, owing to the art of scientific discovery and invention, of enjoying much more than before without striving; and he reminded his audience that man must either strive or degenerate.

INTELLECTUALLY, morally and physically, declared Prof. Armstrong in his lecture, man is being debased by his own inventions. The 'pictures', the wireless, cigarette smoking, and the aimless use of motor-cars all received their due meed of his disapproval; so also did the schools, the universities, the classical (or closed) mind, and the mechanism of society. Nevertheless, it must be admitted that Prof. Armstrong generally hits a nail on the head, even though he is apt to use a steam-hammer for the operation. It is true enough that the function of the schools should be to give training in the art of understanding; not merely to impart knowledge. It is likewise true that men who have no understanding of the modern world cannot train for a service of reasoned intelligence. Wherefore, he claims, we must now place the schools in charge of men of charitable mind, men who will seek to evoke an understanding of the world in their pupils, that they may be enabled with some degree of thoughtfulness to do their duty with efficiency. It is impossible, said Prof. Armstrong, to overrate the danger arising from our failure to place general education on a scientific basis. Democracy is fast being made impossible by the one-sided application of the skill of the few; it can be saved from an early downfall only by an effective general spread of

knowledge, and in particular of the art of using it thoughtfully and with set purpose. A difficulty will be to find teachers; men of action and ability are too much in demand for commercial or industrial posts. Teaching, in the main, is missionary service. Prof. Armstrong looks to the universities to break a vicious circle; but at present they are "so steeped in professionalism that they are of little use to the ordinary world; they neglect general education on behalf of so-called research". We are entirely with Prof. Armstrong in his plea for a wider spread of knowledge, but he will forgive us for reminding him that we cannot both have our cake and eat it unless in some way we provide more cake.

Dr. C. V. Drysdale, C.B., C.B.E.

THE thirteenth Duddell Medal of the Physical Society was presented on February 7 to Dr. C. V. Drysdale, who is distinguished for his outstanding work in connexion with electrical and optical instruments. Dr. Drysdale was responsible for the design of the first accurate single-phase standard wattmeters in 1901, following them immediately by the first double wattmeters for polyphase measurements, and a few years later by accurate phase-shifting transformers for wattmeter and supply meter testing. In 1909 he adapted the phase-shifting transformer to the design of the first alternating and direct current potentiometer, and devised a vibration galvanometer and low inductance resistance standards which enables that instrument to be used for standardising purposes as well as for general testing, applying it particularly to transmission in telephone circuits. He was also responsible for other electrical standardising apparatus. In 1899, he took charge of the Electrical Engineering and Applied Physics Department of the Northampton Institute, Clerkenwell, and in the following year started the first Technical Optics Department at the Northampton Institute, with a lens grinding workshop. Then came a period of active research in optics, and including the design of lens systems, a universal optical bench for the rapid testing of spherical and cylindrical lens, etc.

DR. DRYSDALE was president of the Optical Society in 1904. In 1915 he entered into partnership with Mr. H. Tinsley for the production of instruments for the War, but at the end of 1917 he was called to the Admiralty Experimental Station at Harwich for anti-submarine research, in the course of which he devised sensitive A.C. relays, a system of 'leader gear' for guiding ships along submarine cables, and various acoustic devices, some of which were described in his Kelvin Lecture to the Institution of Electrical Engineers in 1920. From 1921 until 1929 he was superintendent of the Admiralty Research Laboratory at Teddington. During this time he collaborated with Mr. A. C. Jolley in writing a book on "Electrical Measuring Instruments"; he also edited the *Journal of Scientific Instruments* from 1925 until 1928. Dr. Drysdale held the appointment of director of scientific research to the Admiralty from 1929 until 1935, when he retired.

Earth-Tremors in Montserrat

FOR some time, according to *The Times* of February 7, earth-tremors have been occurring in Montserrat, one of the Leeward Islands. The subject having been referred to it by the Colonial Secretary, the Royal Society has recommended that an expedition should be sent to the Island to make a careful study of the tremors, and has undertaken to organise it and contribute the sum of £300 towards the cost. Since its discovery in 1493, Montserrat has shared to some extent in the destructive earthquakes of neighbouring islands, especially in those of Antigua in 1690, 1785, 1831 and 1874, and of Guadeloupe in 1843. In 1897–99, it was, however, visited by four semi-destructive earthquakes (intensity I., Milne scale), the origins of which must have been within, or close to, the Island. Whether the recent tremors are the forerunners of another earthquake of the same type or of an eruption of the Soufrière, or merely an isolated series of slight earthquakes, would be determined effectively by the erection of portable tremometers, such as are used on similar occasions in Japan, at four stations in different parts of the Island. From the duration of the preliminary tremors, it would be possible to determine the surface position and depth of the focus of every earthquake recorded at all four stations. The results so obtained could not fail to be of value. At the same time, they might tend to allay anxiety in the Island or to suggest precautions for the future.

Palæolithic Types in the American Stone Age

AT the St. Louis meeting of the American Association for the Advancement of Science on December 30–January 4, Prof. E. B. Renaud, of the University of Denver, reported the discovery of a large number of stone implements by the Denver University Archæological Survey of the State of Wyoming in the summer of last year. This survey is part of a comprehensive scheme initiated by Prof. Renaud for the inspection and, where feasible, investigation of the archæological sites of Colorado and adjacent States of the south-west, which has now been in progress for some years, and has already achieved some important results. The present find, according to a report circulated by Science Service, Washington, was made in a series of what Prof. Renaud describes as river terraces along the valley of Black's Fork, in south-western Wyoming, and consists of tools, rejects, scraps and pebbles numbering nearly eleven hundred in all. The principal interest of the discovery, however, lies in the fact that Prof. Renaud has classified the implements into five groups, which correspond to the sequence of European palæolithic cultures, Chellean, Acheulean, Mousterian, etc. They are also said to correspond with the stone age implements of the Nile Valley. Prof. Renaud, in stating that this is the first time such a complex of prehistoric stone industry has come to light in North America, regards it as possible that the discovery "may be very significant". In the absence of more precise data and the verdict of geologists and palæontologists, which he awaits, it is not possible to arrive at a critical estimate of

the importance of the discovery in its bearing on the antiquity of the stone age in America; but it is scarcely necessary to say that identity in type is not an infallible indication of contemporaneity in dating, and in default of support from geological evidence, identities with European implements previously recognised in the south-west have carried little weight in argument.

A Remarkable Whale from Japan

PROF. KYOSUKE HIRASAKA, Department of Zoology, Taihoku Imperial University, Formosa, informs us that he has recently received a letter and a photograph from Mr. T. Iwasaki, chief meteorologist at Ishigaki-jima Observatory (124° 10′ E., 24° 30′ N.), one of the main islands of the Sakishima Group in the Riukiu Archipelago, describing a marine animal caught off Ishigaki-jima and brought ashore by fishermen on March 8, 1935. From the characteristic form of head and lower jaw, and also its size, nearly 8 ft. long, Prof. Hirasaka believes that it might be a

FIG. 1.

pigmy sperm-whale, *Kogia breviceps*. The only further information available is that it was a dark-skinned animal, and its flesh was of a reddish hue. Prof. Hirasaka points out that this whale was already known from California (Gill, *Amer. Naturalist*, 1871), as well as in its natural home, the Indian and Southern Oceans, and Mr. Francis C. Fraser, of the British Museum (Natural History), informs us that Van Beneden and Gervais, in their "Ostéographie des Cétacés" (1880), describe and figure a specimen of *Kogia* which was received from Japan.

Future of Steam Propulsion

IN the eighth Thomas Lowe Gray Lecture entitled "The Future of Steam Propulsion" and read before the Institution of Mechanical Engineers on January 10, Mr. John Johnson, chief engineer of steamship services, Canadian Pacific Railway, gave it as his opinion that, for such powers as are necessary for ship propulsion, steam plant will ultimately prove to be unsurpassed in reliability, durability and smoothness of working. A few years ago, the Diesel engine was rapidly gaining in popularity; but, with the improvements already made and likely to appear in the near future, the position is being reversed. It is essential, of course, that the cruder forms of boiler, engine and auxiliary machinery be discarded and be replaced by a system in which each individual part is pre-eminently fitted to give the most efficient service. Boilers in service in the older ships gave an evaporation of 140 lb. of steam per hour per ton weight at an efficiency of 80–82 per cent; with improved water-tube boilers and preheaters, the corresponding figures are anticipated to be 750 lb. and 90 per cent. To reduce costs of cleaning and repairs, Mr. Johnson looks forward to the use of de-aerated water being accepted as fundamentally necessary in boilers, just as a lubricant is in bearings. Equally effective improvements are suggested in the case of steam turbines, condensers and auxiliary plant.

THE long life of turbines, their relative freedom from wear and repair, and the fact that they require no internal lubrication give them an initial advantage over their rivals, and Mr. Johnson proposed that it would be possible to operate a system with a working pressure of 500 lb. per square inch, and an initial temperature of 900° F. giving 7 per cent wetness at exhaust. With a boiler efficiency of 90 per cent, and 29 in. vacuum, the fuel consumption would be as low as 0·48 lb. of oil per shaft horse-power per hour. To obtain the most favourable results, the author pleads for co-ordination between the several interested parties—the coal industry and the individual firms manufacturing boilers, engines and other units—to promote improvements. It is, he says, the lack of this close co-operation that has retarded the full development of the steam engine.

Steam, Oil-Electric and Electric Rail Tractors

ONE of the main purposes of a railway is to transport the products of industry from the place where they are produced to the place where they are consumed. In passenger transportation, a service is performed in conveying the passenger from his starting point to his destination. To serve the needs of a country, a certain number of units of transportation (measured in ton-miles and passenger miles) must be produced every year by the transport system. A discussion of this problem is given by Mr. A. M. Wright in a paper published in the *Journal of the Institution of Electrical Engineers* of December. The principal competitors of the electric tractor are the steam locomotive and the oil-electric tractor. It has to be remembered that it is not sufficient for a transport system to be capable of producing a given number of ton-miles a year. It is often essential that the units of transportation be produced very rapidly. To take advantage of the superior performance of electric tractors, large capital expenditure for track equipment and substations is required.

MR. WRIGHT shows that there is a permissible economic capital expenditure for electrification in pence per ton-mile carried per annum. He works out a hypothetical example of a transport system capable of handling various tonnages of goods traffic. The costs of equipping the track for electric working

are given, and the annual operating costs are compared with those for steam haulage. He proves that when the traffic density is fairly high, railway electrification is economically feasible. A discussion of the various methods of electrification shows that the single-phase system has attractive possibilities. He concludes that if a transport system were developed *ab initio* in an advanced industrial country like Great Britain, electric working would be extremely attractive. But where a railway is already in existence, the capital cost of converting to electric haulage is of prime importance, the reason being that the problem at the moment is not so much economic as financial.

Memorial to Prof. T. Eric Peet

As the result of the appeal issued in 1934, the sum of £1,010 15*s*. 9*d*. has been contributed for the purpose of a memorial to Thomas Eric Peet, who was, at the date of his untimely death, professor of Egyptology in the University of Oxford. This sum, it is announced by Prof. J. P. Droop in a letter in *The Times* of February 7, has been paid over to the Council of the University of Liverpool for investment. The income from the endowment thus created will be used for the quinquennial award, on the recommendation of the executive committee of the University of Liverpool Institute of Archæology, of a fellowship, tenable for one year by a graduate of a British university, who proposes a course of study either in "The Ancient Egyptian Language and Egyptology" or "The Prehistory of the Mediterranean Lands and/or the Near East". Unless the dispensation of the executive committee is obtained, four months of the year of tenure must be spent out of England. Awards will be made in the month of June of the year of award, and one half of the value of the fellowship (£150) will be paid on award, the balance being payable on receipt of a satisfactory report on his work from the fellow at the close of the first six months. It is within the competence of the Council to vary the terms of the award, so long as the provisions as to the qualifications of candidates and the subjects of study are observed. The first award will be made in 1941.

Immunity in Protozoal Disease

THIS was the title of the presidential address delivered by Lieut.-Colonel H. E. Shortt to the Section of Medical and Veterinary Research of the twenty-third Indian Science Congress, Indore (Jan. 2–8). After a brief survey of the subject of immunity in general in infective diseases, Colonel Shortt proceeded to discuss the mechanisms that may exist for the production of immunity in the protozoal diseases trypanosomiasis, malaria, leishmaniasis and piroplasmosis, and concluded that they are very similar to, if not identical with, those which are operative in immunity against bacterial diseases. In the case of malaria, it might be thought that no immunity develops, for individuals may suffer not only from numerous relapses during the course of an attack, but also may be repeatedly re-infected. In the case of natives dwelling in a malarious district, however, it would appear that the community does acquire a relative immunity after about twelve years exposure to infection. One of the factors limiting immunity in protozoal diseases is the development of strains of the parasite immunologically different and distinct from the original infecting strain, and a relapse or a re-infection may be caused by a strain immunologically different from the original one. Thus, it has been shown with the trypanosomes that a mouse, incompletely cured of its infection twenty times, produced seventeen immunologically different relapse strains. A full and useful bibliography is appended to the address.

Co-ordination of Botanical Research in the British Empire

THE Report of the third Imperial Botanical Conference (see NATURE, **136**, 402 ; 1935) held in London on August 28–30, 1935, has recently been issued (Royal Botanic Gardens, Kew, price 1*s*.). Apart from the various discussions reprinted from NATURE, Sir Arthur Hill, president of the Conference, made an eloquent plea for the furtherance of the scheme for the creation of liaison officers from the Dominions and Colonies, thus ensuring closer co-operation with the National Herbarium at Kew. Since 1883, an assistant for India has been working at the Kew Herbarium, supported by the Government of India. The Government of the Union of South Africa similarly maintains an assistant for Africa at Kew. As in these cases, there are preserved in the Kew Herbarium most of the early collections of Australian and New Zealand plants and many from Canada. Naturally, these historic collections cannot leave the country, and it is highly desirable that young botanists from the Dominions should be given the opportunity of working on these collections, of getting into touch with botanical colleagues, and of acquiring a knowledge of methods of work in large British and Continental herbaria and libraries at present out of their reach. A resolution was therefore passed at the Conference that the authorities be asked to appoint liaison officers and exchange officers from Australia, New Zealand and Canada. It was also resolved that the "exchange both of members of the staff and research students between the Universities and Research Institutions and relevant Departments of the Empire" should be encouraged, and the establishment of a permanent committee for this purpose be recommended.

Chemical Engineering Congress

PROVISIONAL programmes of the business which will be discussed by the twelve sections of the Chemical Engineering Congress of the World Power Conference in June next have just been published. The Congress will meet at the Central Hall, Westminster, on June 22–27 ; with it will be associated visits to works and opportunities for social intercourse in the form of receptions and a banquet. During the course of the Congress, the British Chemical Plant Manufacturers' Association will hold its periodical exhibition of British chemical plant at

the Central Hall. The several sections of the Congress are concerned with various phases of chemical engineering, as follows : (*a*) ferrous metals in chemical plant construction ; (*b*) refractories, rubber, plastics, and other materials in chemical plant construction ; (*c*) separation ; (*d*) size reduction, grading and mixing; electrolysis, etc. ; (*e*) destructive distillation ; (*f*) treatment and disposal of effluents and waste materials ; lubrication ; (*g*) high-pressure reactions and high vacua ; (*h*) heat exchange ; (*j*) education and training ; (*k*) statistics ; administration ; safety and welfare ; (*l*) trend of development ; (*m*) general aspects. Papers are being presented from Great Britain, Holland, the United States of America, Canada, Japan, Sweden, Austria, Germany, Poland, Russia, Denmark, Hungary and Switzerland ; about one hundred and twenty titles are given in the provisional time table. The president is Viscount Leverhulme. Chairmen of committees are as follows : organising, Sir David Milne-Watson ; technical, Mr. W. A. S. Calder ; hospitality, Sir Alexander Gibb ; finance, Mr. J. Davidson Pratt ; publicity, Dr. E. W. Smith. The general secretary is Mr. M. W. Burt, and the international secretary is Mr. C. H. Gray. Communications from Great Britain should be addressed to the Congress Office, 56 Victoria Street, London, S.W.1, and those from other countries should be addressed to the Office of the International Secretary, 36 Kingsway, London, W.C.2. Further announcements will be made in due course.

Tracing the Dawn of Life

IN 1917, there was inaugurated at the Cawthron Institute of Scientific Research, Nelson, New Zealand, an annual lecture to commemorate the generosity and foresight of the founder of the Institute, Thomas Cawthron. Each year since then, with the exception of 1931, the Cawthron Lecture has given a distinguished investigator an opportunity of setting before the public the results of progress in some particular branch of knowledge. The lecturer of 1935 was Dr. R. J. Tillyard, his subject "Tracing the Dawn of Life Further Backwards". In following the conditions of life in geological epochs from the present to the earliest times, he discussed briefly the outstanding products of each age. The climax of his story was the statement that in Pre-Cambrian rocks, belonging to the Middle Proterozoic series of Tree Gully near Adelaide, the late Prof. David and he had discovered remains which he had described (in a paper shortly to be published) as belonging to a new class of Arthropods, differing from all other arthropods in having the segments of the head freely articulated.

The Warburg Institute

IN May 1934 the Warburg Society was formed with the object of establishing the Warburg Institute, formerly of Hamburg, in England. The first annual report since this movement took place shows that the transference has been successfully accomplished, and that in its new rooms in Thames House, London, the Institute has been able to resume most of its old activities and to feel its way towards new ones. The Institute has three links with the public—its library, its series of lectures, and its publications. The transference of the first was completed on June 28, 1934, and since then the number of serious and research readers has steadily increased. Several lecture courses on various aspects of the history of art were given by English, German and French scholars, including a three-weeks' course on palæography by Prof. R. Salomon of Hamburg. The report makes grateful acknowledgment of the help given by English patrons.

Congress of Refrigeration

THE seventh International Congress of Refrigeration will be held at The Hague and Amsterdam on June 16–27. The Congress will be divided into four sections : (1) Scientific (physics, chemistry, thermodynamics, units, biology and medicine) ; (2) Refrigerating Machines and Materials (air-conditioning, insulating materials, refrigerating plants and testing methods) ; (3) General Applications of Refrigeration (food and perishable products, agricultural industries, ice industries, chemical and rare gas industries, low temperatures) ; (4) Refrigerated Transport, etc. (land and water transport, legislation, education and propaganda, general economics and statistics). Among the visits arranged is one to the Kamerlingh Onnes Laboratory at Leyden, where lectures and demonstrations of cryogenic work will be given by Prof. H. W. Keesom and Prof. W. J. de Haas. Further information can be obtained from the Organisation Office, 107 Stolbergloan, The Hague.

Announcements

THE following medals will be awarded at the annual corporate meeting of the Institution of Chemical Engineers on March 6 : Moulton Medal, for the paper on "The Evaporation of Water from Plane and Cylindrical Surfaces", to R. W. Powell and Dr. Ezer Griffiths ; Osborne Reynolds Medal, for meritorious service in the advancement of the Institution, to F. A. Greene ; and the William Macnab Medal (first award), for the best set of answers submitted in the associate-membership examination in 1935, to D. K. Moore.

LORD RAYLEIGH has been elected chairman of the governing body of the Imperial College of Science and Technology in succession to the Marquess of Linlithgow, who has resigned on taking up his appointment as Viceroy of India.

AT a meeting of the executive of the Parliamentary Science Committee held on February 6 at the House of Commons, under the chairmanship of Sir Arnold Wilson, Mr. Alan Chorlton, M.P. for Bury, was re-elected deputy-chairman of the Committee ; and Lord Melchett, Prof. Graham Kerr and Mr. Andrew McLaren were elected as additional parliamentary members of the executive.

AT a recent meeting, the Council of the Royal Asiatic Society conferred honorary membership upon Prof. Georges Cœdès, of the Ecole Francaise

D'Extrême Orient, Hanoi, French Indo-China, in recognition of his eminent services to the history, epigraphy and geography of the Malay Peninsula and the Far East; and upon Prof. H. E. Winlock, director of the Metropolitan Museum of Art, New York City, for his distinguished services in the cause of Egyptology.

THE following appointments have recently been made by the Secretary of State for the Colonies: J. H. Gisborne, to be superintendent of agriculture, Nigeria; Miss A. N. Smith, to be curator, Peace Memorial Museum, Zanzibar; L. Starbuck, to be professional assistant, Royal Observatory, Hong-Kong; D. S. Davies (agricultural officer), to be senior agricultural officer, Uganda; Major C. D. V. Georgi (assistant agricultural chemist), to be chemist, Research Branch, Agricultural Department, Straits Settlements and Federated Malay States; G. J. Williams (field geologist, British Guiana), to be assistant geologist, Tanganyika.

A GERMAN Society for Researches in Nutrition was inaugurated on December 16 at the Public Health Office of the Reich in Berlin.

THE work entitled "The Geology of the Argentine" by the recently deceased German geologist Anselm Windhausen, professor of geology at Cordoba, has been awarded the second prize for the best scientific and literary work in the Argentine Republic for the years 1931–32.

THE German Society for Balneology and Climatology will hold its annual meeting at Munich on March 16–17, when the three principal subjects for discussion will be: (1) the south wind in its meteorological and bioclimatic aspects; (2) recent investigations on water and their physiological importance; (3) spa treatment of catarrh and asthma.

THE German Röntgen Congress will be held at Wiesbaden on March 26–28. The meetings on the first day will be held in conjunction with the German Society for Internal Medicine. Further information can be obtained from Prof. Dr. Dietlen, Landeskrankenhaus, Saarfalz, Hamburg.

THE Soviet Government has decided to organise a special Institute for Experimental Physiology and Therapeutics at Pirogoff municipal hospital, and has set aside 500,000 roubles for its equipment. Physiologists, biochemists and other scientific workers will take part in the work at the new institute.

WE are asked by the Trustees of the Percy Sladen Memorial Fund to announce that almost the whole of the income of the Fund for this year and next is already pledged. A small sum has been reserved to meet urgent cases, but no application for any large sum can be considered for at least another eighteen months.

THE position of virus physiologist at the Rothamsted Experimental Station rendered vacant by the appointment of Dr. John Caldwell as lecturer in botany at the University College, Exeter, is to be filled by Mr. F. C. Bawden, research assistant at the Potato Virus Research Station, School of Agriculture, Cambridge. Mr. Bawden graduated at Cambridge, where he was elected a college scholar at Emmanuel College. He was trained in plant pathology under Mr. F. T. Brooks, and since June 1930 has worked at virus disease in plants under Dr. R. N. Salaman at the Potato Virus Research Station, Cambridge.

THE Institute of Metals is arranging a special meeting on March 10, in connexion with the Institute's annual general meeting, to discuss the subject of "Metallic Wear". The discussion will be opened by Dr. H. W. Brownsdon. Members of other institutions, including the Institution of Mechanical Engineers, the Institution of Naval Architects, the Institution of Automobile Engineers, the Iron and Steel Institute and the Royal Aeronautical Society, have been invited to take part in the discussion. Cards of invitation may be obtained from Mr. G. Shaw Scott, Secretary, The Institute of Metals, 36 Victoria Street, London, S.W.1.

ERRATUM.—The eleventh Annual Conference of the Electrical Association for Women will be held on May 13–15, not March 13–15 as announced in NATURE of February 1, p. 184.

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

A metallurgist to the British Non-Ferrous Metals Research Association—The Secretary, Regnart Buildings, Euston Street, N.W.1 (Feb. 17).

A teacher of engineering in Norwich Technical College—The Director of Education, 41 St. Giles Street, Norwich (Feb. 17).

A civilian technical officer (thermodynamics) in the Department of Scientific Research and Experiment, Admiralty—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (Feb. 21).

Assistants (Grades I, II and III) in chemistry at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (Feb. 22).

A tutor and lecturer (woman) in hygiene and methods of teaching biology, and a tutor and lecturer (man or woman) in methods of teaching mathematics in the Institute of Education, Southampton Row, W.C.1—The Secretary (Feb. 26).

A lecturer in the Engineering Department, Leicester College of Technology—The Registrar (Feb. 29).

A Grade II (*c*) lecturer in mechanical engineering in the University of Birmingham—The Secretary (March 2).

A woman lecturer in geography and nature study in the Glamorgan Training College, Barry—The Director of Education, County Hall, Cardiff (March 2).

A vice-principal of the Blackpool Technical College—The Director of Education, Education Office, 51 Cookson Street, Blackpool.

Chemists for the R.N. Cordite Factory—The Secretary of the Admiralty (C.E. Branch), London, S.W.1.

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. 279.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Inertia and Energy

A LUCID account has been provided by Lord Rutherford in his James Watt lecture (NATURE, Jan. 25) of the recent extraordinary development in the world of atomic projectiles and rays, which would be incredible on the usual electric basis were it not that, from the nature of the subject, as soon as a result is announced it is capable of immediate test, with marvellous precision, by the experts in other laboratories. A basic principle in the speculative side of this subject is the identity of mass and energy, including extinction of structural atoms, which the chemical world, with its great tradition and achievement, appears to accept with equanimity; it has, however, as now appears, been coming into question, but can of course be adjusted by the supposition that there are types of energy hitherto unrecognised. For, as Lord Rutherford insists, universal energy is an abstraction, unheard of a century ago, and repudiated even much later by great astronomers; and energy as well as mass is relative, depending on the frame of reference.

The discrepancy now encountered may permit reference to another aspect of the case, not loosely supported. So far as I am aware, this dogma of identity pertains strictly only to the abstract four-fold continuum (now changing into translatory *quanta* ?) of space-time, in which energy is merely the last of the ten components of a fundamental tensor into which it is found that mass (except inertia of atomic spin ?) has to be fitted. But this abstract translatory mass in the universe of space-time has, as one may note, nothing to do directly with the inertia that is measured by an observer with his instruments which are located in his own environment in his personal space and time, with which alone even astronomers can deal. Incidentally, one is here tempted to quote a pronouncement of Torricelli ages ago which fascinated Clerk Maxwell (at the end of the "Treatise", § 866), that energy "is a quintessence of so subtle a nature that it cannot be contained in any vessel except the inmost substance of material things".

The present subject takes on a different, though doubtless more intricate, aspect when developed directly, as it was originally, in terms of the associated (Lorentz) group of frames of reference of the various possible related observers travelling throughout the unique universe, of which the space-time merely affords a hypergeometric condensation convenient for certain purposes of analysis. But the subject, surely fundamental in metaphysics as well as in cosmical physics, scarcely admits of brief exposition. A discussion, from the side of this experimental foundation in spaces and times of observers, relating specially to the inertia of radiation and its interchange with the inertia of the radiators, involving loss of kinetic mass from the latter, may be referred to in a lecture by the writer to the International Association of Mathematicians at Cambridge (1912), reprinted with cognate papers and notes in "Mathematical and Physical Papers" (1928), cf. vol. 2, p. 444; the verification there is restricted, as coming from a Lorentz transformation, to *translatory energy* in relation to *translatory inertia*.

JOSEPH LARMOR.

Holywood,
Co. Down.
Feb. 2.

'Extra' Rings in Graphite Electron Diffraction Patterns

RECENTLY we have obtained transmission patterns from graphite powders in which prominent 'extra' rings appear; owing to insufficient resolution these have hitherto escaped notice. Two of these rings lie in a band comprising also the 100 and 101 diffractions (see Fig. 1), and others lie out beyond this region. These 'extra' rings have been obtained from both natural and artificial graphite powders of high carbon content, and are therefore not due to impurities; nor can they be ascribed to a Lennard-Jones surface lattice deviation effect, because the sharpness of the 110 ring negatives any such explanation. The dimensions of the 'extra' rings and the manner in which they break up into arcs on inclining an orientated specimen in the beam shows that these rings are due to planes, the spacings of which have no counterpart in the structure assigned to graphite by X-rays.

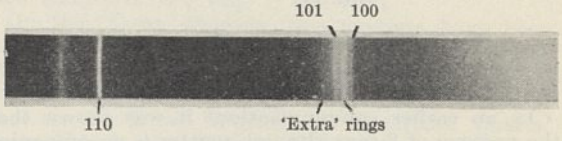

FIG. 1. Electron diffraction pattern (much enlarged) from graphite powder.

A relatively thick graphite crystal gives a Kikuchi line pattern which, however, completely confirms the X-ray structure, whilst a sufficiently thin flake cleaved from the same crystal gives a cross-grating type of pattern containing the 'extra' diffractions. Hence we are faced with the apparent paradox that although the thick and thin crystals must both have the same lattice structure, the thin crystals contain certain Bragg plane spacings not exhibited by the thicker graphite. It seems to us that the solution lies in the fact that in the case of a thin graphite flake the periodicity of certain lattice rows is not fully developed; hence parallel planes are not necessarily equally densely populated. Thus, let

Fig. 2 represent the (h00) cross-section through a thin crystal. Then the points of the corresponding cross-grating are also the projections of infinitely long atom rows, and the lattice extends virtually to infinity in the (00l) plane dimensions, but is strictly limited in the l axis direction by the thickness of the crystal, in this case taken as three lattice points thick by way of example. It will immediately be evident that, though the (0k0) planes all contain equal numbers of lattice point rows, successive (0kl) planes (where k and l are one even, one odd and $k<3$) in general contain different numbers of lattice rows, with the result that, in the example under consideration, the effective d_{0kl} values are integral multiples of what, in the absence of limitation in the l axis direction, would have been the corresponding normal Bragg plane spacings.

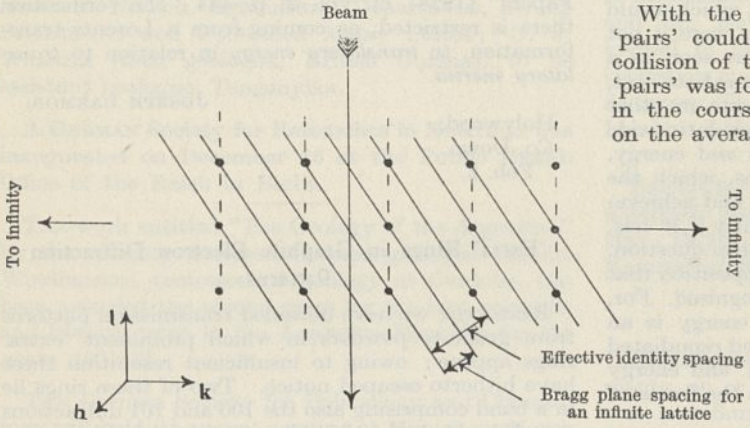

FIG. 2.

We have on these lines been able to account with excellent quantitative agreement for the graphite 'extra' rings so far observed. Similarly, the banded nature of the 100–101 group can be reasonably explained in terms of this new effect.

G. I. FINCH.
H. WILMAN.

Department of Chemical Technology,
Imperial College of Science.
Jan. 21.

Production of Positrons by β-Rays

IN an earlier communication[1] it was shown that the passage of β-rays through matter is accompanied by the emission of positrons. Since this is quite inconsistent with present theory, further confirmation was clearly necessary by a more direct method. Investigations were accordingly carried out with a beam of fast β-rays from a radioactive source (3–5 mc. of radium bromide) placed outside the expansion chamber at a distance of about 30 cm.

A beam of β-rays, passing through a slit and deflected through an angle of 90° by a small electromagnet, entered the chamber through an aluminium window, after which it passed through various screens inside the chamber. The latter was protected from the γ-radiation of the source by a 15 cm. layer of lead. The velocities of the β-rays obtained in this way were mostly greater than 2,000 ekv. Screens of aluminium (0·5 and 1 mm. thick) or lead (0·07 and 0·13 mm.) were placed at right angles to the rays, as well as in certain cases a glass plate at an angle of 45°.

FIG. 1.

With the above arrangement, the formation of 'pairs' could be observed directly at the point of collision of the β-particle. The greatest number of 'pairs' was found in the lead (not less than 10 'pairs' in the course of 300 expansions, with 4 particles on the average emerging from the screen during one expansion). Fig. 1 is a photograph of such a 'pair' produced in lead.

In addition to the formation of 'pairs', the absorption of the primary β-particle is sometimes accompanied by the emission of a single positron. In aluminium, this is the predominating effect.

A comparatively weak magnetic field (500 gauss) was used on purpose, so that the electrons emitted by the plate should not return to it. In a field of this intensity, the tracks of the primary particles are only slightly curved and the photographs cannot be used for verifying the energy balance.

The production of positrons along the path of the β-particle in the *gas*, as has been already reported in our previous publications, was also observed in these experiments. Five positrons have been detected over a total length of 275 m. The effective cross-section in nitrogen is therefore of the order of 5×10^{-24} cm.^{2}, while according to our previous estimate the value obtained was 10^{-23} cm.^{2}.

Our results disagree with those of Alichanow[2] obtained by means of the electrical counting method. The percentage yield, as given previously by us, requires therefore verification. However, significant error in the order of magnitude is impossible, and Alichanow was certainly incorrect in concluding that the effective cross-section for β-rays is smaller than that for γ-radiation.

With regard to the disagreement with theory, the facts described in our previous note, as well as some experimental data which will shortly be published on the scattering of β-rays, show that the interaction between fast β-particles and the nuclear field cannot be described by any of the existing theories.

D. SKOBELTZYN.
E. STEPANOWA.

Physical Technical Institute,
Leningrad.
Dec. 12, 1935.

[1] *J. de Phys.*, **6**, 1 (1935).
[2] A. Alichanow, A. Alichanian and M. Kozodaew, NATURE, **136**, 719 (1935).

Nuclear Photo-electric Effect in Deuterium

CHADWICK and Goldhaber[1] in their experiments on the splitting of deuterium by γ-rays from thorium ($h\nu = 2{\cdot}62 \times 10^5$ ev.) measured, by means of an amplifier and a recording oscillograph, the ionisation of each 'photo'-proton produced. They found the average size of this ionisation to be 7,200 ion-pairs, which, assuming 33 ev. as the ionisation energy of deuterium and adopting for the masses of hydrogen and deuterium 1·0081 and 2·0142 respectively, leads to the value 1·0084 for the mass of the neutron.

By means of a very sensitive electrometer and a semi-automatic compensating and registering device (constructed by G.I.), the ionisation produced in deuterium by each photo-proton was measured (by M. H.). The ionisation chamber, with a volume of 1,700 c.c., was made of silvered glass and divided in two symmetrical halves, the walls of which were charged to opposite potentials. On account of this symmetrical arrangement, the electronic ionisation

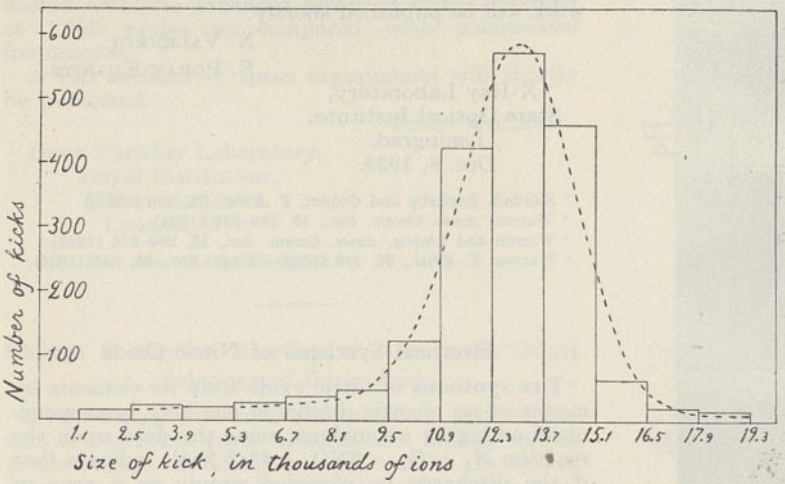

FIG. 1.

produced by the γ-rays only resulted in a slight wandering of the electrometer needle, while a photo-proton manifested itself by a 'kick' in one direction or the other, depending upon the half of the chamber in which it originated. The electrometer had a sensitivity corresponding to 2,900 ions per scale division, its time of indication being about 6 seconds.

The γ-ray sources consisted of mesothorium and radiothorium preparations with some radium, equivalent in all to about 3·7 mgm. radium. The γ-rays were only slightly filtered; two of the sources being shielded only by a few millimetres of glass and the other two by about 2 mm. of brass in addition. In spite of this simple filtering, there was no trouble with background. In the main experiment, the frequency of registering was about 140 'kicks' per hour. Only 10 per cent of them were null effects.

Fig. 1 shows the distribution in size of 2,000 kicks, after subtracting the null effect. The essential features of the curve correspond to one definite size of the kicks with a Gaussian distribution of observational errors superimposed. The top of the curve lies at 13,000 ions which, with the assumptions mentioned above, will give 1·0080 as the mass of the neutron.

The mean error in the determination of the size of a kick amounted to about 1,300 ions and was mainly (to about 3/5) due to the Brownian fluctuations of the electrometer needle.

Further details concerning the experiments will be published later.

GUSTAF ISING.
MATTS HELDE.

Physical Laboratory,
University,
Stockholm.
Jan. 7.

[1] *Proc. Roy. Soc.*, A, **151**, 479 (1935).

X-Ray Investigation of the Glassy State

X-RAY diffraction has been used to examine vitreous silica prepared by different methods, and also to study a series of soda-silica glasses subjected to thermal treatments of different duration. Experimental conditions: filtered $K\alpha$ copper rays ($\lambda = 1{\cdot}538$ A.) were used, the diameter of the cylindrical camera being 29·0 mm.

Vitreous Silica. A factory sample of pure quartz glass showed on the X-ray diffraction diagram (Fig. 1, No. 67), in addition to an intense maximum at a scattering angle $2\theta = 21° 16'$, a very feeble and indistinct second maximum corresponding to a much greater scattering angle (approximately 83°) which, although observed by Randall[1], was not regarded by him as really existing in view of its feebleness; this maximum has also been observed by Warren[2] at a scattering angle of 71° approximately.

This slight maximum was more pronounced in a sample of quartz-glass obtained by us from quartz and by melting in the Tammann furnace (at 1,760° for 20 min.), and in addition traces of new maxima appeared, clearly visible in the X-ray pattern of the sample melted by us in identical conditions from a mixture of crystobalite with tridymite (see Fig. 1, No. 101).

On this X-ray diagram, five maxima have been obtained by us corresponding approximately to the following angles of scattering: 21° 16′, 36°, 48°, 64° and 83°. All these maxima coincide with groups of lines on the X-ray diagrams of devitrified 'quartz' glass (Fig. 1, No. 67*a*) and of micro- and macro-crystalline mixtures of crystobalite with tridymite (Fig. 1, Nos. 74 and 89).

All samples of the vitreous silica have been observed with a polarisation microscope, and no traces of crystallisation have been observed.

Soda-Silica Glasses. Five different sorts of soda-silica glasses with the following composition were investigated:

Specimen	Molecular percentage		Weight percentage	
	SiO_2	Na_2O	SiO_2	Na_2O
1	50·00	50·00	49·21	50·79
2	62·50	37·50	61·76	38·24
3	66·66	33·33	65·96	34·04
4	73·00	27·00	72·36	27·64
5	77·00	23·00	74·43	23·57

Examination of the X-ray diagrams obtained from these glasses gave evidence of the following effects: with rising temperature and on increased duration of heating of the glasses, the new maxima appeared on the diagram at large glancing angles; the intensity and sharpness of these maxima increased until the transition into a diagram corresponding to the crystalline state was completed. At the same time the sharpness of the principal maximum also increased. On heating specimens 1, 2 and 3, the maxima

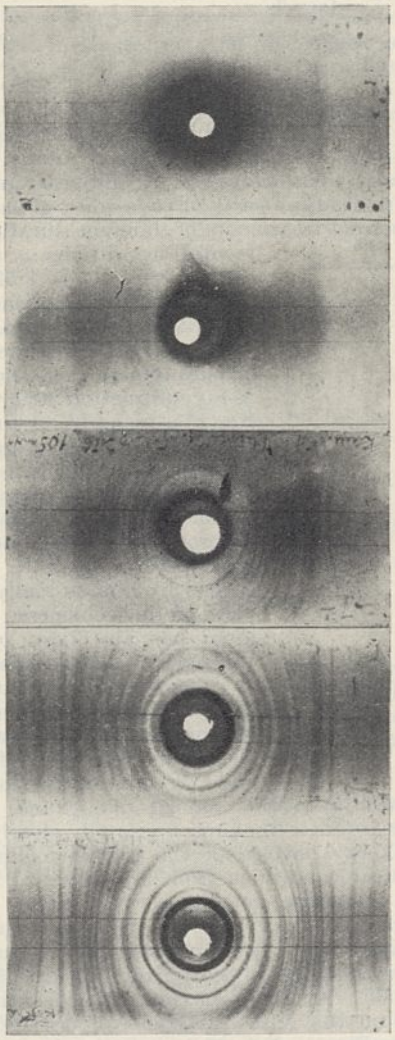

FIG. 1

obtained corresponded to the scattering angles of about 33°, 45° and 59°, not coinciding with any of the scattering angles of the maxima of the vitreous silica. Specimens 4 and 5 showed two principal maxima (approximately 33° and 45°) and, in addition, three maxima belonging to the vitreous silica (21° 16′, 64° and 83°). Warren[3] obtained for all kinds of soda-silica glasses (not heated) examined by him two maxima (21° 16′ and 32° 8′).

Discussion. The gradual change of the diffraction pattern on transition from the vitreous silica to the crystalline mixture of crystobalite and tridymite (see Fig. 1) and also from the heated soda-silica glasses to the devitrified ones clearly proves the lack of a sharp boundary between the glassy and the crystalline states. It demonstrates the gradual growth of the crystallites, giving thereby strong support to the 'crystallite' theory of Randall[1] and disposing of the objections put forward by Warren[2,4] against this theory.

Of course the growth of the crystallites should become more evident at large scattering angles than at the principal intense maximum. Yet the maxima corresponding to the larger angles of scattering are so feeble that their detection is most difficult. This circumstance evidently explains the total lack of information on the distribution curves of the scattered intensity from glassy substances at great angles of scattering (the largest angles of scattering given by Warren[2,3] are approximately 71° for SiO_2 and 44° for soda-silica glasses). However, as these maxima can be observed on all the X-ray diagrams obtained by us, the lack of sharp boundaries between the glassy and the crystalline state is to be considered as qualitatively ascertained. A full report of this work will be published shortly.

N. VALENKOF.
E. PORAY-KOSHITZ.

X-Ray Laboratory,
State Optical Institute,
Leningrad.
Dec. 8, 1935.

[1] Randall, Rooksby and Cooper, *Z. Krist.*, **75**, 196 (1930).
[2] Warren, *Amer. Ceram. Soc.*, **17**, 249–254 (1934).
[3] Warren and Loring, *Amer. Ceram. Soc.*, **18**, 269–276 (1935).
[4] Warren, *Z. Krist.*, **86**, 349 (1933). *Phys. Rev.*, **45**, 657 (1934).

Electrical Synthesis of Nitric Oxide

THE synthesis of nitric oxide from its elements by means of an electric discharge has long been recognised as highly anomalous, since the data upon the reaction $N_2 + O_2 \rightarrow 2NO - 43{\cdot}2$ kcal. indicate that if the discharge be regarded simply as a zone of exceedingly high temperature, the maximum yield of product should be obtained by the passage of an equimolecular mixture, followed by the most rapid cooling to *c.* 1,000° C., and independently of the pressure of the gas. In practice, however, the best results are obtained with slow circulation at *c.* 100 mm., a mixture of one part of nitrogen and four parts of oxygen being nearly as effective as the other. It has therefore been supposed that, apart from possible errors in the calculations due to extended extrapolation, the reaction is primarily electrical and incapable of simple thermodynamic interpretation, although conditions of experiment may in some cases permit of the superposition of a thermal process so strong that predictions are fulfilled.

Recent observations in this laboratory seem to have a bearing on the subject. It has been found that, with a 1 : 1 mixture of the gases, the yield at 5–10 mm. pressure and with a rapid circulation of the gases is practically independent, over a wide range, of the power supplied, the nitric oxide being oxidised to nitrogen dioxide and frozen out by liquid air at a fixed distance away from the discharge. If, however, two traps are used in series, one close to and the other some distance away from the discharge, seven to ten times as much nitrogen dioxide is obtained when the condensation is effected in the

former rather than in the latter, although the equivalent time interval is only *c.* $\frac{1}{20}$ second. The effect no longer appears if a plug of oxidised copper is inserted between the discharge tube and the first trap, and addition of large excess of oxygen to the glowing gas at the same point also enables the same amount of nitrogen dioxide to be collected in either vessel. It would appear that active nitrogen—which is very susceptible to catalytic destruction by copper oxide or oxygen—is formed simultaneously with the nitric oxide, and decomposes a good deal of it unless a suitable third body is present. The effect diminishes as the percentage of oxygen increases, as is to be expected.

The marked superiority of the impulse discharge already reported for the production of active nitrogen[1] has also been observed for this reaction and for the dissociation of oxygen. In the latter case, however, the yield of atomic species increases very considerably with the frequency, although the power input is held constant, an effect which may possibly be connected with the enhanced yields of ozone observed at 1,000 cycles as compared with commercial frequencies.

A full account of these experiments will shortly be published.

JOHN WILLEY.

Davy Faraday Laboratory,
Royal Institution,
Albemarle Street,
London, W.1.

[1] *Proc. Roy. Soc.*, A, **152**, 158 (1935).

Change in Optical Rotation of Glucose in Dilute Solutions of Boric Acid

SOME unexpected results obtained on the respiration of a strain of yeast in boric acid buffers[1] led us to investigate the changes in *p*H and in the optical rotation of glucose in boric acid and in borax solutions. In spite of the claim to the contrary[2], we observed a change in the optical rotation of glucose in boric acid solutions at certain concentrations. The table below and Fig. 1 show the changes in *p*H values and in $[\alpha]_D$ of glucose when different amounts of boric acid (H_3BO_3) or borax ($Na_2B_4O_7$) are added to solutions containing 10 per cent (5·55*M*) glucose. The solutions were prepared 24 hours prior to observation.

H_3BO_3 experiments				$Na_2B_4O_7$ experiments			
Conc. of H_3BO_3	[Glucose]/[H_3BO_3]	*p*H	$[\alpha]_D$	Conc. of $Na_2B_4O_7$	[Glucose]/[$Na_2B_4O_7$]	*p*H	$[\alpha]_D$
0	0	—	52·5	0	0	—	52·5
M/10	55·5	4·14	51·8	*M*/15	83·1	6·88	46·9
M/7·5	41·7	4·06	46·6	*M*/12·5	69·5	6·88	41·9
M/5	27·8	3·90	48·0	*M*/10	55·5	6·93	38·7
M/2	11·1	3·59	50·3	*M*/7·5	41·7	6·98	36·1
				M/5	27·8	7·14	33·8

Two facts stand out in these results: While the changes in *p*H in both the boric acid and the borax solutions and the change in $[\alpha]_D$ of glucose in borax solution may be represented by smooth curves, the change in $[\alpha]_D$ of glucose in boric acid solution is not a smooth curve. The total change in $[\alpha]_D$ is of the order of 20° in the borax series, while the maximum change in $[\alpha]_D$ in boric acid solutions amounted to only about 6°. Using a 10 per cent sugar solution and a tube length of 20 cm., a change of 6° in the specific rotation amounted to only about 1° in the rotation actually observed.

The data for the boric acid series is presented graphically in Fig. 1, the upper part of which gives the data for *p*H and the lower part, $[\alpha]_D$, all plotted against the common abscissa, which is the concentration of boric acid. The line separating the two curves gives the specific optical rotation of a pure glucose solution. We see that the value of $[\alpha]_D$ of glucose in an *M*/10 boric acid solution is about the same as that for a pure glucose solution, dropping suddenly to a sharp minimum at *M*/7·5 boric acid; it then rises gradually to about the same value as that for pure glucose as the concentration of boric acid is further increased. The (molar) ratio of the concentration of glucose to that of boric acid at the point where the minimum occurs is 42 : 1.

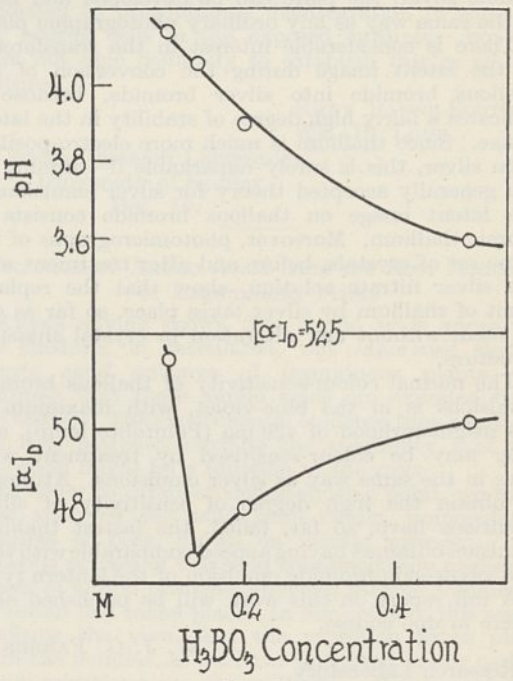

FIG. 1.

This sudden change in the angle of rotation of glucose in a limited range of boric acid concentration accounts for the conclusion of Darmois and others[2] to the effect that even at saturation, boric acid does not change the optical rotation of glucose, though the speed of mutarotation is accelerated by the presence of boric acid

Detailed experiments on the complex formation between glucose and boric acid is being planned in collaboration with the Department of Chemistry of this University.

P. S. TANG.
P. N. SUNG.

Physiological Laboratory,
National Wu-Han University,
Wuchang, China.
Dec. 2.

[1] Tang, MS. sent to the *J. Cell. Comp. Physiol.* (1935). Tang and Lin, MS. sent to *Science* (1935).

[2] Darmois and Peyroux, *C.R. Acad. Sci.*, **193**, 1182 (1931); and citations given by these workers.

Detection of a Latent Image in Thallous Bromide

So far as I am aware, there is no evidence in the literature that the compounds of any element, other than silver, possess the property exhibited by silver halides of recording an invisible—and chemically undetectable—latent image under the influence of light, such image being afterwards convertible into a visible image by suitable processing. Experiments which I have recently made with emulsions of thallous bromide in gelatine have conclusively shown that *thallous bromide* is also capable of receiving a latent image. Direct reduction of the exposed thallous bromide to yield an image in metallic thallium is not possible, the most powerful reducing solutions being without effect. But by bathing the exposed thallous bromide in silver nitrate solution a double decomposition takes place, the thallium in the emulsion being replaced by silver *without destruction of the latent image*; after washing out the excess of soluble silver, the plate can be developed and fixed in the same way as any ordinary photographic plate.

There is considerable interest in the transference of the latent image during the conversion of the thallous bromide into silver bromide, because it indicates a fairly high degree of stability in the latent image. Since thallium is much more electro-positive than silver, this is surely remarkable if—arguing on the generally accepted theory for silver emulsions—the latent image on thallous bromide consists of atomic thallium. Moreover, photomicrographs of the same set of crystals, before and after treatment with the silver nitrate solution, show that the replacement of thallium by silver takes place, so far as can be seen, without any alteration in crystal shape or structure.

The normal colour-sensitivity of thallous bromide emulsions is in the blue-violet, with maximum in the neighbourhood of 420 mμ (Pointolite lamp), and they may be colour-sensitised by treatment with dyes in the same way as silver emulsions. Attempts to obtain the high degree of sensitivity of silver emulsions have, so far, failed, the fastest thallium emulsion obtained having a speed comparable with that of a silver-iodo-bromide emulsion of the lantern type.

A full report on this work will be published elsewhere in due course.

W. J. G. FARRER.

Research Laboratory,
Ilford, Ltd.
Jan. 15.

Influence of Temperature on *p*H Measurements in Alkaline Media

ANTIMONY and other suitable electrodes are used frequently for the quick determination of *p*H values in highly alkaline media, but in industrial research papers giving alkaline *p*H values the temperature of the measurement is often omitted.

Whereas, however, *p*H values in acid media are nearly independent of the temperature, and can be corrected for temperature differences, if necessary, by a correction factor which gives the 'true' value, valid over a range of several degrees, the *p*H values in alkaline media depend on the solubility-product law, and cannot be assumed to be constant over a range of temperatures. Thus an alkaline *p*H measured at t_1° C., with an apparatus giving direct readings for t_2° C., can be corrected to give $p\mathrm{H}_1$, the 'true' value, at t_1. In order to get the *p*H value at any other temperature, t_3° C., we have $p\mathrm{H}_3 = p\mathrm{H}_1 + \log K_1 - \log K_3$, K_1 and K_3 being the solubility products at t_1 and t_3. Thus a soil, having $p\mathrm{H} = 8{\cdot}50$ at 15°, has 8·16 at 25° (taking the K values from L. Michaelis, "Wasserstoffionenkonzentration", Berlin 1922), 7·99 at 30° and 7·68 at 40°! An alkaline artificial culture medium, kept at 37°, has a *p*H 0·22 less than the measured value at 30°; an alkaline technical solution, measured in a room 3° colder than the factory, has a *p*H 0·10 less than the measured value.

The introduction of activity factors does not essentially modify the conclusion that alkaline *p*H values without temperature indication are useless. It is therefore very desirable that international agreements should be made as to the temperatures to which alkaline *p*H values should be referred; for example, one for soils, one for the alcohol industry and so on. In this way, mistakes might be avoided and research facilitated.

P. SZIGETI.

Sarkad, Hungary.

Cultivation of the Unfit

IN NATURE of January 11, in an article by E. W. M. headed "Cultivation of the Unfit", the statement is made that wolves had been imported into New Zealand to weed out unfit deer. Wolves have never been imported into New Zealand, and there is none in the Dominion—except stuffed specimens in museums, and one or two perhaps in zoological gardens!

H. T. B. DREW.

London.
Jan. 22.

I ACKNOWLEDGE with regret that in the article entitled "Cultivation of the Unfit" contributed by me to NATURE of January 11, I made a statement which I now find to be incorrect. I stated that when deer were introduced into New Zealand they multiplied very rapidly and produced many weakly and malformed specimens which had to be weeded out in order to keep up the standard of the herd, and that wolves were introduced to effect this. I find that the statement that wolves were introduced is incorrect, but I find also, on communicating with the New Zealand offices, that my argument in the article is not affected by this mistake. I quote some sentences in a letter sent me from the New Zealand Government Office.

"As you state, they [that is, the deer] were free from natural enemies and multiplied and spread at a very great rate and in many cases produced magnificent heads. . . . As you state, the great increase in the number of deer during recent years has been accompanied by a marked increase in the number of defective and weakly specimens. Endeavours were made by the various Acclimatization Societies to remedy this defect by paying hunters to shoot off the defective deer and I find in a book of reference on the subject that in the 1918–1919 season the Otago Acclimatization Society alone had a thousand head of deer shot off in one locality and a further six hundred and sixty-seven head in the same district in the following year."

So that in my article, if the words "wolves were introduced" are deleted and the words "hunters were paid" are substituted for them, the error, which I regret, will be eliminated.

E. W. M.

Estimation of Vitamin A

THERE is some risk that the letter under the above heading in NATURE of January 25 may create the incorrect impression that certain decisions were rashly taken by the 1934 International Conference on Vitamin Standardisation and that those responsible for these decisions are taking no steps to resolve the difficulties which have arisen. That there could be no intention to give this impression is clear from the fact that, of the three signatories to that letter, one was himself a member of the International Conference and a second was present as expert in an advisory capacity, while both are members of the Vitamin A Sub-Committee (of the Accessory Food Factors Committee, appointed by the Medical Research Council and Lister Institute) which is now attempting to deal in a constructive manner with problems which have arisen in connexion with the International Vitamin A Standard.

Nevertheless, the letter of Messrs. Bacharach, Drummond and Morton may cause uneasiness in the mind of anyone interested in vitamin standardisation and unaware of the above facts. It therefore seems desirable to explain that the problems of vitamin standardisation are admittedly very difficult, and that the decisions taken by the International Conference were regarded as subject to the verdict of experience.

The doubt which has arisen regarding the accuracy of the factor 1600, recommended for adoption by the International Conference, to relate the results of the spectroscopic examination for vitamin A with those obtained by biological tests, is well known, and this problem is at present the subject of active inquiry and experiment.

The possibility that the cod liver oil subsidiary standard may in some circumstances be unstable has also been reported, and information is awaited from the United States, where this material has been in use for some years, as officially issued by the Trustees of the United States Pharmacopœia.

It is well that the existence of these difficulties should be ventilated and that the views of anyone having experience of vitamin A standardisation be invited. It is, however, doubtful if the interests of international biological standardisation are furthered by destructive criticism on matters of temporary difficulty which are being investigated in this and other countries, and for which the knowledge at present available does not permit a better or a more permanent solution.

E. M. HUME.
(Secretary to the Vitamin A Sub-Committee of the Accessory Food Factors Committee jointly appointed by the Lister Institute and the Medical Research Council.)

The Lister Institute,
Chelsea Bridge Road,
London, S.W.1.

Tissue Cultures Exposed to the Influence of a Magnetic Field

EXPERIMENTS have recently been performed in order to determine whether exposure to a magnetic field has any visible effect on normal cells cultivated *in vitro*. The tissue employed was obtained from the heart of chick embryos of eight to nine days incubation, and the cultures were prepared by the hanging drop technique in a medium of fowl plasma and saline extract of embryonic tissue. After the first sub-cultivation, the culture chosen for treatment was placed in a small incubator between the poles of a magnet, the glass slide bearing the culture lying in a vertical plane, midway between the poles. The field strength, as measured in the air gap between the poles (after removal of the incubator), was about 5,000 gauss.

The cultures were allowed to remain in the field for periods which varied between three and six hours, and were, in general, fixed and stained immediately after removal from the field; several specimens, however, were incubated for various periods before fixation. Cultures from the same batch, which had been incubated without exposure to the magnetic field, were used as controls, in each experiment.

The exposed cultures exhibited no visible abnormalities in the arrangement of chromosomes in the dividing cells. There was observed, however, a slight tendency to protoplasmic disintegration in some of the resting cells in the exposed cultures; but we were not able definitely to establish this in all the cultures.

RUBY PAYNE-SCOTT.
WM. H. LOVE.

Cancer Research Laboratory,
University of Sydney.
Dec. 10.

Excretion of Amino Acids from the Root Nodules of Leguminous Plants

AFTER having shown that amino acids appear in the medium in inoculated, but otherwise sterile, quartz sand cultures of leguminous plants, we assumed that these amino acids are excreted from the *nodules*. The experimental evidence then available did not, however, exclude the possibility that the excretion might be a function of the *roots*.

In order to establish definitely this point, we have now analysed the sand from sterile, uninoculated cultures of peas, grown on nitrate nitrogen. An aqueous extract of this sand contained only negligible traces of amino nitrogen, showing that no significant excretion had taken place. In our opinion, this result confirms the view that the excretion takes place from the nodules, as we have suggested in our earlier communications on the subject. We regard the excreted amino acids (aspartic acid, lycine) as the primary products of the nitrogen fixation which takes place in the root nodules, and not as decomposition products of proteins.

ARTTURI I. VIRTANEN.
T. LAINE.
SYNNÖVE V. HAUSEN.

Laboratory of the Foundation
for Chemical Research,
Helsingfors.
Jan. 10.

Molecular Structure of Chitin in Plant Cell-Walls

UP to the present time, no X-ray investigations have been carried out on the molecular structure of chitin as present in plant cell-walls. The cell-walls of the sporangiophores of the fungus *Phycomyces* proved to be excellent material for such studies. Distinct diagrams were obtained with this material, the fibre diagrams being identical with those obtained from chitin of animal origin (wing of *Periplaneta*),

It was possible to get preparations with definite orientation of the lattice in all three dimensions. From these preparations it was found that in the cell-walls, tangential and radial planes are present with spacings 9·6 A. and 4·65 A. respectively, and that identity periods of 10·40 A. and 10·15 A. are present in the direction of the long axis of the organ.

The spacing 4·65 A. agrees with the side-spacing of protein chains and must be ascribed to the protein side-chains of the chitin molecule.

A probable position of molecules in the cell-wall of the cylindrical unicellular organ and in the unit cell may be derived from these data. The protein side-chains of the chitin molecule have radial arrangement in the wall; the cellulose chains of the chitin molecule are almost, but probably not completely, arranged parallel to the long axis of the organ. The plane of glucosamin residue ring is perpendicular to the tangential face of the wall.

A full account is given in *Protoplasma*.

A. N. J. HEYN.

University of Utrecht,
Holland.
Jan. 21.

Directional Properties of Short-Wave Frame Aerials

WHEN a receiving frame aerial is rotated about an axis parallel to the electric vector of an incident wave, then with long waves the frame current changes from zero to some finite value as the frame rotates from a position where its plane is perpendicular to the direction of wave propagation to a position where its plane is parallel to this direction. Upon this fact the normal directional properties of frame aerials depend.

With waves of lengths comparable to the frame dimensions, this is no longer a correct statement. When the frame is perpendicular to the direction of the propagation of short-waves, it is found that current antinodes of equal amplitude occur at the ends AA of that diameter of the frame (Fig. 1) which is parallel to the magnetic vector H of the wave, and current nodes occur at the ends NN of the diameter parallel to the electric vector E of the wave. Other nodes and antinodes may be symmetrically disposed round the frame at points which depend on the ratio of the wave-length to the frame perimeter.

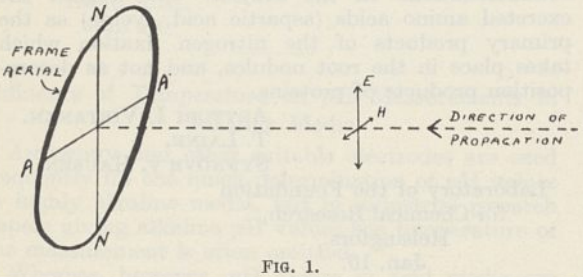

FIG. 1.

As the frame rotates about the diameter NN, these latter antinodes move round the frame and change in number and magnitude until the current assumes the distribution previously described[1] for a short-wave frame oriented so that its plane is parallel to the direction of wave propagation. When the frame is rotated about the diameter AA parallel to the magnetic vector of the wave, then the current obviously becomes zero when the plane of the frame is again parallel to the direction of wave propagation.

With long waves the frame current will be zero for *any* position of the frame which allows one diameter to be parallel to the magnetic vector of the wave, but with short waves there is only *one* position for which the frame current is zero, namely, when the plane of the frame is perpendicular to the electric vector of the wave.

These results accord with a theory now being developed and have been established qualitatively by using small frames with 40 cm. waves under water.

The exact way in which the current distribution varies with the position and dimensions of the frame compared with the direction of propagation and length of wave respectively, and the consequences on the directional properties of short-wave frames, is now being investigated. It is hoped that a full account of the work will be published in the near future.

L. S. PALMER.

University College,
Hull.
Jan. 4.

[1] "The Current Distribution round a Short-wave Frame Aerial". Palmer, Taylor and Witty, *Proc. Phys. Soc.*, **46**, 76–84 (1934).

Spectrum Emitted by Potassium Bromide Crystal under X-Rays

ON general grounds, one might anticipate an emission spectrum from a crystal bombarded by X-rays, as the result of the return of electrons to vacant levels. The present note shows the results obtained from work commenced originally in 1933 and later continued in 1934; the experiment was carried out with a small-aperture low-dispersion spectrograph necessitating 24 hours of exposure. The accompanying spectrum (Fig. 1) shows the light emitted by an artificial KBr crystal under bombardment by molybdenum X-rays from a Mueller-Shearer X-ray tube. The comparison lines are the Hg lines, 5791, 5461, 4353, 4047, 3657.

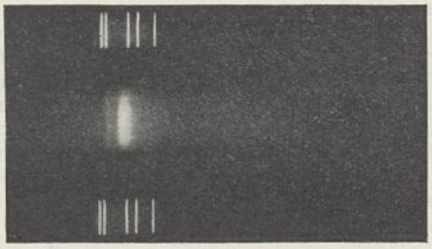

FIG. 1

The spectrum shows three bands, the third in the ultra-violet being less distinct than the others; these bands have their centres at 5310, 4520, 3810; the slight apparent continuous spectrum on each side of the bands is a defect of reproduction. The emission bands may be compared with those found by Roos[1] when specially coloured alkali halide crystals were illuminated by ultra-violet within the special ultra-violet absorption band (U band). In the present X-ray case, when an uncoloured crystal was used, there appear only some alternate bands found by Roos, and the intensity distribution is quite different.

P. W. BURBIDGE.
T. G. MOORCRAFT.

University College,
Auckland, N.Z.

[1] *Ann. Physik*, **20**, 783 (1934).

Use of a Radial Deflection Cathode Ray Oscillograph as a Time Comparator

THE comparator principle is well known in the accurate determination of lengths. It may also be applied to the measurement of time intervals. By installing an extra electrode system in a standard type of cathode ray tube, radial deflections and spiral time bases are readily produced. Such a modified tube has advantages over the ordinary tube when the latter is used to obtain radial deflections, whether by anode voltage modulation [1,2,3,4], or by auxiliary apparatus[5].

With a spiral, one convolution of which is performed in 1/1,000 second, and assuming a resolution of 1° on the photographic record, the maximum error in the determination of a time mark would be approximately 3 micro-seconds. Thus, if two pendulums nominally beating seconds were arranged to record their transits at the beginning and end of ten swings, a difference of one micro-second in their periods would be detectable. That is to say, an observation lasting only ten seconds could be utilised to reveal a difference of periods such that in a week the faster would have scarcely gained a beat on the slower. The corresponding use of the tube as a 'time microscope' is obvious.

Having already developed a practical form of radial deflection cathode ray oscillograph, we are now investigating in this laboratory the possibilities of this, among other, applications of the tube.

JOHN J. DOWLING.
THOMAS G. BULLEN.

University College,
Dublin.
Jan. 8.

[1] Lilienfeld, 'Oszillographenröhre', German Patent 373,834.
[2] Dye, *Proc. Phys. Soc.*, **37**, 158 (1925).
[3] Kipping, *Wireless World*, **13**, 705 (1924).
[4] Gouban and Zenneck, *Z. Hochfrequenztechnik*, **37**, 207 (1931).
[5] Radio Research Board, Slough, *J. Inst. Elect. Eng.*, **71**, 82 (1932).

Points from Foregoing Letters

SIR JOSEPH LARMOR states that the identity of mass and energy is now being questioned, and points out that it was originally deduced from the relativity principle. He considers that energy, whilst possibly equivalent to the abstract mass concept of the four-dimensional space-time, has little to do with the inertial mass as directly measured in the laboratory.

Certain 'extra' rings have been observed by Dr. G. I. Finch and H. Wilman in the diffraction patterns obtained by the passage of electron beams through flakes of graphite, as compared with electron patterns from thick crystals, or those obtained with X-rays. The authors show diagrammatically how these 'extra' rings may result: owing to difference in the density of atoms along different planes, certain Bragg spacings between planes, not effective in ordinary crystals, become effective when thin flakes are used.

Photographs of electron-positron 'pairs' are submitted by Prof. D. Skobeltzyn and E. Stepanowa as further evidence of the production of positrons by β-rays (electrons) during their passage through matter. The authors add that the absorption of the primary electron is sometimes accompanied by a single positron. The effective cross-section appears to be of the order 10^{-24}–10^{-23} cm.^{2}.

When γ-rays pass through heavy hydrogen, some of the deuterium atoms are split, with production of charged particles the energy of which can be measured by the 'kick' produced in a galvanometer. From the number and intensity of such 'kicks', Prof. G. Ising and Matts Helde calculate the mass of the neutron as 1·0080, somewhat lower than the previously calculated value 1·0084.

Photographs showing gradual changes in the X-ray diffraction pattern on transition from the vitreous silica to a crystalline mixture of crystobalite and tridymite (microcrystalline forms of quartz) are submitted by N. Valenkof and E. Poray-Koshitz. The authors state that similar transition patterns were obtained with soda-silica glass, rising temperature and increased duration of heating leading to the gradual appearance of the crystalline pattern.

By introducing liquid air traps in an apparatus for the production of nitric oxide from equimolecular mixtures of nitrogen and oxygen at 5–10 mm. pressure, Dr. J. Willey finds about ten times more nitric oxide near the electric arc than at a distance from it. He ascribes this to the simultaneous formation of active nitrogen which can decompose some of the nitric oxide formed. This effect can be prevented by inserting a plug of copper oxide or by introducing excess oxygen, a fact which explains why excess oxygen rather than the theoretically calculated amount is used in practice.

Contrary to current opinion, the optical rotation of glucose is found by Prof. P. S. Tang and P. N. Sung to be changed in boric solutions, showing a minimum at $M/7{\cdot}5$ boric acid (pH 4). This fact may have a bearing on the rate of respiration of certain strains of yeast in boric acid solutions.

Emulsions of thallous bromide are found by W. J. G. Farrer to have the property, hitherto only observed in silver preparations, of recording under the influence of light an invisible image which can afterwards be developed by suitable treatment. This involves first bathing the exposed thallous bromide in silver nitrate solution, and then following with the usual procedure as in the case of a photographic plate. The present theory of the photographic image may have to be revised to account for these new findings.

Exposure to strong magnetic fields (5,000 gauss) produces no observable change in the arrangement of chromosomes or the growth of cells cultivated *in vitro*, according to Ruby Payne-Scott and W. H. Love. There was some indication of a slight tendency to protoplasmic disintegration in some of the resting cells in certain exposed cultures.

The way in which the current in a receiving frame aerial varies with the direction of propagation and length of wave is discussed by Prof. L. S. Palmer. He points out that with short waves there is only one position for which the frame current is zero, as against several positions in the case of long waves.

A photograph showing the spectrum of light emitted by an artificial crystal of potassium bromide under the influence of X-rays is submitted by Prof. P. W. Burbidge and T. G. Moorcraft.

Research Items

Stone Pipes in South Africa

SOME interesting deductions as to early tribal distributions are drawn from the evidence of ancient stone pipes found in the Orange River Colony which, with other objects, have recently come into the possession of the National Museum, Bloemfontein (*Argeologiese Navorsing van die Nas. Mus.*, 2, 2–4). A small decorated pipe of sandstone, coming from the vicinity of Bethlehem, is described by Dr. E. C. N. van Hoepen. It is decorated with grooves, the surface between the grooves being marked with curved and straight lines, but no system or figure can be made out. In contrast, the "Susanna" pipe found nearby is characterised by a snake-figure. This, it is suggested, was the totem or *siboko* of the maker's tribe, which would have been called the Banoga. A tribe of that name now lives near Potchefstroom, claiming to be a branch of the Bahurutsi. Another pipe, also described by Dr. van Hoepen, comes from Buispoort. It shows two vertical figures separated by fields of hanging lines. The figures are shown to represent crocodiles. If these represent the totem of the maker, he must have been one of the Baquena, or possibly of the Bahurutsi, in whose territory the pipe was found, and who are a younger branch of the Baquena. Several pipes from Uitvlugt, near Bethlehem, are also described; but decoration being absent, or consisting only of parallel lines or grooves with a number of connected V's, gives no clue to the makers. A small pipe from Drakenstein also shows the V ornament. The design of grooves and V's as a whole may represent a highly conventionalised vine with leaves and fruit, the *siboko* of the Bamorara, a Baquena people, whose ancestors may have lived in the vicinity of Bethlehem. The interest of these pipes lies in the fact that they come from the territorial limits of peoples who once made stone pipes, erected stone kraals and built stone houses.

Air-breathing Fishes of India

IN a recent important contribution to our knowledge of air-breathing fishes (*Trans. Nat. Inst. Sci. India*, 1, No. 1), Dr. S. L. Hora directs attention to the habitats and habits of the numerous air-breathing fishes of India. He groups them into four ecological associations: (1) fishes of fast-running streams; (2) marshy area fishes; (3) estuarine fishes; and (4) marine fishes; and discusses the factors which appear to have influenced or induced the air-breathing habit in these various environments. In a detailed study of the respiratory function itself, the author has repeated many of the 'drowning' experiments of previous workers and devised a number of new ones. From these laboratory experiments, backed by exceptionally extensive field observations, the conclusion is reached that in all these fishes, with the single exception of *Heteropneustes fossilis*, "the aquatic and aerial respiratory surfaces are capable of interchanging their functions". Whether a fish depends mainly upon aquatic or aerial respiration, therefore, it can live both under water and out of it. Evidence is presented in support of the contention that, in the 'drowning' experiments of previous workers, the quick death of certain of the fishes, when debarred from having access to atmospheric air, was due either to the foulness of the water or to the locking up of air in the air chambers. When such entrapped air surrounding the respiratory epithelium becomes deoxygenated, suffocation and death ensue. The respiratory current is rendered ineffective because it cannot bathe the respiratory surfaces. If this entrapped air be pressed out of the respiratory cavities, for example, in *Anabas* and *Ophicephalus*, so that water may freely enter, aquatic respiration is carried on, and the fish continue to live quite happily for long periods even when kept totally submerged.

The Aleurodidæ of Malaya

AMONG a number of papers published in vol. 17, Part 4 (November 1935) of the *Journal of the Federated Malay States Museums*, brief mention may be made of Mr. G. H. Corbett's contribution on the Aleurodidæ or 'white flies' of Malaya. The fact that, out of 124 species recorded in this paper, 94 are described as new, is an indication of how little many groups of insects have been explored in tropical lands. In the present case, the material had been collected mostly in the vicinity of Kuala Lumpur, Selangor, and consequently the area of Malaya, as yet little explored for these creatures, will doubtlessly yield many more forms. In the text-figures the pupa case, and often certain detailed structural features, are portrayed in the case of more than a hundred species. All the new genera (four in number) and species are based upon characters afforded by the pupal cases; it is not stated whether the imagines were reared in any instances or not, and none is described. The largest number of species (57) is comprised in the genus *Dialeurodes*, which is evidently dominant in the area concerned.

Antigenic Components of Botulinus Toxins

THE micro-organism, *Clostridium botulinum* (*Bacillus botulinus*), the toxins of which when present in foodstuffs give rise to the form of food-poisoning known as botulism, has been subdivided into several types or varieties; these differ in some of their cultural characters, and particularly in their immunological relationships. The *A* and *B* types, which especially affect man, are monospecific, that is, their toxins are distinct in that the toxin of one is not neutralised by the antitoxin of the other. Types *C* and *D* mostly affect birds and farm animals, and their toxins are similarly not identical, though not so specific as those of *A* and *B*. According to J. H. Mason and E. M. Robinson (*Onderstepoort J.*, 5, No. 1, July 1935, p. 65), the *C* type toxins contain three components, C_1, C_2 and *D*, the latter in only very small amount. The *D* type toxin contains chiefly the *D* component, with a small quantity of the *C* fraction.

Gas Bubbles in Living Plant Cells

MISS LILIAN FRASER, writing from the School of Botany, University of Sydney, records the occurrence of gas bubbles within air-dry living cells of a number of fungi, liverworts, etc. She suggests that gas is

present in solution under pressure in the turgid cell, and on release of pressure by loss of water some of the gas comes out of solution and appears as a bubble. Her attention was attracted to the phenomenon during her studies of the Australian sooty mould fungi, which form a superficial mat on the leaves and stems of plants attacked by scale insects or aphis. Such fungi must be exposed to wide extremes of temperature and humidity, and the occurrence of gas within these cells may be of importance in avoiding plasmolysis under dry conditions. Earlier observations upon gas in drying cells have been made by several of Renner's pupils, notably by Holle (*Flora*, 108, 75; 1915).

Follicular and other Hormones and Plant Growth

IT has been claimed that the work of Schoeller and Goebel has proved that small quantities of follicular hormones markedly accelerate flowering. In view of the possible horticultural interest of such a phenomenon, investigations were undertaken by Dr. M. A. H. Tincker (*Ann. App. Biol.*, 22, No. 4, 619–629). The experiments were designed to supply the substances ketohydroxyoestrin, theelol and auxin to various flowering species. The solutions of these substances were administered to the roots, by injection and by application to cut surfaces. In no case was any acceleration of growth or flowering obtained, and in the case of hyacinths treated with theelol some retardation of foliar growth was noticed. At the same time, Dr. Tincker is careful to point out that there is no proof that the substances presented to the plant were taken up by the tissues, and suggests that a method which would ensure that the substances reached the flowering region is highly desirable. In the case of root cuttings grown in gelatin, rapid and considerable bacterial growth was observed and proved to be due to a hitherto unknown organism. This has been described in an appendix by Dr. S. E. Jacobs, who has called it *Bacterium auxinophilum*.

Subsidence of East Tokyo

IN three interesting papers, Prof. N. Miyabe considers the remarkable subsidences that have occurred since 1923 in the eastern portion of Tokyo (*Bull. Earthq. Res. Inst.*, 10, 844–857; 1932. 13, 587–591, 763–770; 1935). Series of precise levellings were carried out in November 1929 and March 1932, and with two exceptions of little consequence, all of the 42 bench-marks were depressed, three of them by more than one foot. The zone of greatest depression occupies the district between the Rivers Sumida and Yedo, or that in which the alluvial covering is thickest. Prof. Miyabe divides the whole area into six regions, corresponding with crust-blocks. One of them includes the area of greatest depression, and the tilting of the four surrounding blocks is in each case directed approximately towards its centre. Further light is thrown on these movements by the records at two mareograph stations in the southern half of the area. The mean monthly height of the sea-level is subject to a well-marked annual period, and there is also a secular change by which the mean level at one station rose about 5 in. in each of the years 1932 and 1933, though in 1934 the upward movement had almost ceased. Prof. Miyabe in his third paper considers the origin of this general depression and concludes that it is the result of several causes, such as the reduction in pressure of underground gases, the contraction of the surface soil due to the observed lowering of the underground water-level, etc., acting in combination with crustal deformations, such as block-movements, that are known to prevail over wide areas in Japan.

The Pennine Wool Industry

MUCH has been written on the factors that localised the wool industry in the Pennine area of the West Riding, but Mr. W. B. Crump in a recent paper ("The Wool Textile Industry in its Physical Setting", *J. Textile Inst.*, 26, 1935) considers the subject more fully than usual from a geographical point of view. From York, the original textile centre of the north of England, the industry spread southwards, and by the sixteenth century had taken a firm hold in the West Riding. The grit-stone country was particularly favourable in production of wool and of soft water, while the adjacent Lower Coal Measures with their larger population provided a nearby market. The poverty of the small holdings on the uplands encouraged the manufacture of cloth. Early in the nineteenth century, the application of steam power was facilitated by the proximity of the Lower Coal Measures to the grit-stone area. Only Manchester and Wakefield were textile towns at a distance from the grit-stone country and both had easy access. Another important localising influence was the occurrence of iron ore, since iron wire was needed in carding. This is expressed in the expansion of the industry into the Middle Coal Measures with their black band iron ore in the district of the Calder valley. These and other influences are fully discussed and illustrated in distributional maps.

Progressive Lightning

B. F. J. SCHONLAND, D. J. Malan and H. Collens have continued their observations of lightning flashes, using a Boys' camera with two lenses mounted on a rapidly revolving disk. Their results (*Proc. Roy. Soc.*, *A*, Nov. 15, 1935) now cover a fair sample of South African lightning discharges. The lightning flashes are in general quite complex and each stroke consists of a 'leader' spreading from cloud to ground and a return stroke from ground to cloud. The first process of all is a 'stepped' discharge which is propagated downwards with high velocity, but with pauses of the order 10–100 microseconds. The 'steps' often start out in a new direction, giving the channel of the discharge a zig-zag form, and downward branching is frequent. As soon as this leader reaches the ground, a bright discharge starts at its lower end and spreads upward with velocity of the order 5×10^9 cm./sec. This discharge spreads into the previously formed branch channels, and usually gets less bright as it moves upward. Later strokes do not usually show the stepped effect; their leaders are 'darts' moving downwards at velocities of 10^8–10^9 cm./sec. A theoretical discussion is promised in another paper.

Electron Optical Bench

IN the Research and Experimental Section of the recent Physical Society's Exhibition held at the Imperial College of Science, the Research Laboratories of the G.E.C. showed an apparatus for investigating the performance of experimental electrode systems for cathode ray tubes. A special 30 cm. (12 in.) diameter cathode ray bulb is

provided with a vacuum-tight round glass joint at the end of the neck. The detachable portion of the joint carries a 12-pin cap for making connexion to the twelve sliding contacts on the 'electron optical bench' contained inside the tube. The apparatus was developed to facilitate the design of high vacuum cathode ray tubes for television. The effect of different arrangements of the electrodes on the size of the spot, on brightness and distortion, on sensitivity to control, etc., can be readily determined. The tube operates satisfactorily at 4,000 volts, and the time required to open it, make an adjustment and pump out again, is usually less than 30 minutes. The cathode retains its emission after several exposures to the atmosphere. It should prove very useful to those experimenting on television.

Interatomic Distance and Resonance

IN 1932 L. Pauling pointed out that resonance between two or more structures leads to interatomic distances nearly as small as the smallest of those for the individual structures. In benzene the carbon–carbon bond resonates approximately equally between C–C and C=C, and the observed carbon–carbon distance, 1·39 A., is much nearer the C=C distance, 1·38 A., than the C–C distance, 1·54 A. Where the two structures contribute unequally, the bond may have any intermediate character. L. Pauling, L. O. Brockway and J. Y. Beach have now (*J. Amer. Chem. Soc.*, 57, 2705) considered the nature of the function expressing the dependence of interatomic distance on single bond–double bond resonance, and have used the function to obtain information regarding the electronic structures of resonating molecules for which interatomic distance values are available. The effect of resonance on bond angles is also discussed. They plot the distances 1·54, 1·38, 1·39 (benzene) and 1·42 (graphite) against the "bond character", benzene being half-way between diamond and the double bond, and graphite two-thirds single bond character. The curve shows that a small amount of double bond character causes a large decrease of interatomic distance, but even fifty per cent of single bond character produces little change in the double bond value. The distance criterion for resonance thus provides quantitative information only through about half the bond character region. The authors then use the curve to calculate the amount of double bond character for a number of carbon compounds for which the interatomic distances are known. Polynuclear aromatic hydrocarbons are included in the discussion.

Spectrographic Analysis of Biological Material

J. S. FOSTER, G. O. Langstroth and D. R. McRae (*Proc. Roy. Soc.*, Dec. 2, 1935) describe in detail their technique for determining traces of lead in cerebrospinal fluid. The method is applied to concentrations between 10^{-8} and 2×10^{-5} gm./c.c. and the precision of a determination is said to be better than 15 per cent. The fluid is dried on a plane metal plate, which is made one electrode of a point-plane spark gap excited by D.C. condenser discharges. The spark is made to traverse the whole surface of the plate. The intensity of the lead lines is compared on a microphotometer with that of a magnesium line present in the spectrum, and the comparison is repeated on another sample of the same fluid with the addition of a known amount of lead. The intensity of the lines is proportional to the amount of lead if this is small.

Fluorine and its Compounds

IN a review of the chemistry of fluorine, A. Damiens (*Bull. Soc. Chim.*, 3, 1 ; 1936) points out that modern methods of electrolysis of fused acid fluorides with a graphite anode in an apparatus of copper, graphite, silver, magnesium or monel metal, could be adapted to the industrial production of fluorine if the element found technical uses. The compounds of fluorine with other halogens are : ClF, ClF_3 ; BrF, BrF_3, BrF_5 ; IF_5, IF_7. The monoxide, F_2O, is a stable gas, which is obtained by the action of fluorine on water in presence of alkali, and was previously confused with ozone. It is a powerful oxidising agent, liberating iodine from potassium iodide solution, which absorbs it completely. By the action of the electric discharge on a mixture of oxygen and fluorine at low temperature and pressure, to avoid explosion which otherwise occurs, an orange-coloured solid, melting at −160° and volatile at −100° to a brown gas, is obtained. The gas is F_2O_2 ; it decomposes at −64° into a colourless gas, FO, which at higher temperatures dissociates into a mixture of oxygen and fluorine. On cooling FO it does not again form F_2O_2 (Ruff and Menzel, 1933). Nitrogen fluoride, NF_3, is a colourless gas, insoluble in water, obtained by the electrolysis of acid ammonium fluoride (Ruff, Fischer and Luft, 1928). Small quantities of NH_2F and NHF_2 are also formed in the reaction. Several compounds of fluorine with carbon have been described (CF_4, C_2F_6, C_3F_8, C_4F_{10}), of which the tetrafluoride is best known ; it is a colourless, inert gas, with a boiling point of 126°.

Research Surveys of the Minor Planets

MORE than one thousand asteroids have been discovered and sufficiently observed to admit of fairly reliable determinations of their orbits. The task of keeping track of these small bodies is a stupendous one, for which international co-operation offers the only hope of securing adequate resources. The Berlin Rechen Institut bears most of the burden of correcting orbital elements and computing ephemerides ; but in 1925 the International Astronomical Union entrusted to Prof. A. O. Leuschner, of the University of California, the task of carrying out a research survey of the orbits and perturbations of all the minor planets of which trustworthy orbits were available. The "Research Surveys of the Minor Planets 1 to 1091" has now appeared as vol. 20 of the Publications of the Lick Observatory. The history of the discovery and details of the orbits that have been computed are set out for every planet. To quote Prof. Leuschner, "The preservation of planetary discoveries by observation and prediction with the aid of approximate perturbations is not the ultimate end of astronomical science, but a necessary and unavoidable means to an end. The ultimate aim rests on a determination of mean elements and general perturbations which hold for all time or at least for very long periods within the limits of accuracy set by observation". Whether this aim will ultimately be realised or no, Prof. Leuschner's volume is of great importance in presenting in a compact form information which was previously scattered throughout more than a hundred journals, some of which are old as modern periodicals are reckoned. The minor planets which are bright enough to be observed with a meridian telescope are now to be used to play an important part in fundamental astronomy, and it is expected that in their case, at least, Prof. Leuschner's ideal will be realised within a decade.

Pure and Applied Physics in the U.S.S.R.*

DIFFERENCE of language has had a large part in perpetuating international misunderstanding. The relations between Russia and western Europe have suffered exceptionally badly from this effect, as the Russian language is difficult and few non-Russians read it easily. The lack of accessible accounts of the aims and achievements of the U.S.S.R. in science has prevented western European scientific workers from acquiring a knowledge of facts upon which a sound valuation of Soviet ideals and efforts in science might have been based.

In order to acquaint scientific workers who do not read Russian with what has been done, and to improve the contact between those in Russia and the rest of the world, the Soviet scientific authorities have launched several scientific journals published entirely in western European languages. The *Physikalische Zeitschrift der Sowietunion* was started in 1932, and its papers are published in German, English or French. They are devoted to researches in theoretical and experimental physics. In 1934 the journal of physical chemistry, *Acta Physicochimica*, was started. This is the medium through which Frumkin, Semenov and other eminent physical chemists communicate their results to Western readers. *Technical Physics of the U.S.S.R.* dates from the same year.

The conduct of three first-class scientific journals in foreign languages is a heavy task. British men of science can easily imagine the extra labour they would have if they had to publish their papers in German, French or Russian. The difficulties of exact expression, proof correction, and other labours connected with publication are great enough in one's own language, and far greater in a foreign language. The Soviet authorities have decided that systematic publication in other languages besides Russian is helpful to Russian scientific workers in spite of the extra labour and expense. They have made it much easier for foreigners to follow what is happening in the U.S.S.R., especially in physics, technical physics and physical chemistry. The movement for conducting journals in foreign languages has been accompanied by increasing efforts to master these languages. Until recently, German was the second language of Soviet scientific workers. They formerly published a large number of papers in German journals. The political changes in Germany lessened the desire to publish in that country. These changes have stimulated the study of the English language. Many scientific workers who knew little English two years ago have already become fairly proficient. English should ultimately become the second language in Russia.

About three hundred journals of various sorts dealing with some aspects of technical physics are published in Russian. This development is a reflection of the growth of industrialisation. About fifty thousand workers with some degree of qualification are engaged in work which touches on technical physics. It is hoped that *Technical Physics of the U.S.S.R.* will assist foreign readers to appreciate both the successes and the failures produced by all this effort. The Russians believe that their schemes of planning for industrial research, which can be gleaned indirectly from the choice of investigations revealed in their research papers, will be of interest, besides the reports of new facts. The journal deals especially with the physics of dielectrics, high voltage, high frequency, gaseous discharge, testing of materials, structural analysis, heat technology, applied optics, acoustics and high vacua.

The eleven numbers of the journal to hand contain several papers on the mechanism of the breakdown of insulation in cables. Inge and Walter have investigated the effects of the electric field on the decomposition of the oil in impregnated paper insulation. The change in the magnitude of the breakdown current with time has been studied, in order to discover the maximum potentials that may be used in testing cables without damaging them. They find this limit is about 22,000 volts per millimetre. Direct experiments on the insulating power of oil films between glass plates under pressure show that the insulating power per millimetre increases with decreasing thickness. They advise that the paper insulating tape should be as thin, and as tightly wound, as possible, in order to decrease the thickness of oil films. The application of external pressure to the cable increases the insulating power by decreasing the thickness of the films. Goldman and Wool find that chemical ageing in cable insulators is due to the formation of ozone and oxides of nitrogen, and recommend the use of atmospheres of nitrogen or the inert gases to avoid it.

There is a long series of papers on the important researches of Mandelstamm and his school on non-linear oscillations. These researches have led to the invention of a new type of dynamo which produces a current by varying the capacity of a condenser in a circuit containing a self-inductance. There is an account and illustrations of this remarkable machine in vol. 2, II–III. This sort of dynamo has advantages over the ordinary electro-magnetic dynamo, and may have an important industrial future.

Bontch-Bruewitch gives an account of the Polar Year observations made at Murmansk on the Kennelly-Heaviside layer. The E and F layers were observed in the polar regions during the summer solstice and for some time after. The E layer is less active than in temperate latitudes. Periods of complete cessation of echoes have been observed. These lasted from one minute to several hours. It is suggested that these are due to some sort of screen formed below the E layer, at a height less than 65 km. A relation between echo cessation and magnetic activity was observed, and it is suggested that the difficulty caused by magnetic storms of maintaining continuous radio communication over high latitudes may be partly attributed to the existence of the suggested absorbing layer.

The journal is produced in a good format. It is not confined to Russian contributors. The editors hope they will receive contributions from abroad, and thus contribute to the international co-operation of scientific workers in the acceleration of technical progress and the conquest of the material world.

* Technical Physics of the U.S.S.R. Editor: A. Joffe; Assistant Editor: S. Gutin. 1, I–VI (1934); 2, I–V (1935). Mezhdunarodnaya Kniga-Antiquariat, Kuznetski Most 18, Moscow, or W. H. Smith and Son, Ltd., London. Subscription 4·0 dollars per volume of six issues.

The Teaching of Optics in Schools

AT the annual meeting in London of the Science Masters' Association, a large body of schoolmasters met to consider the findings of the committee convened by the Council of the Physical Society to report upon various matters connected with the teaching of geometrical optics. The discussion was opened by Mr. G. N. Pingriff, of Merchant Taylors' School, a member of the committee, who gave a brief summary of the report in so far as it is concerned with teaching in schools, and confining himself chiefly to the question of signs of distances involved in lens and mirror calculations and experiments.

In most advanced work, and invariably in technical optics, it is customary to call a converging lens positive and a diverging lens negative, whereas the opposite custom is usually followed in school teaching and in nearly all school text-books : in these, the rule which has become established is that distances should be measured from the lens or mirror, and if measured in the direction of the incident light they should be considered negative. The committee had carefully considered this and a number of other conventions used by writers of various advanced text-books, and had unanimously agreed that it was desirable that all teachers should henceforward adopt one or the other of the two schemes given below. It had not been possible to reach unanimity in recommending one only, though both of the schemes advocated agree in making the focal length of a converging lens positive and hence in reversing the school system. The report also emphasised the desirability of teaching lens theory before that of curved mirrors, and of introducing the idea of the power of a lens at an early stage.

The alternative schemes recommended were : (*a*) to use a Cartesian frame of reference in which the positive direction is the initial direction of progress of the incident light, and (*b*) to measure all distances along the rays of light, giving a positive sign to paths which the light has actually traversed and a negative to distances only traversed virtually.

The opener of the discussion explained the exact implication of each of these systems and the advantages to be derived from a change from the present school usage, after which numerous other speakers gave their opinions, and in some cases experiences of work done, on one or other of the new schemes. All speakers were definitely in favour of making a change but here again there was no unanimity as to which of the alternatives should be adopted, though on the whole the majority of the speakers seemed to be in favour of the second, that is, (*b*) above. The advantage of this scheme which appealed to many speakers was that it leads to the same simple general formula for mirrors and lenses. On the other hand, it was recognised that the first scheme could be adopted with a less radical change of procedure, and also that it is largely used in the teaching of applied optics. The main view expressed by the different speakers was emphatically confirmed by an informal show of hands at the end of the discussion, there being a very large majority of members, all of whom were schoolmasters having practical experience of the matters under consideration, in favour of a change from the present school practice. It was pointed out that the only further requirement to enable these views to be put into practice is the supply of suitable elementary text-books. G. N. P.

School Certificate Biology

IT is probably safe to say that there has been in recent years a greater increase in the number of candidates taking biology in the School Certificate Examination than in any other subject. It is therefore not surprising that a short time ago the committee of the Science Masters' Association appointed a sub-committee to draw up a syllabus in biology which represented as far as possible the views of all its members. The preliminary draft of this syllabus appeared in the December issue of the *School Science Review*, and members were asked to communicate their criticisms to the secretary of the sub-committee. At the recent annual meeting of the Association in London, two discussions on this subject were arranged. These were well attended and the views of members on a number of debatable points were heard. The general committee of the Association now intends to invite representations of all examining boards to meet a few of its members who have drawn up the syllabus. It is hoped that the examining boards will co-operate in this respect, and in some cases revise their syllabuses in accordance with the views of those who are actually teaching the subject.

The aim of the sub-committee has been to produce a syllabus in which general biological principles are established rather than a mass of detailed facts. It is quite clear that in working to many of the existing syllabuses there is only time in teaching to work through a number of types. For this reason the number of types to be studied has been reduced, and, although individuals may be sorry that their 'pet' organism has not been included, it is absolutely essential that the syllabus should be much shorter than most of the existing ones. The experience of examiners has shown quite clearly that while candidates may be able to describe the arterial system of a frog or of a mammal or the structure of a stem, for example, in detail, their answers to general questions are very poor.

The first section of the syllabus deals entirely with general biology. No definite types are mentioned, choice of examples for illustration being left in the hands of the teacher. It is possible, if the time available for the subject is short, to use only as illustrations the types mentioned in the remainder of the syllabus, but it is hoped that a wider view will be

taken—but not expected by the examiner. From the criticisms received and from the discussions held it is obvious that teachers are almost unanimous in preferring the mammal as the type of vertebrate to study rather than the frog. The heading to this part now reads as follows :

"The general elementary structure of a mammal as illustrated by the following scheme. (It is suggested that the rabbit or guinea pig be used for most of this work, including demonstration dissections, but it is important that reference should also be made to Man and that the frog should be used occasionally for experimental purposes.)"

The other zoological types included are *Hydra*, where the principle of differentiation and specialisation of parts of a multicellular organism can be well seen, an earthworm, chiefly for its habits and economic importance, certain insects, for their life-histories only, and *Amoeba* or *Paramecium*, excluding, of course, details of conjugation processes in the latter.

The section dealing with flowering plants differs only from similar sections in existing syllabuses by being more explicit, in order to limit the amount of morphological knowledge required. Suggestions are also given for plant physiological experiments, and in this connexion the sub-committee would like to record its gratitude to one examining body for the lead given to the sub-committee. The study of other plant organisms is reduced to *Spirogyra*, *Mucor* and yeast, although the roles played by bacteria in Nature are mentioned in the general biological section.

Ecology has not been neglected, though it is a very debatable point as to whether it is worth while for the examiner to set questions on this subject at the School Certificate stage. The opinion of the sub-committee is best summed up by the following extract from the syllabus :

"A knowledge of more than ONE habitat for plants and ONE for animals is not expected. It is desirable, however, that the same habitat be chosen for both plant and animal field-work so that the inter-relations between plants and animals in the field may be appreciated. Answers to questions in this section must show clearly that the candidate has personally studied the actual habitat selected."

It is felt that neither evolution nor genetics is a suitable examination subject for boys and girls of this age. The following paragraph, however, appears in the general preamble to the syllabus :

"No questions will be set on Evolution but the idea of evolution should be taught and illustrated at relevant points in the course based on the syllabus. It is hoped that teachers will at least outline the evidences for evolution from classification (e.g. of vertebrates), from the occurrence of fossils and from simple morphology. The fact that certain characters are hereditable could be included with the general discussion of reproduction."

The Quetta Earthquake of May 31, 1935

A PRELIMINARY report by Mr. W. D. West on the Quetta earthquake of May 31, 1935, has been published within six months of its occurrence in the *Records of the Geological Survey of India* (69, 203–240 (1935)). Further study of the materials may provide a more detailed series of isoseismal lines, and the discussion of the seismographic evidence will no doubt throw light on the position of the region in which the movement began. Otherwise, we cannot expect that much will be added to the details contained in this interesting report.

As in many another great earthquake, the shock came with but slight warning from fore-shocks in the central area, though one of moderate intensity was felt at Kalat on April 25, and four others at Bostan (near Quetta) between the middle of March and the end of May. The great earthquake occurred at about 3.3 a.m. Madras time (May 30, 9.33 p.m., G.M.T.), an electric clock in the telegraph office (apparently at Quetta) having stopped at this time, which, within a few seconds, agrees with the seismographic evidence.

The epicentral tract is about 68 miles long and 16 miles wide and runs in the direction S. 15° W. from Baleli (north-west of Quetta), through Dingar and Mastung to Mand-i-Haji, and includes the Shirinab valley to the west of the Mastung-Kalat road. Within this zone, the intensity of the shock was about 10 of the Rossi-Forel scale. The absence of damage to trees and to roads, except in the neighbourhood of streams, the fact that lamp-posts and telegraph-posts were not as a rule thrown down, and the rare injury to railway lines, show that the earthquake fell far short of the intensity of the great earthquakes of Assam in 1897, Kangra in 1905 and Bihar in 1934. Moreover, the disturbed area was unusually small—approximately 105,000 square miles. Even if we make a considerable allowance for its occurrence at night, the earthquake must have been felt over an area that is insignificant compared with the areas of between 1½ and 2 million square miles disturbed by the three great earthquakes mentioned above.

The intensity of the shock faded away rapidly from the epicentral region. Though no definite estimate of the focal depth has yet been founded on the seismographic evidence, it is probable, as Mr. West suggests, that the depth was less, rather than more, than five miles.

A number of after-shocks were felt—unfortunately an unknown number, for no one on the spot seems to have kept any record. Five or six severe shocks occurred within the first twenty-four hours after the earthquake. On June 1, there were strong shocks at about 1.30 and 5.30 a.m. The most violent of all occurred on June 2 at about 3 p.m., one that would certainly have been destructive in the lower part of Quetta if there had been any buildings left there to destroy.

The effects of the earth-movement on the ground were not of much importance. The mountain sides round Quetta, precipitous and for the most part of limestone, were scarred by the fall of immense masses of rock. A line of fissuring in the ground was traced, with occasional interruptions, from the south side of Chiltan to the neighbourhood of Kalat. Over the

greater part of this distance of 65 miles, it took the form of a crack or network of branching cracks in the soil. To the west of Mastung, where the fissuring was most marked, the ground on the west side had subsided about 2½ feet, though, a little farther to the south, the east side was depressed. At the point where the fissure crosses the railway from Spezand to Nushki, the lines were crumpled. The average direction of the fissure near Mastung is N. 15° E., so that it coincides both in direction and position with the longer axis of the epicentral zone. In every place where hills crossed the line, the fissuring died out, though rock-falls were numerous. Mr. West thus concludes that the fissuring affected the alluvium only and did not penetrate the solid rock below.

The study of the earthquake has thrown little light on its origin. In the neighbourhood of Quetta, and in this part of Baluchistan only, there are several thrust-faults, in each of which the rocks on the north-west side have been forced over those on the other. One of these faults lies to the south-west of Quetta, and, though it neither coincides with the centre of the epicentral zone nor is parallel to its longer axis, a careful examination of it was made, with the result that no sign of any movement along it could be detected, though a number of rock-falls occurred in its vicinity. If, then, the earthquake was caused by a movement along a fault, it must have been connected with one that dies out before reaching the surface. C. D.

Manufacture of Humus by the Indore Process

THE Indore process is now fairly well known, and in the tropics it is widely used for converting all manner of plant residues into humus. A 'factory', consisting of a series of long, shallow pits, is established, and as waste organic matter becomes available it is placed in the pits in layers alternating with layers of dung, ashes, etc.; frequent watering is essential, and aeration must be promoted by maintaining a loose condition and by turning the heaps. Conditions are then favourable for the fermenting action of fungi and bacteria, and in the space of three months the material is reduced to short humus ready for application to the land. The process has been described previously, and in his lecture to the Royal Society of Arts, Sir Albert Howard dealt chiefly with the place the process, and the principles underlying it, should occupy in agriculture in the tropics and in Great Britain; the issue of the *Journal of the Royal Society of Arts* for November 22, 1935, includes both the lecture and the subsequent discussion, and also an appendix giving detailed directions for carrying out the process on a tea estate.

At the outset some account is given of the nature and value of humus, and the point is made that the organisms concerned in the manufacture of humus have very similar demands to those of plant roots; thus to plough in fresh organic matter tends to lower temporarily the fertility of the land, and it is urged that fermentation should occur before incorporation with the soil. A large part of the lecture deals with the improvement in fertility resulting from the adoption of the process; the system has apparently gained universal approbation in a number of tropical countries and as a means of providing manure for many different crops. In countries where much of the available dung is burnt, and where high temperatures favour rapid fermentation, it is to be expected that low humus content of the soil must often be a limiting factor in crop growth; it is clear that where the process, with its attendant conservation of all plant residues, has been adopted, it has led to considerable increase in productivity.

Agriculturists in Great Britain will be interested most in the last two sections, which deal with the application of the principles underlying the process to conditions in Great Britain, and with the general trend of agricultural research. Here Sir Albert Howard touches on more controversial subjects. It cannot be denied that some plant residues are wasted in Great Britain, but it is difficult to believe that, if all were saved for composting, the organic manure available on the "ordinary English farm" would be doubled or trebled. It is suggested that green manure crops should not be ploughed in direct, but should first receive a dressing of farmyard manure and then be disced, so that the crop, manure and top two or three inches of soil are mixed together; to allow fermentation to occur on the surface in this manner is certainly worthy of trial, though some difficulty in subsequent ploughing might be encountered. It is difficult to agree, however, that the adoption of this method on the potato lands of Lincolnshire would prevent eel-worm attack, or that similar procedure in breaking up leys would overcome the wireworm difficulty.

Considerable stress is laid on the importance of quality in agricultural products. Quality is rather an elusive concept, but to the farmer the word will always denote those features which determine price. In regard to the tea crop, Sir Albert Howard himself uses the word in that sense, but in general his conception of it is altogether different. He claims that adequate organic manuring, as contrasted to the application of chemical fertilisers, produces a quality which confers immunity to all diseases (tuberculosis and foot-and-mouth disease are cited) on the animals consuming the crop; mankind, in turn, may obtain this immunity by consuming such animals or their products. It is argued that most of the ills from which we suffer are due to our N.P.K. mentality—that is, to our thinking too much in terms of the plant nutrients, nitrogen, phosphorus and potash; and it is suggested that an increase in organic manuring (not necessarily to the total exclusion of chemicals) would make it possible to dispense with the services of pathologists of all types. No evidence is offered in support of these sweeping statements and readers will probably find them difficult to accept.

The great value of the work described is, however, beyond question. Sir Albert Howard and his co-workers have undoubtedly achieved much for the tropics. His strictures on manuring in Great Britain serve to emphasise the great importance of humus (which, in fact, is scarcely ever denied), and the moment may be opportune, because mechanisation is apparently to become widespread and mechanised farming tends to foster the N.P.K. mentality.

Educational Topics and Events

BIRMINGHAM.—In his annual report to be presented to the Court of Governors on February 20, the Vice-Chancellor (Sir Charles Grant Robertson) states that rapid progress is being made with the foundations of the new Medical School and the additional block for the Chemistry Department. The Department of Industrial Medicine and Hygiene has made a good start, and an imposing list of contributions to its upkeep from large industrial firms indicates that this new venture is receiving strong support from such bodies.

The impending retirement is announced of Prof. S. W. J. Smith from the Poynting chair of physics, and of Mr. R. C. Porter, who has been lecturer in mechanical engineering for the past thirty-five years and has been for many years in charge of the University power station.

CAMBRIDGE.—J. E. Harris, of Christ's College, has been appointed University demonstrator in the Department of Zoology.

Dr. S. Nevin has been appointed to the Pinsent-Darwin studentship.

Prof. A. Krogh, of Copenhagen, will give two lectures in the theatre of the Physiological Laboratory on March 3 and 4 at 4.30 on the following subjects: March 3, "Osmotic Regulation of Aquatic Vertebrates"; March 4, "Economy of some Animal Communities".

Prof. E. V. Appleton, Wheatstone professor of physics, King's College, London, has been appointed Jacksonian professor of natural philosophy as from October 1 next.

LONDON.—Prof. H. H. Woollard has been appointed as from October 1 to the University chair of anatomy tenable at University College. Since 1929 he has been professor of anatomy at St. Bartholomew's Hospital Medical College.

The degree of D.Sc. has been conferred on C. H. Douglas Clark, assistant lecturer in chemistry in the University of Leeds, for published work mainly on the basis of a system of classifying molecules, which enables certain molecular constants, not so far determined experimentally, to be accurately estimated, especially as described in "The Periodic Groups of Non-hydride Di-atoms" (*Trans. Farad. Soc.*, 31, 1018; 1935).

Science News a Century Ago

Economy of the Cornish Pumping Engines

A CENTURY ago the most economical steam engines were those installed in the mines of Cornwall. These pumping engines were the subject of discussion at the Institution of Civil Engineers on February 2, 16 and 23, 1836. It was then stated that the saving in fuel in the Cornish engines as compared with the Soho engines of Boulton and Watt appeared to be in the proportion of 3 to 1, so that a 1,000 tons of coal in Cornwall were made to do the same work as 3,000 tons in London. The paper on February 16 was by Wickstead, while that on February 23 was by Perkins, who attributed the saving to the use of a small quantity of steam generated under very great pressure in the boiler and allowing it to expand into a large space in the cylinder. There was no doubt that advantage was obtained by expanding the steam, but many members thought the advantage overrated. Some said that there was a difficulty in introducing high-pressure steam, as most of the influential persons in the district thought it was dangerous; while it was considered that Cornish engines could not, like Boulton and Watt's, be applied to driving various kinds of machinery.

Deshayes awarded the Wollaston Donation Fund

THE anniversary meeting of the Geological Society was held on February 19, 1836, the president, Lyell, taking the chair at one o'clock. The proceedings included the usual reports, the election of officers, an address by Lyell, and the award of the Wollaston Medal to Agassiz and of £25 from the Wollaston Donation Fund to Deshayes. In handing the donation to De la Beche, the foreign secretary, Lyell said: "I beg you will express to M. Deshayes, how highly we appreciate his services which he has already rendered to geology by his descriptions of the fossil shells of the strata above the chalk, to which he has chiefly though not exclusively devoted his attention, and we rejoice to hear that he is now engaged in the investigation of the fossil shells of the older formations."

Sale of Fossils from North America

ON February 20, 1836, the *Athenæum* recorded that "a sale, which excited considerable interest among zoologists, took place on Wednesday, at Mr. Steven's, King-street, of fossil remains of the Mastodon and Mammoth of the Ohio, and other curious specimens brought from North America. Among the extensive purchasers were the British Museum, the College of Surgeons, the Bristol Institution and Lord Cole. Some of the more remarkable lots brought high prices; for one in particular, described in the catalogue as 'The Cranium, with two perfect molar teeth, and sockets for two more; length from occiput to end of sockets of tusks, 36 inches, exclusive of portion of socket broken off; diameter across at orbit 13 inches, girth at occiput 57 inches; girth lengthways 83 inches; weight 175 lb., a grand specimen', the British Museum gave £147."

Professions and Consumption

IN a paper in the *Edinburgh Medical Journal*, January–March 1836, on the influence of professions on consumption, Dr. H. C. Lombard, of Geneva, emphasised the advantages which certain workmen might derive from a change of trade, as soon as they began to experience any symptoms of the disease. Workmen who neither had means of enjoying rest nor of changing climate, still less of devoting all their time to the care of their health, and who, if they continued to pursue their insalubrious occupation, would die of consumption, would experience the most advantageous effects from changing their occupation for one less dangerous. Thus strong robust men might assume the occupation of gardener, husbandman, bleacher, waterman, butcher, tanner, wharf-porter, etc. Those whose constitutions might be too delicate for occupations so laborious might become confectioners, cartwrights, slaters, braziers, binders, dyers, grooms, etc. They might, in short, choose one of those trades which were placed above the mean. The same advice might be given to young persons threatened with being consumptive, either from original feebleness of constitution, or from hereditary influence.

Societies and Academies

LONDON

Royal Society, February 6. H. CARMICHAEL: The nature of large cosmic ray bursts. H. LONDON: An experimental examination of the electrostatic behaviour of supraconductors. These papers, abstracts of which appeared in NATURE of February 1 (p. 200), had been postponed from January 23.

EDINBURGH

Royal Society, January 13. R. A. SAMPSON: Studies in clocks and time-keeping (5). The suspended chronometer (see Kelvin, "Popular Lectures and Addresses", vol. 2, p. 360, of which this paper is a continuation). An attempt is made, by careful suspension of a good chronometer, to reduce the effect of suspension on regularity. The attempt proved unsuccessful; the reason is not far to seek: disturbance of a pendulum produces different effects according to where it is applied, and we have no control over the point of application. Better results may be got from a pendulum clock, but even here the same fault makes the use of disturbance unreliable as a control; for example, in the case of the Shortt clocks, it is used for control of the slave by the master. The errors appear to be some hundredths of a second, depending upon the arc. A theory follows the description of the experiment. B. J. MARPLES: The structure of the vascular system of the elasmobranch fish, *Rhina squatina*. The paper gives an account of the vascular system of the fish *Rhina squatina*, and compares it with that of the sharks on one hand and the rays on the other. In external appearance, *Rhina* is intermediate between these two groups, but in its intimate structure it closely resembles the sharks in almost all points. It resembles the rays, however, in having an anterior mesenteric artery which supplies the intestine only. Another remarkable feature is the presence of a complete mandibular arterial arch in the adult, a condition recorded elsewhere apparently only in the holocephalan *Callorhynchus antarcticus*. CHARLOTTE AUERBACH: The development of the legs, wings and halteres in wild-type and certain mutant strains of *Drosophila melanogaster*. In a newly hatched *Drosophila* larva the imaginal disks of all the thoracic appendages are present. Those of the wings and halteres are already invaginated into the body cavity. In the second instar also the leg disks invaginate. During the third instar the *anlagen* of the legs, wings and halteres are formed from the disks. The wing-disk of a mature larva consists of an anterior thorax-forming portion and a posterior wing-forming portion. The latter is markedly smaller in vestigial than in wild-type. During the first six hours after pupation the wing grows out in the form of a hollow pouch. In the form vestigial, its distal part is constricted off and later becomes obliterated. In 13*d*, a mutant with narrow wings, the pouch does not grow out to the same length as in wild-type, and, by a process of rotation, develops into a narrow pupa wing. The dumpy wing acquires its shape only in later stages of the pupal period by obliteration of marginal parts.

PARIS

Academy of Sciences, January 6 (*C.R.*, 202, 1–100). ERNEST ESCLANGON: The proper motion of the variable Hind nebula (*N.G.C.* 1555). The variability of form and motion of this nebula suggests an orbital movement in space. It presents great interest and should be followed regularly. PAUL VINCENSINI: The minimum unitary curves in the theory of superconvexity of A. E. Mayer. O. ERMOLOWA: The dissociation of the variables in an equation containing any number of variables. JOHN ELLSWORTH: Photometric and colorimetric observations of Nova Herculis 1934. ROBERT FLEURENT: The study of sounds in closed spaces in relation with quality and audition. A microphone of the piezo-electric type, with a known response curve, was used, connected with an amplifier, to give oscillograms. In the study of echoes, as the directive effect of the microphone is not well defined, a source of sound giving definite directions of emission was employed. GUSTAVE RIBAUD: The thermal theory of the limit layer in laminated regime. JACQUES YVON: The molecular theory of the dielectric constant of non-polar liquids. PIERRE TRUNEL: The permanent electric moment and structure of phosphorus pentachloride. From measurements of the dielectric constant of phosphorus pentachloride in carbon disulphide and in carbon tetrachloride solution, the author concludes that the chloride possesses a moment and has a non-symmetrical structure. This is in contradiction with the work of Simons and Jessop on the same subject. W. ARKADIEW: The analysis of the dynamic curves of magnetic permeability and of the losses in iron. CONSTANT CORIN and JACQUES HERRY: The infra-red absorption spectrum of liquefied gases. Study of methane. HUBERT GARRIGUE: The ultra-luminous spectrograph of the Pic du Midi. The instrument described embodies several new features, and some results obtained with it are given. MARCEL MATHIEU and MLLE. THÉRÈSE PETITPAS: The study by means of the X-rays of the absorption of cyclopentanone by trinitrocellulose. The phenomena observed are similar to those observed in the gelatinisation of fibres of nitrocellulose by acetone vapour. MLLE. CÉCILE STORA: The Becquerel effect and the photochemical sensibility of some fluorescent colouring matters. SERGIO DE BENEDETTI: The emission of positrons by a thorium B + C source. RENÉ LEDUC and JEAN VILLEY: Propulsive thermal tuyères. FERNAND GALLAIS: Cæsium iodomercurate. The reaction between mercuric chloride and cæsium iodide has been followed by two methods, measurements of the changes in the electrical conductivity and in the magnetic rotatory power. Both methods show that the predominating complex compound formed is Cs_2HgI_4. FRITZ HAMMEL: The anhydrous sulphates of the magnesium series. Results of the application of Debye and Scherrer's powder method of X-ray examination to the anhydrous sulphates of magnesium, manganese, iron, cobalt, nickel, copper and zinc. The absolute parameters are given. PAUL CORRIEZ: Some properties of graphite arising from the transformation of the diamond. Measurements of X-ray diagrams, electrical resistance and magnetic susceptibility of graphite arising from heating diamond to 1,900° C. These were compared with similar data obtained from sugar carbon after heating to 2,000° C. WILFRIED HELLER: The mechanism and kinetics of thixotropic solidification. MARCEL PATRY: The ortho- and metatellurates. Benzidine salts. Two distinct salts of benzidine have been obtained, one an orthotellurate, the other a metatellurate. A. SANFOURCHE and JEAN BUREAU: The discrimination of the constituents of nitrous vapours by the formation of azo compounds. The equimolecular mixture NO + NO_2 is totally absorbed by

aqueous alkali solutions, thus behaving as N_2O_3. Towards amines, such as aniline, this mixture behaves differently, the NO_2 being absorbed producing an azo compound, the bulk of the nitric oxide passing unabsorbed. LOUIS HACKSPILL and WILLY SCHUMACHER: The preparation and properties of rubidium and cæsium fulminates. These alkaline fulminates detonate about 200° C., or, if dry, on slight friction. The mechanical effects of the detonation increase with the molecular weight. HENRY GAULT and EUGÈNE BELOFF: The pyrogenic decomposition of esters in the presence of aluminium chloride. Butyl acetate heated with aluminium chloride gives butyl chloride, butylene, methane, hydrogen and small proportions of other gases. GEORGES DARZENS and ANDRÉ LÉVY: A new method of preparation of halogenmethylene derivatives of naphthalene hydrocarbons. The synthesis of 1.2 and 1.4-dimethylnaphthalene. PAUL WOOG and N. YANNAQUIS: The orientation of the molecules of beeswax and repercussion on the solidity of the honeycomb. MICHEL WOLAROWITSCH: The viscosity of fused rocks. The results of measurements of the viscosity of eight fused rocks are given, together with the analyses of the rocks. The acid rocks, containing the highest percentage of silica, show the highest viscosities. ANDRÉ DEMAY: The magmatic and tectonic signification of the Cevenol complex and on the tectonic at depth of mountain chains. G. LEMÉE: The final climatic association, or climax, in the Perche region. MARCEL BAUDOUIN: The subcondylian apophysis of the humerus in birds. RENÉ MORICARD and JOSÉ VILA: The existence of the ovocytary crown and of the radial vacuome in mice. Starting the first maturation mitosis and parthenogenetic segmentation of the ovocyte by the injection of mitosines. MAURICE PARAT and CHARLES DEVILLERS: The animal associations of the coasts of Jan Mayen island. JEAN RÉGNIER, B. BRIOLET and ANDRÉ QUEVAUVILLER: The variation of the chronaxy of the motor nerve trunk under the prolonged action of cocaine hydrochloride and of novocaine. ALAIN BOURSIN: An electrovibrator combined with high frequency. F. DE CHUITON, CH. MISTRAL and J. DUBREUIL: Transmission of porcine plague to the guinea pig with passage in series. Rapid loss of virulence for the pig from the first passage of the virus to the guinea pig.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 9, 1935). S. COHN-VOSSEN: Complete Riemann's spaces of positive curvature. G. DUBOSHIN: Some conditions of stability for the equation $\ddot{x}+px=0$. P. I. LUKIRSKIJ and T. V. CAREVA: Experiments with slow neutrons. The experiments prove the existence of the temperature effect, and confirm the suggested existence of an absorption of neutrons with thermal velocities. L. S. LEIBENSON: The theory of motion of gases. H. MARK: Preliminary report of the Caucasian Expedition of the 1st Chemical Institute of the University of Vienna. The expedition studied physical properties and crystallography of ice in the Elbrus and Kazbek glaciers. D. KOSTOFF, N. DOGADKINA and A. TICHONOVA: Chromosome number of certain angiosperm plants (*Nicotiana*, *Petunia*, *Oxalis*, *Secale* and *Punica*). V. S. BUTKEVICH and M. S. GAJEVSKAJA: Yield of citric acid from sugar as a basis for examining the mode of its formation from the latter. V. L. KRETOVICH and E. N. RIAZANCEVA: Biochemical changes in the wheat grain under the action of high temperatures. J. A. SMORODINTZEV and K. W. BEBESHIN: The glycogen content of tape-worms (Cestoda). *Tænia saginata* is apt to accumulate three to four times more glycogen than *Tænia solium* and *Diphyllobotrium latum*. Z. S. KATZNELSON: The origin of the sarcolemma of striped muscles. Sarcolemma is a secondary formation from the connective tissue. G. H. MOLOTKOVSKIJ: Study of the state of the stomatal openings by the method of celluloid impressions. T. I. PRIVOLNIEV: Some notes on the rate of growth of the embryo of the salmon (*Salmo salar*). The rate increases at the beginning of development, and later periods of intense growth alternate with periods of depression. A. P. ANDRIASHEV: A new fish of the family Lycodapodidæ from the north-east coast of Kamchatka: *Lycodapus derjugini*, sp.n. A. A. WOITKEVITCH: Activation of the feather papillæ during their development. I. KANAJEV: Regeneration of transplanted stalks of *Pelmatohydra oligactis* (1).

MELBOURNE

Royal Society of Victoria, November 14. ARTHUR W. PARROTT: Observations on the biology of brown trout from Victoria. ETHEL I. MCLENNAN: Notes on the organisms causing brown rot of citrus fruit from Victoria. Citrus fruit in Victoria suffering from 'brown rot' yielded in the autumn *Phytophthora citrophthora*, while in the spring some isolations of *Phytophthora hibernalis*, Carne, were obtained. A comparison of the Australian strains of *P. citrophthora* with a culture of the American strain of this species showed certain physiological differences, although they are morphologically similar. Cultures in prune juice varied widely in the amount of growth for the two strains, and in addition, certain differences were also noted on solid media. The temperature relations of the Australian fungus were compared with those of *P. palmivora*, but these experiments supported the inclusion of this form in *P. citrophthora*. Additional evidence for this conclusion was also obtained by opposing the citrus isolations against the 'cacao' and 'rubber' strains of *P. palmivora*, for in no cases were sexual organs formed. SHIRLEY HOETTE: Pitting disease of bananas in Australia. This disease, known as the cause of serious wastage in Brazilian fruit, has been found to occur in Australia and to be caused by the same fungus, *Piricularia grisea*, (Cke.), Sacc. The symptoms are very similar to those on Brazilian and West Indian bananas. LYLY D. REFSHAUGE and EUNICE M. PROCTOR: The diagnosis of some wood-destroying Australian Basidiomycetes by their cultural characters. Wood is commonly found in a decayed state due to the growth of wood-destroying fungi upon it. In many cases non-fruiting bodies of the attacking fungus are present, which makes the identification of such a fungus difficult. Such forms can be obtained in pure culture comparatively easily, and it is suggested that if keys were available 'to run out' these forms by their cultural characters, their identities could be readily determined. Work was carried out to determine accurately the cultural characters of a number of these wood-destroying fungi, and from such data keys were built for their identification in the laboratory. Fourteen forms were grown on four different media for this comparative cultural work, and their microscopic features were also studied. From these results four dichotomous keys were compiled, three using the results of the comparative cultural work, and one using the microscopic features.

Forthcoming Events

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

Monday, February 17

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Joseph Schafer: "The Social History of American Agriculture" (succeeding lectures on February 20, 24, 27, March 2, 5, 9 and 12).*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—E. Porsild: "A Four-Year Trail from Alaska to the Mackenzie Delta".

Tuesday, February 18

UNIVERSITY COLLEGE, LONDON (CHEMICAL AND PHYSICAL SOCIETY), at 5.—Prof. J. Read: "Humour and Humanism in Chemistry".

ROYAL INSTITUTION, at 5.15.—Peter Fleming: "A Journey across Central Asia: Travel and Politics in North Tibet and Chinese Turkestan" (succeeding lectures on February 25 and March 3).

WARBURG INSTITUTE, at 5.30.—Prof. Niels Bohr: "Some Humanistic Aspects of Natural Science".*

UNIVERSITY OF LEEDS, at 8.—(in the Philosophical Hall, Park Row, Leeds).—Prof. P. M. S. Blackett: "Cosmic Rays".

Wednesday, February 19

ROYAL SOCIETY OF ARTS, at 8.—Sir Leonard Woolley: "The Racial Elements in Sumerian Art History".

Thursday, February 20

ROYAL SOCIETY, at 4.30.—N. Thompson: "The Electrical Resistance of Bismuth Alloys".

E. G. Williams, M. W. Perrin and R. O. Gibson: "The Effect of Pressure up to 12,000 kg./cm.^{2} on Reactions in Solution".

ROYAL INSTITUTION, at 5.15.—W. T. Astbury: "X-Ray Studies of Protein Structure" (succeeding lectures on February 27 and March 5).

ROYAL EMPIRE SOCIETY (SOCIAL SERVICES' GROUP), at 8.—Discussion on "Medical Missionary Work Overseas", to be opened by Miss C. F. Taylor and Dr. T. H. Somervell.

CHEMICAL SOCIETY AND FARADAY SOCIETY, at 8.—(in the rooms of the Chemical Society).—Joint discussion on "The Kinetics of Gaseous Combustion", to be opened by Dr. R. G. W. Norrish.

Friday, February 21

GEOLOGICAL SOCIETY OF LONDON, at 3.—Annual General Meeting.

J. F. N. Green: "The Terraces of Southernmost England". (Anniversary Address.)

INSTITUTION OF MECHANICAL ENGINEERS, at 5.30.—Annual General Meeting.

Dr. H. J. Gough, F.R.S.: First Report of the Pipe Flanges Research Committee.

INSTITUTION OF MECHANICAL ENGINEERS, at 5.30.—Annual General Meeting.

BEDSON CLUB (ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE), at 6.30.—J. D. Bernal: "Modern Crystallography and Organic Chemistry".

INSTITUTE OF PHYSICS (MANCHESTER AND DISTRICT LOCAL SECTION), at 8.—(in the Physics Department, University of Manchester).—Prof. J. Chadwick, F.R.S.: "Cosmic Rays".

ROYAL INSTITUTION, at 9.—Prof. V. H. Blackman, F.R.S.: "Light and Temperature and the Reproduction of Plants".

Saturday, February 22

ROYAL INSTITUTION, at 3.—Sir Leonard Woolley: "The Historical Background of Sumerian Art" (succeeding lectures on February 29 and March 7).

Official Publications Received

Great Britain and Ireland

Bulletin of the School of Oriental Studies (University of London). Vol. 8, Parts 2 and 3: Indian and Iranian Studies presented to George Abraham Grierson on his Eighty-fifth Birthday, 7th January 1936. Pp. viii+297–881+4 plates. (London: School of Oriental Studies; Luzac and Co.) 25*s.* [271

Imperial Institute. Annual Report, 1935. Pp. 60. (London: Imperial Institute.) [32

International Union of Forest Research Organizations. Forest Bibliography with the Index Number 634·9 F, an International Decimal Classification on the Basis of Melvil Dewey's System, adopted on the recommendation of the International Committee on Forest Bibliography, 1906–1933. English translation from the German prepared and issued by the Imperial Forestry Institute, Oxford; translation of Technical Terms kindly verified by Dr. C. A. Schenck. Pp. vii+100. (Oxford: Hall the Printer, Ltd.) [32

Government of India Act 1935. Excluded and partially excluded Areas (Section 91): Recommendations of the Provincial Governments and the Government of India. (Cmd. 5064.) Pp. xli+248. (London: H.M. Stationery Office.) 4*s.* 6*d.* net. [42

Other Countries

U.S. Department of the Interior: Office of Education. Vocational Education Bulletin No. 180 (Agricultural Series No. 47): Summaries of Studies in Agricultural Education; an Annotated Bibliography of 373 Studies in Agricultural Education with a Classified Subject Index and a General Evaluation. Pp. v+196. (Washington, D.C.: Government Printing Office.) 15 cents. [271

The Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1934, together with the Twenty-eighth Annual Report of the Central Committee of the Association for the Year ending 31st March 1935. Pp. 76. (Coonoor: Pasteur Institute of Southern India.) [271

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. A Study of the Genus Hemimerus (Dermaptera, Hemimerina, Hemimeridæ). By James A. G. Rehn and John W. H. Rehn. Pp. 457–508. Zoological Results of the Third De Schauensee Siamese Expedition, Part 7: Fishes obtained in 1935. By Henry W. Fowler. Pp. 509–513. Fresh-Water Fishes obtained in Guatemala by Mr. Rodolphe Meyer de Schauensee in 1935. By Henry W. Fowler. Pp. 515–531. (Philadelphia: Academy of Natural Sciences.) [271

Geological Survey of Tanganyika Territory. Sheet 158: Southern Musoma Goldfield. Scale 1·975 Miles to one Inch. 32 in. × 18 in. Sheet 159: Eastern Musoma Goldfield. Scale 1·975 Miles to one Inch. 33 in. × 28 in. (Dodoma: Geological Survey Department.) [291

Publikace Pražské Státní Hvězdárny. Č. 8: Die Geschicke eines Chronometers der Königl. Böhmischen Gesellschaft der Wissenschaften in Prag (1791–1864); ein Beitrag zur Geschichte der Naturwissenschaften in Böhmen. Von Otto Seydl. Pp. 89. (Prag: Státní Hvězdárny.) [311

XVI International Geological Congress. Copper Resources of the World. Vol. 1. Pp. vii+441+22 plates. Vol. 2. Pp. vi+443–855+ plates 23–41. (Washington, D.C.: XVI International Geological Congress, c/o U.S. Geological Survey.) 5 dollars each Vol., 9 dollars the set, to Members; 6 dollars each Vol., 10 dollars the set, to non-Members. [311

Bulletin of the American Museum of Natural History. Vol. 70, Part 1: The Marine Fishes of West Africa, based on the Collection of the American Museum Congo Expedition, 1909–1915. By Henry W. Fowler. Pp. vii+605. (New York: American Museum of Natural History.) [311

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 8: Private Proprietary and Endowed Schools giving Trade and Industrial Courses. By Maris M. Proffitt. Pp. iv+91. (Washington, D.C.: Government Printing Office.) 10 cents. [311

U.S. Department of Agriculture. Farmers' Bulletin No. 1548: The European Corn Borer; its Present Status and Methods of Control. By D. J. Caffrey. Revised edition. Pp. ii+39. (Washington, D.C.: Government Printing Office.) 5 cents. [311

Smithsonian Miscellaneous Collections. Vol. 94, No. 14: A Caddo Burial Site at Natchitocheo, Louisiana. By Winslow M. Walker. (Publication 3345.) Pp. ii+15+6 plates. Vol. 94, No. 15: Aerial Fertilization of Wheat Plants with Carbon-dioxide Gas. By Earl S. Johnston. (Publication 3346.) Pp. ii+9+6 plates. (Washington, D.C.: Smithsonian Institution.) [32

Report of the Secretary of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ended June 30, 1935. (Publication 3344.) Pp. iii+90. (Washington, D.C.: Smithsonian Institution.) [42

The South African Journal of Science. Vol. 32: Being the Report of the Thirty-third Annual Meeting of the South African Association for the Advancement of Science, Paarl, 1935, 1 July to 6 July. Pp. 712. (Johannesburg: South African Association for the Advancement of Science.) 30*s.* net. [42

U.S. Department of the Interior: Geological Survey. Bulletin 843: A Brief Review of the Geology of the San Juan Region of Southwestern Colorado. By Whitman Cross and Esper S. Larsen. Pp. vi+138+16 plates. 1 dollar. Bulletin 866: Geology of the Tonsina District, Alaska. By Fred H. Moffit. Pp. ii+38+1 plate. 40 cents. (Washington, D.C.: Government Printing Office.) [42

Catalogues

Installations of Cambridge Automatic Regulators controlling Electric, Gas and Oil Fired Furnaces. (Folder No. 51.) Pp. 16. (London: Cambridge Instrument Co., Ltd.)

Colorimetric Analysis with the B.D.H. Lovibond Nessleriser. Pp. 18. (London: The British Drug Houses, Ltd.)