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## Co-ordinating Agricultural Research

ORGANISED agricultural research in Great Britain is developing along lines similar to a modern industry. The chief research centres confine their activities to one or a few aspects of agriculture, and in this respect may be compared to factory shops, in each of which the operatives concentrate on some particular stage of production and usually know little of the processes carried out in other shops. This highly specialised type of organisation is one of the most economical that has yet been devised, but its success depends largely on the existence of a central executive body, capable of ensuring the closest co-operation and co-ordination between the different departments. In recent years, the need for an analogous executive body to co-ordinate agricultural research in Great Britain has become increasingly apparent and has been accentuated by the present tendency to regard agricultural development as one of the most important parts of national policy. When Government not only subsidises agricultural research but also determines agricultural policy, its obvious duty is to see that the money spent on research is used to the best advantage for the furtherance of its policy.

In the other fields of applied science subsidised by national funds, co-ordination has for some time been effected through the Medical Research Council and the Council for Scientific and Industrial Research. In 1931, the framework of the scheme for the national supervision of subsidised research was completed by the establishment, by Royal Charter, of the Agricultural Research Council, which has just issued its first annual report\*.

The chief duty of the Agricultural Research Council is to give advice on research to the agricultural departments and to the Development Commission, and to make recommendations with regard to the administration of the subsidies granted by the Treasury, amounting in 1931 to about £390,000. The Council works in close collaboration with the Medical Research Council and the Council for Scientific and Industrial Research, each of which must have at least one member on the Agricultural Research Council. The work of the latter, however, is complicated by the fact that, when it came into existence, there was already an extensive agricultural research organisation

\* Committee of the Privy Council for the Organisation and Development of Agricultural Research. Report of the Agricultural Research Council for the Period July 1931—30th September 1933. (Cmd. 4718.) Pp. 205. (London: H.M. Stationery Office, 1934.) 3s. net.

operating under the Development Commission and the Agricultural Departments of England and Scotland. It is faced with the delicate task of adapting this organisation, initiated in 1911, to the economic and political conditions of the present time.

A danger which the research worker may foresee in the creation of a co-ordinating body controlled by Government is that political influences may be introduced into the direction of agricultural research. The Council's report should allay all fears on this score, at least for the immediate future. It has been written not only with exceptionally broad vision and a true appreciation of the present needs of agricultural research, but also in a most interesting and informative style.

In the period covered by the report, the Council's main achievement has been to make a general review of British agricultural research. This has involved more than a hundred meetings of committees and sub-committees, and frequent visits to twenty-two different research institutes. In its future difficult task of co-ordination, which will demand the willing co-operation of all concerned, the first annual report will be of the utmost value not only to the Council but also to the directing bodies of institutes which may be called upon to modify their research programmes to fit the general scheme. The whole report forms a permanent and authoritative record of the progress and achievements of agricultural science up to 1933, and it illustrates in an exceptionally lucid manner the interconnexion of the different branches to form a single science.

Every section of the report appears to have been adequately treated, although more prominence is given to veterinary research than to any other subject, and eight special committees have been formed to advise on the study of the chief animal diseases. This, however, is in accordance with the policy of the Council to adapt the national research programme to the probable needs of agriculture in the immediate future. The Council foresees a large increase in Britain's animal population as a result of recent legislation, and recommends that science should, so far as possible, forearm the farmer to cope with the inevitable spread of diseases—an essentially practical outlook which may arouse mild criticism from non-veterinarians who still believe that the discovery of a truth is of greater significance than its economic value. But agricultural research workers, though they may regret the gradual encroachment of bureaucracy on the freedom of scientific investigation, have to recognise that they are primarily public servants whose first duty is to perform their allotted tasks in the social machine. A slight loss of freedom is compensated by a greater sense of security in what is now formally acknowledged as a profession.

The establishment of a national research council marks the beginning of a new epoch in the history of British agricultural science, and so long as the Council interprets its functions in the manner indicated in its first report, both research workers and institutes are assured of the fullest consideration compatible with a planned organisation.

## Reviews

### Population Prospects in the United States

*Dynamics of Population: Social and Biological Significance of Changing Birth Rates in the United States.* By Frank Lorimer and Frederick Osborn. Pp. xiii+461. (New York: The Macmillan Co., 1934.) 15s. net.

THIS book consists of four parts, the first of which, entitled "Population Trends of American Groups", discusses, in four chapters, first the trend of the national population, and then the three aspects of differential fertility, represented by the contrast between town and country, by racial differentiation, and by differences of social class. The writers realise that population growth in the United States will slow down, cease and change to population decline in the absence of any abrupt change in the trend of the birth-

rate, or in the possibility of attracting immigrants. They express a somewhat ostentatious indifference to the economic effects of this population tendency, which has already doomed the economic prospects of thousands of once hopeful small communities; and has forced the Federal authorities to consider a policy of deliberate depopulation of part of the vast area brought under cultivation by the enterprise of American farmers. The authors state truly that the theory of optimum population is at present still in the stage of preliminary definition and clarification, and add, somewhat vaguely, "It may be that a higher standard of living for individuals could be maintained in this country with a population very much greater or very much less than 150 million," without reference to the fact that personal hopes, enterprise and investment, in addition to municipal, State and Federal policy,

have in the past all been dominated and directed by the confident expectation that the resources of their territory were destined progressively to be more and more fully utilised.

On the other hand, the authors believe, and later produce ample evidence for their view, that the "large differentials in reproduction rates among population groups" in their country need far more critical attention than they have yet received, and determine to devote the rest of the book to the study of changes taking place within this population. This is not, avowedly, to be taken to mean that the authors consider eugenics more important than economics, but that they recognise that population changes may affect the composition and standards of a people, wholly apart from any changes in their genetic qualities. "Children tend to be like their parents in part because they are usually brought up in an environment similar to that which has shaped their parents. It is evident, therefore, that the differential increase or decrease of groups with varying social heritage may affect the proportion of different culture levels in our population, just as the differential increase or decrease of groups with varying biological heritage may affect hereditary capacities. The study of both factors is important."

In the following chapter the authors demonstrate that, as in other countries, "there is at the present time a tremendous rural-urban differential in reproductive tendency," and quote Thompson and Whelpton on the current situation. "If prosperity again permits a resumption of the movement of the surplus farm population to city jobs the present urban exodus may do little permanent harm. If this should not occur, there is a danger of developing a large poverty-stricken population on the millions of acres of land which is sub-marginal for business farming, but which will permit self-sustaining farming on a low standard of living."

The authors consider "It is impossible to determine exactly, at the present time, the relative reproduction trends of whites and negroes in the United States", but evidently think there is no great difference. They point to unusually high fertility for several minor racial groups, namely Mexican, Japanese, Chinese and American Indians. They feel also that "there is little interest in the reproduction rates of foreign groups during the first generation of American residence, from the long range standpoint, because foreign groups become native groups in the second generation".

The longest chapter in this part is naturally devoted to the large differences in fertility between social groups, classified by occupation or by economic status. They find that these differences in fertility among urban social classes have

remained fairly constant during the last fifty years, although the absolute rates for all classes have declined considerably during this period. They add, however, "It seems very likely that differentials in fertility among social groups in the United States may become somewhat narrower in the course of the next fifty years." This anticipation seems not to be based on any American data, but on the somewhat credulous acceptance of recent not very well substantiated statements concerning several European cities, as to the validity of which it would be but prudent to reserve judgment.

The methods and attitude of the authors have been illustrated above from the first of the four parts into which the book is divided. Part II deals with the "Measurable Characteristics of American Groups", using, as before, regional racial and social sub-divisions. Part III is devoted to the "Influence of Differential Reproduction on the Characteristics of the American People" under the two headings of its social significance and its biological significance; while Part IV discusses the causes and control of population trends. Causes are divided into physical and medical factors on one hand, and the economic and social factors on the other. Under the possibilities of social control are discussed numerous current movements of thought and political action, which may be believed, with more or less reason, to affect the situation.

In spite of the enormous field which the book is thus designed to cover, it does not suffer from compression, but more frequently from prolixity and occasionally from repetition. The laudable aim of restricting the conclusions to those which can be based on ascertained facts has, of course, greatly limited the field to be traversed. As all who are familiar with the subject know, the material available for discussion would be still more greatly restricted had the authors required not merely that some objective data should be available, but also that it should be sufficient to warrant statistically valid conclusions. It is a sound canon of science that, when they are available, well authenticated, and free from contradictions, direct observations must be preferred to all indirect inferences from other facts. It is, however, a serious and rather widespread failing, particularly dangerous in the social sciences, to give such preference to findings based on data, while their consistency, accuracy, or relevance are open to serious question. In any discussion of social causation we may find some ascertained facts of compelling authority, others which should not be neglected, and others which are entirely irrelevant. Workers in the social sciences should remember that discussions of causation, even in the most exact sciences, invariably turn on the validity of

some rationally connected system of hypotheses, and never wholly on direct observations. It is, naturally, in the latter parts of this book that the lack of a theoretical background, such as the economists have possessed for more than a century, is most severely felt. This criticism should not be taken as denying to the authors a great measure of success in an immensely arduous undertaking.

R. A. FISHER.

### The Endocrine Principles

*Recent Advances in Endocrinology.* By Prof. A. T. Cameron. Pp. vii+365. (London: J. and A. Churchill, 1933.) 15s.

THE endocrine principles are of interest from three aspects, clinical, chemical and social, for there is often an attempt to ascribe differences of personality to their variations. Recently it is on the chemical side that most progress has been made, many of the principles having been isolated in pure crystalline form and even synthesised, so that it is possible to make the physiological study of the mechanism of their action with material of definite composition and structure. There is progress too on the clinical side, though these aspects are more a matter of controversy. Internal secretions are produced by the thyroid, parathyroid, pituitary and adrenal glands, by the islet tissues of the pancreas, the mucous membrane of the intestine and the organs of reproduction. From these there has been isolated thyroxine, adrenaline, insulin and oestrin in crystalline form, and there is presumptive evidence for other compounds.

Prof. Cameron gives six chapters to the well-established endocrine principles and one to the more presumptive ones, and devotes a final chapter to their interrelationships. He summarises what is known regarding their chemistry, their method of action, their physiology and their clinical behaviour. The book has an appeal, therefore, to the medical, as well as to the biochemical, expert. Each chapter has rather full references to the literature up to the end of 1932 and is appropriately illustrated.

Now that the structure of these compounds is known, it should be noted that they bear no relation to one another, and it becomes important to ascertain some clue as to their utility in metabolism. This is still largely guesswork, but there seems to be a hint of some general relation to oxidation phenomena.

The thyroid principle, for example, according to Plummer, exerts an influence on the oxidation proceeding in all the cells of the body and thus produces its actions: the behaviour suggests control of specific reactions. Insulin brings about the disappearance of glucose from the blood: it is

undecided whether it facilitates glycogen formation or direct oxidation of glucose. Adrenaline likewise has an effect on the interconversion of glycogen and glucose. Of the less-known endocrines, secretin is the most interesting: it appears, like insulin, to be a protein, and acts to stimulate the outflow of pancreatic juice and bile. Mellanby considers that it is carried with the bile salts to the general circulation.

The author devotes a final short chapter to endocrine interrelationships, particularly those of the pituitary, which through one or other of the several principles it secretes controls (1) the thyroid and therefore the oxidative processes, (2) the adrenal cortex and thereby muscular contractility, (3) the development of the gonads and hence the secondary sex organs and secondary sex characters, (4) fat metabolism to some degree, (5) the water exchanges of the body.

No additional words are required to emphasise the interest of the conception that crystallisable chemical substances of relatively simple composition are able to control so many effects in the organism, and it is easy to see the many ways in which slight variations in their production can be reflected. Further deductions from these facts soon take us outside the region of ascertained scientific facts and they are wisely eschewed by the author.

When a selection has to be made from so large a quantity of material, it would not be difficult to find faults of omission or over-emphasis, but it would be unfair to criticise the author for these when so much has been achieved in bringing a difficult subject into focus for detailed study. Prof. Cameron's book will be of definite help to all interested in this field.

### A New Atomic Model

*The Sub-Atoms: an Interpretation of Spectra in conformity with the Principles of Mechanics.* By William Mayo Venable. Pp. viii+148. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1933.) 9s.

THIS book describes an attempt to explain spectroscopic phenomena in terms of a model of the atom conforming to Newtonian mechanics. The author assumes the existence of 'sub-atoms', each of which consists of an ellipsoidal or similarly shaped mass of positive electricity, of charge  $e$ , on which rests a smaller negative electron (charge,  $-e$ ). The linear dimensions of the sub-atoms are inversely as their masses, and the atom of any element consists of that particular stable association of sub-atoms which will explain simultaneously its mass, atomic volume and spectrum. For the

lightest eight elements these considerations give a unique structure, but more work is required on the heavier atoms.

The production of spectra is most simply illustrated by the lightest sub-atom, which is identical with the atom of hydrogen. If the electron is disturbed by an external stimulus it bounces, like an india-rubber ball on the earth, with a frequency which varies continuously as the amplitude decreases. This is accompanied by the radiation of a continuous spectrum, the limiting frequency (for zero amplitude) of which is the Rydberg constant,  $R$ . Similar bouncing of an electron in a molecule formed of two such atoms in line gives a continuous spectrum with limiting frequency,  $R/2^2$ , and the 'difference-frequency' between these two limiting frequencies gives the first line of the Lyman series. Co-operation of more complicated molecules yields the other lines of the hydrogen spectrum. By assuming equilibrium positions of the electron at different distances from the centre of the non-spherical positive mass, the characteristics of the secondary spectrum are similarly described in terms of difference-frequencies. The theory is extended to explain the spectra of the other light elements as well as X-ray spectra, and a few remarks on certain cosmic problems are added.

The author shows great ingenuity in interpreting the details of spectra, which he has taken the trouble to understand beforehand, and his idea is not to be ranked with certain fantastic alternatives to the quantum theory which have been suggested without knowledge of experimental facts. It cannot, however, be considered—at least in its present form—as a serious rival to the current interpretation of spectra. It follows facts throughout, often at a considerable distance, and it appears to be devoid of suggestions for increasing our knowledge. Moreover, there are many facts (for example, the existence and spectrum characteristics of isotopes), well accounted for by the quantum theory, with which it is not obviously able to deal at all.

These defects would be considerably discounted if the theory were, as it claims to be, based entirely on Newtonian mechanics, but the behaviour of the atoms and molecules in producing spectra by no means follows inevitably when Newtonian laws are applied to the assumed structures. In the last resort the theory requires postulates as arbitrary as those of the quantum theory, so that a satisfactory comparison can be made only on heuristic grounds, where it is not likely to survive. The author is, nevertheless, to be commended for having produced a very interesting and suggestive hypothesis and for his diligence in developing it so far as he has done.

## Science and Poetry

*The Poetical Works of Kenneth Knight Hallows.*  
Vol. 1: 1896–1934. Pp. xvi+212+2 plates. (London: Methuen and Co., Ltd., 1934.) 7s. 6d. net.

MR. HALLOWES in his recent book has raised again an oft-discussed question and given some interesting illustrations of its possible solution. The question is how far can poetry express and keep pace with the discoveries of science. The illustrations are drawn from poems of Mr. Hallows himself, when on the Geological Survey of India in the years 1905–23. In speaking of these, it will be sufficient here to point out that Mr. Hallows has at least three of the essentials for carrying out the work to which he rightly attaches high importance. He has an observant eye, a passionate love of Nature and a profound sense of one of the greatest truths which modern science has revealed, namely, that the earth and all that it contains are subject to incessant change, and that what we see, though the result of these changes, is often to the superficial glance quite different. It is due to this apparently paradoxical transformation that Mr. Hallows owes some of his most telling word-pictures; for example, "From rock once molten fire blue speedwells bloom". Such pictures of transformation are, as we might expect, frequent in the work of a man who from the starting point of geology sets out on the work of a poet of science.

How does science fare generally in the works of poets? Our contemporary bards tend to deal, in short and rather emotional fragments, with the psychology of persons or striking events. Such psychology is by no means scientific. If we look at the older poets of rather larger scope, we find that the ideas of the Greek philosophers, who were also the men of science, were quite naturally expressed in verse. There was no such barrier in modes of expression as have since arisen. Then, with the Romans, we have the immortal poem of Lucretius, which actually puts into verse a great scientific hypothesis. In the Middle Ages, Dante gives us in more poignantly human form the science and philosophy of his day. Among the moderns, it is noticeable that Goethe, the greatest poetic force of the nineteenth century, was also an important figure in the science of those times. Wordsworth, Browning, Tennyson, Sellby Prudhomme, Alfred Noyes have all written poetry inspired by science. One would be inclined to say that the general lack, of which Mr. Hallows speaks, is rather due to the dispersive, uncontrolled and rather aimless character of much of the writing and thinking of the present day than to any long-standing divorce between poetry and science.

F. S. MARVIN.

## Short Notices

*Contribution à l'étude du peuplement zoologique et botanique des îles du Pacifique.* Par L. Berland, J. Berlioz, E. H. Bryan, Miss E. Cheesman, L. Joleaud, L. Chopard, L. Germain, A. Guillaumin, K. Holdhaus, E. P. Mumford, A. M. Adamson, P. Rivet, L. Seurat, C. Skottsberg, E. Topsent, C. Vallaux. (Société de Biogéographie, 4.) Pp. iv+288. (Paris: Paul Lechevalier et fils, 1934.) 70 francs.

THE volume consists of sixteen papers by specialists who deal with particular parts of the subject. Two papers are geographical or geological, three are botanical, the remainder deal mainly with zoology, four of them with insects. One must recognise that it is extremely difficult to cover the ground adequately, for there are parts of Oceania and certain groups among the plants and animals about which we possess no information at all. But there are several important topics to which less than justice is done. There is, for example, almost nothing about the butterflies—a very important group to the student of island faunas, for these insects have been carefully collected, and a connected account of them could have been written. The birds also furnish an abundance of material, but the paper which deals with them is most indefinite, with facts about the birds of New Zealand and the Hawaiian Islands, but next to nothing on the avifauna of such well-known groups as Fiji and Samoa. Attention must be directed to one error in fact: it is stated that crocodiles occur in the Tuamotu islands, but actually their eastward limit is in the Santa Cruz, more than 3,000 miles to the west. The error is important, for one of the authors, having extended the range of crocodiles across Polynesia, is inclined to regard them as evidence that the area has a 'continental' fauna.

The critic must not forget, however, that, in the present state of knowledge, a work of this nature must inevitably be fragmentary. Certain parts of it are excellent; for example, the general description of the distribution of insects by Holdhaus and the more specialised articles on Orthoptera and on Arachnida by Chopard and Berland. The value of the book as an introduction to the subject would have been greater had more attention been given to completing the lists of references, and had special and general indexes been provided. P. A. B.

*The Chemical Formulary: a Condensed Collection of Valuable, Timely, Practical Formulæ for making Thousands of Products in all Fields of Industry.* Editor-in-Chief, H. Bennett. Vol. 1. Pp. x+595. (Brooklyn, N.Y.: The Chemical Formulary Co.; London: H. K. Lewis and Co., Ltd., 1934.) 6 dollars; 27s. net.

It is difficult to assess the value of a book of this kind until one has lived with it for years. Only then can one discover whether any process of trial or selection has led to the inclusion or exclusion of material, or whether—as appears to be the case in

this instance—there is no kind of entrance examination prior to admission to its pages. The result is that we have a book containing a very large number of formulæ, some attractive in their simplicity ("Liquid brilliantine: light mineral oil, perfume"), some intriguing in their application (such as artificial butter), and others—very many others—which involve the use of materials of undescribed (and hence presumably unknown) composition appearing under proprietary names. It is true, however, that the book is accompanied by a folder quoting many such names, and stating the suppliers of the preparations.

The great variety of recipes is classified in sections, but within the sections similar entries are not always in juxtaposition. Some of the recipes are stated to be in use commercially, whilst others have been taken from patent specifications and the literature, sources which, the reader is reminded, are often subject to various errors and omissions. In view of this fact and of the fact that the significance and application of a great many of the formulæ are intelligible only to those having specific technical knowledge, the ordinary person will not find that the book obviates any need for technical assistance.

A. A. E.

*Electron Tubes in Industry.* By Keith Henney. Pp. ix+490. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 30s. net.

IN recent years great advances have been made in the use of electronic devices in industries outside the sphere of 'communications'. Mr. Henney's book should do much to further the advance. The author, who deals with the varied and sometimes little appreciated applications of electron tubes, is closely connected with many sides of the world of electronics, and this book should find a place on the shelf of every industrial engineer.

The first two chapters deal with electron tube theory and circuit application, and are sufficient to enable the engineer not familiar with these tubes to understand intelligently the various circuits employed. The remaining chapters are devoted to the vacuum thermionic valve, the gas-filled tube, and to light-sensitive devices; the various industrial and laboratory applications given being chosen to demonstrate the fundamental principles involved. The respective merits of the different tubes available are discussed both from theoretical and practical points of view, and the newer forms of tubes, such as the gas-filled relay, also have their place. An excellent bibliography completes each section.

Isolated examples from the book will indicate the wide field covered; the use of the vacuum tube amplifier and photo-electric cell for automatic temperature control, the use of the grid-controlled gas tube as an inverter and commutator; these will be of particular interest to engineers, while physicists will also find the book of value, for many applications of the tubes, particularly in precision measurements, will make an especial appeal to them. M. B.

*Elektrische Gasentladungen : ihre Physik und Technik.* Von A. v. Engel and M. Steenbeck. Band 1 : *Grundgesetze.* Pp. vii+248. 25.50 gold marks. Band 2 : *Entladungseigenschaften, Technische Anwendungen.* Pp. viii+352. (Berlin : Julius Springer, 1932, 1934.) 33.50 gold marks.

THE first volume of this monograph gives an excellent and condensed account of the methods by which ions are generated and destroyed, and of the laws which govern their passage through a gas. In the first part of the second volume the various forms assumed by the electrical discharge through gases are discussed, and so far as possible explained in terms of the conclusions reached in the first volume. The treatment is intended as a necessary basis for the understanding of the conduction of electricity through gases, and does not pretend to be complete.

The absence of any historical or critical survey is apt, perhaps, to encourage in the reader the feeling that a great deal more is known of the details of some of these processes than is actually the case, and that the explanations given and the data furnished are, in fact, correct. On the other hand, it is extremely easy to find the information which the practical worker in the field requires, and the clear graphs and tables render unnecessary those searches for data in the original papers which are so tedious and often so unsatisfactory. This part of the monograph should prove valuable to those who must design or use apparatus employing gaseous discharge phenomena in the laboratory or in technical work.

The second part of the second volume is too limited in scope to be of much value. It describes various technical applications of the discharge through gases, but in far too superficial a manner. For example, a reader who wished to use a Geiger counter would obtain little practical information from the description given. M. E. O.

*Mathematical Problems of Radiative Equilibrium.* By Prof. Eberhard Hopf. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 31.) Pp. viii+105. (Cambridge : At the University Press, 1934.) 6s. net.

THIS tract is an authoritative exposition of problems of radiative equilibrium by one of the original workers in the subject. An initial chapter gives a summary of the general theory and main problem to be treated, namely, the determination of the radiation field of a star when the coefficients of absorption and scattering, the emissivity and the law of scattering are given. The method is based on the solutions of certain integral equations and is expounded in detail in the succeeding chapters, which deal in turn with the cases of purely absorbing and grey material in local radiative equilibrium (Schwarzschild-Milne model) and that of monochromatic radiative equilibrium with scattering but zero emissivity (Schuster-Schwarzschild model). On account of the rigorous analytical method employed, the book is one for the specialist rather than the general reader, and will prove a very useful guide for those interested in the subject.

*An Introduction to Logic and Scientific Method.* By Morris R. Cohen and Ernest Nagel. Pp. xii+467. (London : George Routledge and Sons, Ltd., 1934.) 15s. net.

THIS book, by two American teachers of philosophy, helps to show how far the best representatives of logic in modern universities have travelled from the Aristotelian tradition which formerly prevailed. In an earlier generation Mill and Stanley Jevons, and later Neville Keynes, did much for the reshaping of the old formal logic, and for the development of an inductive logic which brought the subject into more vital relation with the methods of scientific investigation. In more recent times, logical theory has made progress in different directions, so that for educational purposes an eclectic treatment of the whole subject is desirable. Such a treatment is accomplished in this admirable book.

The authors have, we think wisely, adopted a fairly conservative attitude towards the traditional views, with which they have sought to connect the newer work in exact logic. In giving the main results of symbolic or mathematical logic, they have refrained from stepping across the boundaries between logic and mathematics. They hold that the alternative systems of logic which have been worked out are really different systems of notation for the same logical facts. Their illustrations, freely drawn from the natural sciences, are such as a college student may be expected to understand and appreciate. We think highly of the attempt of the authors to provide a sound introduction to the principles of logic and scientific method.

*Recent Advances in Vaccine and Serum Therapy.* By Prof. A. Fleming and Dr. G. F. Petrie. (Recent Advances Series.) Pp. x+463. (London : J. and A. Churchill, 1934.) 15s.

AN authoritative and up-to-date account of modern serological remedies and therapeutic and preventive vaccines is much needed by the medical practitioner, and this book should go far to supply this want. Dr. Petrie deals with the serological side, including the treatment of snake, scorpion and spider bites, and Prof. Fleming with the vaccines, including non-specific vaccine and protein therapy. The veterinary side of the subject is also considered by both authors.

Though primarily concerned with recent advances, the older work is referred to, and the volume, which is well produced and very readable, provides a comprehensive practical account of the whole subject. A chapter is devoted to bacterial variation in relation to immunising power, and the importance of the 'rough' and 'smooth' and 'H' and 'O' variants is detailed, and the work of Perry, Findlay and Bensted on the suitable strain of typhoid bacillus for the preparation of anti-typhoid vaccine is included. A lengthy chapter is devoted to the vaccine treatment of chronic rheumatic conditions, in the preparation of which Prof. Fleming is able to draw upon his own considerable experience.

A short bibliography is appended to each subject, and an index of authors as well as of subjects is included.

## Arctic Meteorology\*

By DR. G. C. SIMPSON, C.B., C.B.E., F.R.S.

IN 1905 appeared Mohn's discussion of the meteorological records obtained during Nansen's drift across the north polar basin on board the *Fram* during the three years October 1893–August 1896. No one who is interested in polar meteorology needs to be reminded of the outstanding value of that great work, which has been for thirty years the source of practically all we know about the atmosphere over the Arctic Ocean.

Now has appeared another great contribution to our knowledge of arctic meteorology, again obtained on the drift of a Norwegian ship and discussed by another outstanding Norwegian man of science. When Mohn's work appeared, the name *Fram* was a household word to the whole civilised world; but how many people even in England know anything about the *Maud*? Yet the *Maud's* sojourn in the Arctic, where she was engaged on the same enterprise of scientific research, was even longer than that of the *Fram*, and her scientific results no less valuable.

Amundsen's successful dash to the South Pole was a mere episode in a project on which he had been working for several years: namely, to repeat Nansen's drift across the Arctic Ocean in the *Fram*. In fact, he was on his way from Norway to the Bering Straits around Cape Horn when he changed his plans at Madeira and went to the Antarctic. On his return to Norway he proceeded with his original plans; but the old *Fram* was found to be nearing the end of a glorious life and was no longer fitted for such strenuous work. Then the War broke out, but Amundsen did not relinquish his plans. In 1916 he gave orders for a new ship to be built, on the lines of the *Fram*, but smaller; on June 7, 1917, the new ship was launched and christened *Maud*.

On July 18, 1918, the *Maud* left Vardø, with Amundsen in charge, the total ship's party being only nine men. The plan was to sail eastwards along the Siberian coast towards the Bering Straits and then turn northwards into the ice and drift with the pack across the Pole. That was the plan, but it did not eventuate: for seven years the *Maud* remained in the Arctic the greater part of the time, either frozen fast near the coast or drifting aimlessly to the east of the New Siberian Islands.

Luckily for him, and more so for science, Amundsen in 1917 invited H. U. Sverdrup, a

young Norwegian who had never been in the Arctic before, to take charge of the scientific work of his expedition. Sverdrup consented and was one of the two men who alone saw the expedition through, starting with the *Maud* at Vardø in 1918 and leaving her when she returned to Nome in August 1925.

During the first three years, Sverdrup was the only trained scientific worker on board—Amundsen helped with the magnetic work but he was disabled for a long period with a broken arm—but in 1922 F. Malmgren, whose tragic death after the disaster to Nobile's airship in 1928 will be fresh in the memory of most, joined the expedition as assistant scientist. In these circumstances the amount of scientific work carried out on the expedition is amazing. Observations of the first importance on oceanography, terrestrial magnetism, atmosphere electricity and meteorology were carried out; zoological, botanical and geological collections were made, and Sverdrup spent seven and a half months living with a little-known group of native nomads in order to study their language and customs, and characteristically enough during the whole time he was with them he made meteorological and magnetic observations.

The volume on meteorology which has just been published consists of two parts: Part II (527 pages) contains all the data in 28 well-arranged tables, and Part I is a discussion running to 331 pages written by Sverdrup himself. Naturally one compares Sverdrup's discussion of the results of the *Maud* expedition with Mohn's discussion of the *Fram* results. There is one striking difference: Mohn's discussion is limited almost entirely to working up the statistics of the observations, while the outstanding feature of Sverdrup's treatment is his investigation of the physics and dynamics underlying the observations. The difference is symptomatic of the great advance made by meteorology in the interval. Thirty years ago meteorological observations, even in settled countries, consisted of little more than observations of pressure, wind, temperature, cloud and precipitation all made at the surface, and the meteorologist could do little more than find statistical relationships between them. Such were the observations carried out on the *Fram*, and Mohn's discussion was necessarily statistical. On the *Maud* similar observations were made, and Sverdrup has treated them in the same way and quite as thoroughly as Mohn treated the *Fram* results; so that the two sources of information

\* The Norwegian North Polar Expedition with the *Maud*, 1918–1925. Scientific Results. Vol. II. Meteorology. By H. U. Sverdrup. (Geofysisk Institutt, Bergen, in co-operation with other Institutions.)



support and supplement one another. In the *Maud*, however, many other observations were made, and it is Sverdrup's complete and able discussion of the light which these new observations throw on old meteorological problems which makes his discussion so interesting and valuable.

For the first time we have a mass of observations from the upper air in the Arctic obtained by sounding balloons, pilot balloons and kites. The observations of the upper air temperature made by balloons and kites, of which there were 162 ascents, reveal an unexpected and important distribution of temperature over the ice. The few previous measurements of upper air temperature made over ice in polar regions had led us to expect a marked temperature inversion near the snow-covered ground during the winter. In other words, that there was a 'cold layer' of air near the surface.

It was supposed that this layer was easily removed by the wind. The observations made on the *Maud* show, however, that this is not the case. All that the wind does is to stir up the layers quite near to the ground. In this stirred-up layer, as one would expect, temperature decreases with height, but above it the strong inversion remains and the normal fall of temperature with height does not set in, in any season, much below 1,000 metres. There are, therefore, three definite layers of air over the Arctic sea ice, (a) a layer, 150 m. thick in the winter, increasing to 500 m. thick in the summer, in which the temperature decreases slightly with height, (b) a layer in which there is a strong inversion, the top of which varies in height above the surface from 280 m. in the winter to 600 m. in the summer, (c) a layer probably reaching to the tropopause in which the temperature decreases with height in the normal way. The pilot balloon observations, of which there were 621, gave very complete information regarding the variation of wind velocity and wind direction with height.

The peculiar distribution of temperature and the observed variations of wind with height over the ice can only be caused by eddy motion set up in the lower layers of the air, and Sverdrup uses the results of his observations to test the various formulæ put forward by Richardson, Schmidt, Köhler and Hesselberg in their theoretical work on the eddies in the atmosphere. Sverdrup's discussion is a valuable contribution to a difficult subject, and the numerical values he obtains will be found of use in a number of problems.

The diurnal variation of temperature in polar regions has been the subject of much discussion since the writer pointed out in his discussion of

the meteorological observations made on Capt. Scott's Antarctic expedition that there are two types of daily variation, in one of which the maximum amplitude occurs in a spring month and in the other in a summer month. The observations taken on the *Fram* showed a rapid increase in the amplitude after the return of the sun until April, after which it decreased to very low values in the summer months; while in McMurdo Sound the amplitude increased steadily from the appearance of the sun until the summer and then decreased again as the altitude of the sun decreased. The observations on the *Maud* showed the same type as observed on the *Fram*, and Sverdrup gives a new explanation. It has already been mentioned that the lowest layer of the atmosphere in which the eddies cause the temperature to decrease with height thickens from the winter to the summer. Sverdrup considers that the layer is warmed up by contact with the ground and, therefore, as it gets thicker it takes more and more heat from the surface. After the sun returns, the daily temperature range tends to increase as the altitude of the sun increases; but the thickness of the layer also increases and that tends to reduce the range. The actual course is due to the relative efficacy of the two factors, the solar effect being the stronger until about April and then the eddy effect predominates.

During the last three years, after Malmgren had joined the expedition, an increased number of observations became possible, and amongst these were measurements of the incoming solar radiation, the long wave radiation received from the sky, the temperature of the actual surface of the snow and the temperature of the ice at three depths below the surface. These data supply all the information necessary to calculate the flow of heat during calm weather to and from the surface, and one of the most interesting chapters in Sverdrup's discussion is that in which he uses the results of these observations to investigate the heat balance of the atmosphere over ice-covered surfaces. He calculates that the average minimum temperature on clear calm days in the winter should be  $-38.8^{\circ}\text{C}.$ ; the observations give  $-38.9^{\circ}\text{C}.$  According to the calculations, the absolute minimum temperature over the frozen polar sea should lie between  $-43.9^{\circ}\text{C}.$  and  $-49.5^{\circ}\text{C}.$ ; the actual observations taken on the *Maud* in four winters give values varying between  $-41.7^{\circ}\text{C}.$  and  $-46.3^{\circ}\text{C}.$  The lowest possible winter temperature at Arctic land stations is calculated to be between  $-63^{\circ}\text{C}.$  and  $-75^{\circ}\text{C}.$ , the former being the more probable; the lowest recorded temperature is  $-69.8^{\circ}\text{C}.$  at Werchojansk in February 1892. By using the value of the 'eddy diffusivity' found from the kite and

balloon observations, similar calculations are extended to conditions during the summer and in winds. This discussion of the heat balance is of particular value for a large number of meteorological problems.

During the latter part of the expedition, entirely new methods of observing amounts of precipitation and the formation of hoar frost were devised and successfully used; but lack of space forbids further reference to the fascinating results obtained. This short article must be closed by a reference to the last chapter in the work, entitled "The Circulation of the Air". For the first time the new ideas of the Bergen school of meteorologists have been applied to the interior of the polar regions. Depressions with their characteristic

'fronts' are recognised and their motion determined in so far as that is possible without synoptic charts. There appear to be two main permanent 'fronts' in the Arctic on which depressions form in the winter months—one in north-west Siberia, near to the Bering Straits, and the other between Spitsbergen and Norway. During the winter months the pressure distribution over the Arctic is found to be mainly anticyclonic, but the anticyclonic conditions are frequently destroyed by deep cyclones which form on these two fronts and progress eastwards and northwards into the centre of the polar basin. In the summer the general weather situation is of a more cyclonic character, but the actual disturbances are small and weak compared with the deep winter cyclones.

### Development of the Modern Broadcast Receiving Valve

THE specification of most modern broadcasting receivers contains an imposing list of titles describing the various thermionic valves employed in the set. The simple terms, 'high-frequency amplifying', 'detector' and 'low-frequency amplifying', are now no longer sufficient to describe the type of valve and its function in a wireless receiver; and one is led to speculate whether those investigators who were responsible for the introduction of the terms 'diode' and 'triode,' about sixteen years ago, envisaged the possibility of the octode as a manufacturing proposition in 1934. In the presence of such attainments, it is useful to review the developments which have led to such a complicated valve. Such a review, with special reference to the technique of the manufacture of receiving valves on a mass-production basis, was made by Mr. S. R. Mullard in his chairman's address to the Wireless Section of the Institution of Electrical Engineers on November 7 last.

The thermionic valve, in both the two- and three-electrode forms, was in existence prior to 1914, and its early development was considerably accelerated by the demands of wireless communication during the War period. After this period, the main receiving valve available in Great Britain was the then well-known *R* type, comprising a cylindrical anode, spiral grid and a co-axial filament of pure tungsten. This valve was available for general purposes as a high- and low-frequency amplifier, a detector or as an oscillation generator. Judged by present-day standards, the valve was very inefficient and, incidentally, rather expensive. Its chief extravagance, as a valve to be used almost universally with batteries, was its filament, the function of which was to produce an electron emission of one or two milliamperes. The main improvements in this direction were the intro-

duction in turn of the thoriated tungsten filament and the oxide-coated filament, which is in use in most modern receiving valves; the more recent development of the mains-operated valve has involved the necessity for electrically insulating the heater from the metal cathode carrying the oxide coating. The use of a heated wire coated with oxides of one or more alkaline earths, such as barium and strontium, is reminiscent of the early work on thermionic emission carried out by Elster and Geitel about fifty years ago.

Having placed the cathode in a fairly satisfactory position as an efficient source of electron emission, the valve designer has had to turn his attention to the provision of more than one grid and one anode in order to meet the requirements in the progress of receiving circuit technique. By means of lantern slides, Mr. Mullard illustrated the constructional development of the valve up to the octode of quite recent production. The desirability of keeping the overall size of the receiving valve approximately constant has necessitated the attainment of considerable precision in the dimensions and spacings of the electrode system, and the valve has therefore become, very largely, a machine-made article.

The purpose of the introduction of the additional electrodes into the triode, and the functions fulfilled by the various types of modern receiving valves, are usefully described by A. L. M. Sowerby in a series of four articles in recent numbers of the *Wireless World* (September 21 and 28, October 12 and November 2). In the first place, the attainable amplification from a three-electrode valve, when used at radio frequencies, is limited by the coupling between the input and output circuits effected through the capacitance between the grid and anode. This difficulty was overcome by the intro-

duction of a screen-grid between these electrodes, and the tetrode is thus available as an efficient high-frequency amplifier. It is also desirable to be able to vary the amplification of a stage without incurring the risk of distortion of the received signals, or of decreasing the effective selectivity. This is conveniently carried out by making the control grid spiral of a non-uniform pitch, so that the amplification depends on the grid bias voltage provided for the valve. Here we have the tetrode with variable mutual conductance between grid and anode circuits (variable- $\mu$  tetrode).

The above types of four-electrode valve suffer a limitation in use, which is due to secondary emission effects from the anode. This drawback has been removed by the introduction of a third, or suppressor, grid, which is located between the screen grid and the anode, and is in direct electrical connexion with the cathode. Thus we have arrived at the high-frequency pentode, which may or may not be provided with the variable- $\mu$  characteristic. The pentode is also available as an output valve specially designed to deliver audio-frequency power to the loud speaker. This valve is more sensitive and more efficient than the corresponding output triode, but necessitates rather more care in design and operation with a suitable output load.

Wireless receivers of the supersonic-heterodyne type require the provision of a stage in which local oscillations are generated, and of another stage in which these oscillations are suitably combined with the incoming signals to produce oscillations of the beat-frequency for subsequent amplification. The oscillation-mixing process may conveniently be carried out by using a hexode valve provided with two control-grids, one for the incoming signal and one for the local oscillations, and two screen grids to separate them from each other and from the anode. The introduction of a fifth grid will enable the separate triode oscillator valve to be dispensed with, and we thus have the heptode or

penta-grid convertor, as a self-contained frequency-changer unit for supersonic-heterodyne reception. If it is desired to be free from the disadvantages of secondary emission, mentioned above, still another suppressor grid is required next to the anode, and we have arrived at the octode. An alternative arrangement of the electrodes in a frequency-changing valve, involving a triode-hexode in one envelope, was referred to in NATURE of October 13, 1934 (p. 577).

The introduction of the variable- $\mu$  amplifying valve described above has enabled a system of automatic volume control to be developed, by means of which overloading of the receiver by strong signals from a local station is avoided and also the effects of fading of weaker signals from distant stations are largely counteracted. These results are achieved by making the rectified signal provide the grid bias for the variable- $\mu$  valve and so control the amplification of the stage. To obtain the relatively large bias voltages required, it has become necessary to use a diode as detector; further, in order to avoid loss of sensitivity in the receiver as a whole, separate detectors are desirable for the signal rectification and for the automatic volume control. These detectors are provided in the double-diode valve. Such a valve requires a relatively small amount of electron emission, and this may be derived from a portion of the cathode of the triode or tetrode used for audio-frequency amplification of the signals after detection. Thus we have arrived at the double-diode-triode and double-diode-pentode valves used in many commercial receivers of to-day.

The development of these multi-electrode valves has necessitated the use of considerable ingenuity in the design and construction of valve bases and sockets; for, except in certain high-frequency valves in which the connexion to one electrode is led out at the top of the glass envelope, all the electrode connexions are made by pins of the familiar type.

### The Deutsche Physikalische Gesellschaft

IN the year 1843, Magnus was professor of natural philosophy at Berlin and created a physical colloquium, or, as the obituary notice in NATURE of June 23, 1870, says, "Graduates and undergraduates assembled round him once a week, to enjoy what he called physical conversations. Here students in turn reported on investigations recently published, the master criticising the report, and opening a discussion on those points which appeared to deserve a fuller explanation". From all accounts, Magnus was an inspiring teacher, and it was under the influence of this colloquium that, two years later, in 1845, six young physicists—

Beetz, Brücke, Heintz, Karsten, Knoblauch and Emil du Bois-Reymond—founded a society which had as its object, first the communication of original papers, and secondly the issuing of an annual volume of reports on all publications of a physical nature which should have appeared during the year. The society went by the name of the *Physikalische Gesellschaft zu Berlin*, which in 1899 became the *Deutsche Physikalische Gesellschaft*, to indicate the nation-wide scope which it had attained. This Society is, then, celebrating this year, on January 14, its ninetieth birthday.

Of the names of the original founders, probably

only those of du Bois-Reymond and of Beetz are familiar to the average reader nowadays, but in spite of the aristocratic indifference of some of the older representatives of science in Berlin, the Society grew rapidly. Among the fifty-three members who joined in the first year, we find the names of Dr. Helmholtz, Lieut. Werner Siemens and G. H. Wiedemann, while Kirchhoff and Clausius joined in the following year. A period of wonderful fertility was beginning for German physics, and practically every name of note during that period can be found in the lists of the Society.

In 1882 began the publication of the *Verhandlungen*, which, from being merely a record of meetings and short notices, later, in 1899, became a reputed journal for the printing of original papers, particularly valued for its quick publication. Meanwhile, the *Fortschritte der Physik*, published by the Society, became celebrated for the care and accuracy of its short abstracts of original papers in physics appearing in all countries. The fifty years celebration held in Berlin in January 1896 under the presidency of one of the founders, du Bois-Reymond, gave evidence of the prosperity of the Society, the membership of which then numbered about three hundred. The first series of photographs taken by Röntgen with his newly-discovered rays was shown, and experimental demonstrations were given by, among others, E. Warburg, Arons, Aschkinass, Neesen, Rubens, Goldstein, Nichols, W. Wien and F. Kurlbaum—a very respectable list of names!

The new life of the Society, as the *Deutsche Physikalische Gesellschaft*, may be said to have been initiated under the influence of a discourse which Planck—a name long respected and beloved among physicists the world over—gave in December 1900 on the laws of radiation. His famous paper in which the conceptions of the quantum theory were first given to the world appeared a few months later. On the experimental side Goldstein and Rubens were addressing the Society on the fundamental investigations for which their names are best known. At the beginning of the War, the Society numbered more than seven

hundred members, and the *Verhandlungen* were publishing papers of the first importance.

After the War, the Society initiated fundamental changes, which increased its influence both inside and outside Germany. Local branches were founded in all the chief centres of physical research throughout the country, and, in conjunction with the newly founded society for technical physics (*Deutsche Gesellschaft für technische Physik*, in the foundation of which, if I may obtrude a personal note, my old friend Hausser, whose death in 1933 at the early age of forty-seven years was so widely lamented, played a prominent part), yearly meetings were arranged, somewhat similar to our British Association meetings, but for physics only. The most recent of these meetings was held last September at Bad Pyrmont, and nearly five hundred physicists attended.

Changes which were widely felt outside Germany were made in the publications of the Society. There were in 1920 two extensive publications which gave abstracts of the world literature in physics; the *Fortschritte der Physik* and the *Beiblätter* of the *Annalen der Physik*. In place of these a single publication was issued, the *Physikalische Berichte*, which has attained a high reputation, outside as well as within Germany. The abstracts are, in general, exceedingly good, and appear promptly. In the same year, 1920, the *Verhandlungen* were discontinued, and in their place appeared the *Zeitschrift für Physik*, under the auspices of the Society. This publication is so well known to physicists in Great Britain as not to need commendation.

The Society is a powerful agent for the promotion of physical knowledge and for international accord and co-operation in the search for scientific truths. It now numbers some fourteen hundred members, of whom almost a third live outside Germany. Its work was never more important than now, and on its ninetieth birthday, which is being celebrated in Germany as a jubilee, it will receive the congratulations and good wishes of physicists of all nationalities.

E. N. DA C. ANDRADE.

## Obituary

DR. THEOBALD SMITH, FOR.MEM.R.S.

WITH the death on December 11 of Dr. Theobald Smith, there has passed away a great figure in the science of animal pathology. Much of his life was spent in research on veterinary science, and his work illustrates the natural intimate connexion between human and veterinary medicine, for his researches were of so accurate and fundamental a character that they made far-reaching additions to knowledge of disease both in man and the lower

animals. The breadth of his outlook was remarkable and many branches of pathology have been enriched by his keen insight.

Theobald Smith was born at Albany, N.Y., in 1859, and after taking the degree of Ph.D. at Cornell in 1881 and of M.D. at Albany in 1883, he was appointed director of the Pathology Laboratory of the Bureau of Animal Industry in the U.S. Department of Agriculture in 1884, and his earliest work was recorded in the annual reports of that department.

From 1896 until 1915 he was director of the Pathological Laboratory of the Massachusetts Board of Health and was professor of comparative pathology at Harvard University from 1896 until 1915, when he was appointed director of the Animal Diseases Branch at Princeton of the Rockefeller Institute, where he was emeritus professor at the time of his death.

The quality of Theobald Smith's work was recognised throughout the world, and in 1932 he received the Copley Medal of the Royal Society. He was a foreign member of the Royal Society, the Paris Academy of Sciences, the Danish Royal Society and honorary member of many other scientific societies. He was awarded the Manson Medal of the Royal Society of Tropical Medicine of London, and received many other scientific honours.

The best known of Theobald Smith's discoveries was that of the relation of ticks to the disease known as Texas fever or red-water of cattle. In 1889 Smith and Kilborne accurately described the causal protozoon, *Pirosona bovis* (*Babesia bigemina*) and in 1893 they showed that the disease was transmitted from one animal to another by the tick *Boophilus* (*Margaropus*) *annulatus*. This was the first instance in which a protozoal disease of a mammal had been proved to be transmitted by an arthropod. The cycle of the protozoon was complicated by the fact that the tick, after sucking the blood of an infected animal, fell to the ground and laid its eggs on the grass, and not until the eggs had hatched, after weeks, or months, were fresh cattle infected by the bites of the larval ticks. By this work many obscure features of this serious plague of cattle were explained and several entirely new factors in epidemic and epizootic disease were disclosed.

The time when Theobald Smith began his work was one of rapid advance in bacteriology, especially in the direction of describing new bacteria associated with special diseases. His observations were often of striking originality and related rather to the manner of action of bacteria, but they were often unheeded and forgotten, to be rediscovered later by others. The discovery of new phenomena appears to have been his chief interest though the subjects at which he worked had eminently practical aims, and his career illustrates the fundamental value of informed and intensive observation by those engaged in work on practical issues. It has come as a surprise to many to learn that with D. E. Salmon in 1886 he showed that a culture of bacteria killed by heat if inoculated into a warm-blooded animal—a bird—gave protection against a lethal dose of the same living micro-organism. This was the first recorded use of a dead vaccine, though the discovery is commonly attributed to Pfeiffer, who in 1896 began a long series of fundamental experiments on the same subject. Another early observation, reported in 1895–96, was the occurrence of a "peculiar disease" with deep and subcutaneous hæmorrhages causing the death of guinea pigs in four to eight weeks if they were fed only on oats and bran without any green food. This appears to be the first description of scurvy in the guinea pig, which has been used as a valuable indi-

cator of scorbutic diets in research on vitamins in recent years. Smith, however, did not mention the similarity to human scurvy, but was concerned to show that this deficiency in the food led to the death of animals inoculated with a bacterium innocuous to guinea pigs fed on a normal diet.

In 1889 Smith began a series of investigations into the chemical products and growth requirements of bacteria, which were continued for many years and led to results of much practical and theoretical value in bacteriology. The chief of these observations were on the differential fermentation of sugars, the reducing power of bacteria, and the oxygen and carbon dioxide needs of different species and races of these micro-organisms. Among the characters of bacteria which most interested him was their capacity for variation in virulence and in other ways. In 1895–96 he published a paper on the existence of two kinds of tubercle bacilli exemplified by strains from a bear and a bull respectively, and in 1896 he correctly described the differences between human and bovine strains and the forms of disease which they produced, anticipating Koch's better-known statement on the same subject in 1901.

Another early but neglected observation, published by Smith with Reagh in 1903, concerned the non-motile varieties of certain motile bacteria, and the distinct agglutinins which were produced in animals for the flagella and bodies of the bacteria. These important facts were rediscovered in 1917 by Weil and Felix. Smith made a number of new observations on the culture of the diphtheria bacillus and on its toxin, and in 1910 he showed that balanced mixtures of toxin and antitoxin could be used to induce immunity to infection. In this way he laid the foundation of the present methods of protecting man against diphtheria.

Smith's zeal for the advancement of knowledge for its own sake is seen in the story of his discovery in 1904 of anaphylactic shock in the guinea pig resulting from a second injection of horse serum. The symptoms had often been seen by others and wrongly interpreted. This discovery he communicated to Ehrlich by letter, and the first publication on the subject was by Otto in 1906 in a paper on "Das Theobald-Smithsche Phänomen der Serum-überempfindlichkeit".

In 1922 appeared his work on the first milk or colostrum of cows which, if taken in the first two or three days of life, protected calves from otherwise dangerous infections. From among his numerous other original investigations may be mentioned those on the form of streptococcal mastitis of cows which may convey serious infections to man through the milk, on the forms of contagious abortion in cattle due to *Brucella abortus* and to the *Spirillum abortus* which he discovered, and on sarcosporidia. He continued at work in apparent health until last summer.

In 1934 were published Smith's Vanuxem lectures on "Parasitism and Disease" in which he summed up the history and theories of parasitism and recorded his mature reflections on this fascinating theme, with little or no reference to the share which he himself had taken in its development.

## DR. J. WALTER LEATHER

THE death of Dr. J. W. Leather on November 14 removes one of those who have been largely responsible, during the last forty years, for the development of scientific work in relation to Indian agriculture, and he cannot be allowed to pass away without some reference to his activities in this and other fields.

Born in 1860, at Rainhill in Lancashire, he entered his father's chemical factory at St. Helens after leaving school, and, when he had served an apprenticeship to chemical work there, he was sent, in 1883, to study chemistry under Kekulé at Bonn. There he stayed three years and left in 1886 with the degree of Ph.D. On leaving the University, the appointment of senior assistant to Dr. J. A. Voelcker, the consulting chemist to the Royal Agricultural Society of England, was offered to him, and he held this post for six years. During this time he developed very high technical skill in chemical work in connexion with agricultural problems, a skill which he retained throughout his career. He originated several new methods, and one of these—a process for the detection of castor seed in feeding-stuffs—is universally used at the present day. In 1891 he became professor of chemistry at the Harris Institute, Preston, but the call to his real life work in India came before he had really settled down there.

In 1892, as a result of the recommendations of Dr. Voelcker in his report on the improvement of Indian agriculture, the Secretary of State for India decided to appoint a chemist and an assistant chemist to the Revenue and Agricultural Department of the Government of India, and Leather was selected for the former appointment. It was in this appointment of agricultural chemist to the Government of India, and in that of Imperial agricultural chemist which followed it in 1906, that Leather did what may be considered his life work. There he remained with few intervals until 1916, when he retired and settled down in Malvern.

When Leather was appointed to India in 1892, the position he occupied led to his having to range the length and breadth of the country, studying and advising upon the various problems which were placed before him by the authorities of the various provinces. He was, in fact, the only chemist attached to all the agricultural departments in India. His activity was tremendous, but it was an almost impossible position. His publications during this period (most of which appeared in the *Agricultural Ledger* then edited by Dr. Watt) were varied and numerous. They include the first general account of Indian soils, the first series of analyses of Indian manures, studies of alkali and salt lands, studies of sugar-cane and the composition of the Indian varieties, and a multitude of other questions. On the whole, the conditions under which Leather worked at this time did not permit him to push any of his many inquiries to a final issue in the improvement of methods or the better utilisation of Indian resources. A summary of his work during this first stage of his Indian career is contained in his final report on the

first five years of the work of the Agricultural Chemist to the Government of India, issued in 1897.

The more congenial part of Leather's Indian work came in 1904, when the Imperial Research Institute at Pusa was founded, and he settled down as the head of the chemical department at that Institute, as Imperial agricultural chemist. As a result of his activities there, we have a series of publications, most of them published as memoirs of the Department of Agriculture in India. These deal with such subjects as the water requirements of crops in India, the composition of Indian rain and dew, soil temperatures in India, the problems of drainage and the loss of water from the soil in the tropics, and the interaction of calcium carbonate and carbon dioxide in soil under tropical conditions. It cannot be said that the work he did was of an epoch-making character, but he gave us a very useful collection of data which did not exist before, and which nobody else has gathered together. Within its limits, his results were always reliable, and for several generations many workers will bless the name of Leather for the careful observations which can form the basis for real agricultural advances to be initiated by others.

So far as his work generally was concerned, Leather was essentially a laboratory worker. Of his industry there was no doubt, while he had a great capacity for friendship, and there are many who look back to their association with him as a time when they were initiated into that close study of a limited objective which was the special characteristic of his work.

H. H. M.

WE regret to record the deaths on January 2, as the result of an accident in the Austrian Tyrol, of Mr. Kenneth F. Armstrong, aged twenty-five years, and Mr. John Howard, aged twenty-six years. Mr. Armstrong was associated with his father, Dr. E. F. Armstrong, in the preparation of monographs on the glycosides and the carbohydrates, and Mr. Howard was a research worker at the Fuel Research Station, Greenwich.

WE regret to announce the following deaths:

Capt. J. E. Bernier, known for his explorations of the Canadian Arctic, on December 27, aged eighty-two years.

Sir Maurice Craig, consulting physician in psychological medicine to Guy's Hospital, on January 6, aged sixty-eight years.

Prof. Roland B. Dixon, professor of anthropology in Harvard University since 1916, an authority on the languages and culture of the Indians of the Pacific coast, on December 20, aged fifty-nine years.

Sir Alfred Ewing, K.C.B., F.R.S., formerly professor of mechanism and applied mechanics in the University of Cambridge, lately principal and vice-chancellor of the University of Edinburgh, on January 7, aged seventy-nine years.

Mr. J. C. Lawson, University lecturer in classics in the University of Cambridge, an authority on Greek folk-lore, on January 5, aged sixty years.

## News and Views

The Right Hon. Sir Herbert Maxwell, Bt., K.T., F.R.S.

ALL who love Scotland, whatever may be the grounds of their affection, will join in the tribute of congratulation and wishes of good will to Sir Herbert Eustace Maxwell of Monreith on the celebration of his ninetieth birthday on January 8. He has shown himself a most loyal son of a race noted for pride in its motherland; and as much as any writer since the days of Sir Walter Scott, he has successfully interpreted to his fellow-countrymen, as well as to the southerner, the charm, never too obvious, of the Scottish countryside in all its variety, and the romance of the chequered and turbulent course of Scottish history. Here he has ranged from the making of Scotland and the high adventure of the Bruce to the lowly annals of the hamlet, obscurely and imperfectly preserved in local tradition and place-names. His numerous studies of national and local history, the latter especially in his own Galloway, deserve well of Scottish students; but archæologist and historian alike are no less indebted to him for his activities as president of the Society of Antiquaries of Scotland and as chairman of the Royal Commission on Scottish Historical Monuments in practical affairs relating to Scottish history and archæology. Sir Herbert's literary achievement has covered a wide field—from romance and fiction, history and biography, including a life of the Right Hon. W. H. Smith and a survey of the first sixty years of Queen Victoria's rule, to "British Freshwater Fishes"; but he is most at home when he seeks to convey the interest and charm of the birds and beasts of his own countryside, the trees of the woodlands and the flowers of a Scottish garden. Here, indeed, *nihil tetigit quod non ornavit*.

Prof. D'Arcy W. Thompson, C.B., F.R.S.

ON December 23, Prof. D'Arcy Wentworth Thompson completed the fiftieth year of his tenure of a professorial chair; for he was appointed professor of biology in the newly founded University College of Dundee in 1884. Fresh from the biological renaissance in Cambridge under Michael Foster and Frank Balfour, the young professor found in Dundee every possible kind of discouragement, scanty endowment, mean and unsuitable buildings—and the depressing atmosphere of an industrial city. The title of his chair was soon changed to that of zoology, and in the closing years of the century the incorporation of the College in the University of St. Andrews, and the establishment of a medical school, brought a small increase in the number of his students. In 1917, on the retirement of his senior colleague, Prof. W. C. McIntosh, D'Arcy Thompson was transferred to the chair of natural history, which he still occupies, in the United College at St. Andrews. Fortunately, the time has not yet come to sum up or to pass judgment upon D'Arcy Thompson's achievements. His innumerable friends, however, and his pupils—none too numerous, alas!—will join with us in congratulating him on the jubilee of his

professorship. Few men of our time have been so much at home in both the fields of the old and the newer learning. He is, we believe, the only holder of a chair of science who has been president of the Classical Association, and there must be many among those that have passed through his class-room, who found in an elementary course of lectures on zoology at least the beginnings of a liberal education.

## A National Institute of Science for India

THE Calcutta correspondent of *The Times* reports on January 7 that:—"The Governor of Bengal has inaugurated a National Institute of the Sciences of India, of which the object is to promote scientific knowledge in India. The institute will act through national committees, and will serve as a national research council for the undertaking of work of national and international importance required by the public and the Government. Dr. L. L. Fermor, Director of the Geological Survey of India, is the first president." From this report it would seem that the new body is to combine the characteristics of a National Academy of Sciences and a National Research Council, but it is difficult without further details to know how it is related to existing organisations in India.

It may be remembered that in 1930 an Academy of Sciences was formed in the United Provinces, with its seat at Allahabad. Later, there was a movement for the establishment of an Indian Academy of Sciences through the development or affiliation of the U.P. Academy or by the formation of a new body. It was suggested that the ancient Asiatic Society of Bengal might appropriately become such an All-India institution, and with the view of considering the whole matter a committee was appointed by the Indian Science Congress to prepare a report. Without awaiting the recommendations of this Committee, Sir C. V. Raman, now director of the Indian Institute of Science, Bangalore, himself registered the title of "The Indian Academy of Sciences", and the *Proceedings* of this Academy, similar in format to those of the Royal Society of London, began publication in July last. There are thus now two academies of sciences in India—one in Allahabad and the other in Bangalore, that is, in north and south India respectively. There is plenty of room in the country for these two academies, but objections can be raised to either of them assuming the sole right to use the prefix "Indian"; and it is not surprising, therefore, that Sir C. V. Raman's action has caused a storm of protest. No doubt the claims of different societies and places in India to recognition as centres of publication for the whole country have been considered by the committee of the Indian Science Congress. We await with interest the recommendations of the committee and trust that they will assist in removing the confusion which at present exists and will promote unity of purpose among scientific workers in all parts of the country.

### British Art in Industry

ON Friday, January 4, the Prince of Wales opened an Exhibition of British Art in Industry at the Royal Academy, Burlington House. It is to remain open until March 9, and has been organised jointly by the Royal Academy and the Royal Society of Arts. The chief aim of this large-scale experiment is to show the public that British manufacturers of textiles, glassware, furniture, etc., are alive to the importance of consulting artists, when designing their products. The part played by science in rendering it possible to realise this ambition is not referred to nor perhaps could it be within the limited space available at Burlington House. But the scope of the exhibition is wide, and especially striking is the increasing use made of synthetic resins such as bakelite in the manufacture of a great variety of household things. Imperial Chemical Industries, Ltd., show a new form of this colourless plastic material (called Resin M) which it is claimed actually exhibits the sheen found in certain transparent natural crystals, and which can be carved and shaped into many beautiful objects. The glass exhibit, too, is particularly important and interesting. Then there are sets of furnished rooms of modern design, together with a vast display of fabrics, as well as some beautiful jewellery and metal work.

THE alliance of activities referred to above is assisted by the publication of an abridged account of the aims and work of the Royal Society of Arts, issued by and under the aegis of the Council of the Society, entitled "The Story of the Royal Society of Arts" (London: John Murray, 1935. 3s. 6d.). We read that in 1753, one William Shipley, residing at Northampton, published certain proposals for raising by subscription a fund for distribution through premiums, for the promotion of improvements in the liberal arts and sciences, manufactures, and so on. Whereupon, in 1754, a Society came into being for the "Encouragement of Arts, Manufactures and Commerce in Great Britain". The organisation had no exact prototype at the time, and was under the obligation (like the later movement elsewhere by Count Rumford), of going forward, or going under. It succeeded in the former process, and has thus achieved a hundred and eighty years of existence, which, however, have included interludes of vicissitudes. Here we must leave reminiscent records to speak for themselves. But it remains to recall that the Prince Consort became president of the Society of Arts in 1843, and was in office at the time of his death in 1861. Prince Albert's foresight and initiative were of signal value; since his death the interest of our Royal Family has been steadily maintained, strengthened and broadened in recognition of the Society, its aims of the present, and its outlook upon the future.

### Eumorfopoulos Collection

THE announcement by Sir George Hill and Sir Eric Maclagan that the British and Victoria and Albert Museums, assisted by the National Art-Collections

Fund and other donors, have secured the Eumorfopoulos collection for the nation is a source of intense gratification to a wide circle. Not only is the collection of Far Eastern art made by Mr. George Eumorfopoulos the finest in existence, but also the combination of informed taste, opportunity and the necessary financial resources which has made its assembly possible is not likely to recur. The aesthetic, historical and scientific significance of these examples of the artistic activities in every form and material of the peoples of the Far East, and more especially of the Chinese, from the first millennium B.C. onward, has been made widely known by the generosity of its owner, as well as in monographs devoted to the study of specific examples or of classes of objects. In future, a collection of the highest educational value will be available for the instruction of a wider public, more especially if as a whole or in part it should be incorporated in the much desired central Museum of Asiatic Art, which this acquisition may have brought a stage nearer. Nearly one half the purchase money is available to be handed over forthwith to secure the immediate possession of a proportionate part of the collection. An early and ready response to the appeal of Sir George Hill and Sir Eric Maclagan for contributions towards the balance of the cost will be a graceful recognition of the public spirit of the owner in accepting a relatively low figure for what is, in effect, a priceless collection.

### Professional Men and Research

AN address entitled "A Talk about Research" was delivered by Mr. W. P. Elderton to the Institute of Actuaries Students' Society on November 19 and has now been published. The details of the address were highly technical, but the general principles laid down seem to be applicable to any profession, though they are on rather different lines from those suitable for workers in pure science at universities or research institutes. Many young men would like to undertake some kind of research work, but they find it difficult to think of suitable subjects. Of course, a genius would find his own problems and solve them. Leaving aside such, as needing no guidance, some general advice can be given to those less original. One way of starting consists of a study of the history of ideas on a certain subject, taking care to examine French and German sources as well as English. This study will often reveal the inadequate foundation of current theories, and it will then naturally lead on to the attempt to replace the weak portions by something sounder. Another profitable and indeed indispensable task is the reconsideration of the professional practices that were established as the best in the past, in view of the change in contemporary conditions. Mr. Elderton warned his hearers against a hurry to rush into print. They should endeavour to take all possible precautions against error before publication, and to write in good English, so as to be intelligible to any diligent, well-informed reader. Controversy should be avoided, and when they think another writer has made a mistake, they should try to follow his line of thought and consider carefully whether the



mistake is not their own. The advice of Francis Galton, "Never resent criticism and never reply to it", is good, though hard to follow by those not possessing Galton's saintly disposition and philosophical calm.

#### Statistics and Inductive Inference

IN a paper read before the Royal Statistical Society on December 18, Prof. R. A. Fisher surveyed the recent change in the outlook of mathematical statisticians. The most profound modification seems to have taken place rather in the logical than in the mathematical aspect, though it has been brought about by the resolution of mathematical difficulties. Statisticians are now dealing with types of uncertain inference wider than those of the theory of probability. Prof. Fisher expressed the view that the current teaching of pure mathematics is not an altogether adequate preparation for fruitful work in this field, for this teaching is purely deductive, omitting the essential concepts of inductive logic, and insists on 'rigour' in a limited sense which he considers very inadequate to the requirements of an inductive problem. The questions raised by Prof. Fisher are of great interest and importance, but it should not be overlooked that there is still some difference of opinion concerning them, as will be seen by a perusal of the series of papers in the *Proceedings of the Royal Society* (1932-4) by Dr. H. Jeffreys.

#### Early Man in North America

DR. FRANK H. H. ROBERTS, JR., according to a communication issued by the Smithsonian Institution, Washington, D.C., has discovered in the foothills of the Rocky Mountains, in northern Colorado, a habitation site and factory of 'Folsom' man. This discovery is of the greatest importance for American archaeology, as not only is it the oldest known habitation site in America, but it is also the first occasion upon which there has been any indication of the mode of life of the peoples by whom the 'Folsom' points were made, beyond the bare fact that they were hunting tribes of a high antiquity—a deduction from the association of these points with the bones of extinct bison, musk ox and mammoth, known to have pastured at the edge of the ice-sheet. The 'Folsom' points, it will be remembered, were first discovered five years ago at Folsom in New Mexico, and since then these finely-chipped flint implements have been found, frequently in association with extinct mammals, all over the United States from New Mexico to Virginia and Pennsylvania. It is thought by some authorities that they point to the existence of man in America several thousand years earlier than had previously been supposed. Dr. Roberts's discovery provides something of a cultural background for these scattered finds. The site he has now discovered rests upon a hard, chalk-like formation with about fifty feet of alluvial deposits above it. These must have been laid down very slowly. It is about a quarter of a mile in extent, but as yet only a small part has been excavated. The relics represent

several camp sites occupied over a period of years. Flint nodules from which the implements were manufactured are plentiful. Thirty characteristic points and a great variety of scrapers, rough stone blades, drills, engraving tools and hammerstones, with a large number of broken animal bones, have been collected.

#### Antiquity

WITH its December issue, *Antiquity* completes its eighth year. The editor of the only free-lance journal entirely devoted to archaeological matters is to be congratulated on his success in having carried through this enterprise successfully, and without the assistance of any official organisation, in a period of exceptional difficulty. While there is undoubtedly a considerable public which is interested in archaeological discovery up to a point, to hold that interest requires both tact and judgment. The editor, whose aim is to present to his readers scientifically sound and accurate information of the latest movements in archaeological discovery in a popular form, has a difficult course to steer, if he is to avoid the appeal to the sensationalism which flavours the news of 'finds' as it appears in most of the daily Press. On the other hand, the editor of *Antiquity*, both by his own 'tilting' in his unconventional notes and otherwise, encourages his contributors to an engaging freedom of treatment which in itself adds no little attraction to the pages of his periodical. The contents of *Antiquity* of December illustrate these qualities admirably. If, for example, Mr. Noel Myres' criticism of Dr. Mortimer Wheeler's article in a previous issue on the topography of Saxon London ventilates further a subject which is of perennial interest to a wide circle, Dr. Wheeler's reply will appeal equally to those who appreciate learning worn lightly. Among the remaining contents of this issue, which are as a whole no less attractive, it is, perhaps, permissible to refer to the contribution by Sir George Macdonald on the Romans in the Middle East, which is an illuminating commentary on M. A. Poidebard's recently published air survey of the Roman frontier in Syria. Like its predecessors, this issue fully supports the editor's appeal for an extended circulation to ensure the continued existence of a publication which is doing excellent work for archaeological science by keeping its achievement before a wider public than is reached through channels of a more formal nature.

#### Thermo-remanence of Bricks

A LETTER has been received from Mr. T. G. Bocking, Princes Chambers, 6 Corporation Street, Birmingham, 2, giving an account of some observations on the magnetic properties of bricks. Bricks were selected from a number of South Staffordshire kilns, the direction in which the bricks were lying when baked being noted. The polarity was most clearly marked when the bricks had been lying in a north-south direction, and it was found that the bricks were magnetised approximately along the line of magnetic dip. Among the bricks examined were

some made from Etruria marl, containing about 11 per cent iron oxide. The kiln temperature was  $1150^{\circ}\text{C}$ . The content of iron oxide (mainly  $\text{Fe}_2\text{O}_3$ ), to which such ferromagnetic properties may be attributed, varies considerably in the materials from which bricks are made. It is usually well below 2 per cent in the fire-clays giving white and cream bricks, about 7 per cent in the clays giving red bricks, and 10 per cent or more in those giving blue and black bricks. Among recent relevant investigations are those of Koenigsberger (*Phys. Z.*, **33**, 468; 1932) on hæmatite ( $\text{Fe}_2\text{O}_3$ ), magnetite ( $\text{Fe}_3\text{O}_4$ ) and other ferromagnetic compounds. He finds that hæmatite, when cooled down in the earth's vertical field ( $0.4$  gauss) from above the Curie point (about  $670^{\circ}\text{C}$ .), shows a residual magnetisation which approaches the saturation remanence, and may be a considerable fraction of the saturation magnetisation. It is, of course, not possible to generalise about bricks. Each set of bricks presents a special problem, and precise discussion of the magnetic properties would require a detailed knowledge of the chemical composition of the clays, and of the conditions of baking and cooling. It is, however, probably not widely realised that most bricks are magnets—though feeble ones; and Mr. Bocking's observations are of interest in indicating that the phenomenon of thermo-remance may be demonstrated with such a common object as an ordinary brick.

#### A Remarkable Cloud Form

A PHOTOGRAPH of a remarkable cloud, of which a reproduction is shown in Fig. 1, has been received from Prof. I. S. Astapowitsch, of the Astronomical Institute, Fontanka 34, Leningrad. It was observed some time in 1932 at Stalinabad (lat.  $38^{\circ} 34' \text{N}$ ., long.  $68^{\circ} 47' \text{E}$ .) above the Hissar Valley, and is described as having a rotational movement. Rotation round a vertical axis is strongly suggested by the appearance in the photograph of the middle and upper parts of the cloud. Students of cloud



FIG. 1.

forms will recognise at once the very unusual character of this cloud, which has some structural resemblance both to the cumulo-nimbus cloud associated with a thunderstorm and to the funnel cloud of the tornado. By a curious coincidence, in

a recent number of the *Meteorological Magazine* (Nov. 1934, vol. 69, No. 826) a sketch is shown of a cloud observed on October 4, 1934, near Waltham Cross, Hertfordshire, by Mr. Donald L. Champion, which has strong points of resemblance to the cloud just described. In each case a strong upward growth appears to have taken place over one part of a rather flattened cumulus cloud, the base of which was inclined to be convex, the central parts appearing to be lower than those farther from the centre. In the cloud near Waltham Cross the rapid vertical extension was formed in a few seconds, and after about five minutes the mushroom-shaped top spread out horizontally to form an 'anvil' cloud like those so often seen over thunder clouds. In both cases it is likely that opposed wind currents and convection, perhaps associated with local heating, may have combined to produce rapid ascent of air with rotation.

#### Distribution of Birds at Sea

Most ocean travellers must have noticed the very irregular distribution of birds on the open sea on different days, notwithstanding the apparently similar conditions of air and ocean. Censuses made during the crossing of the Atlantic record statistically these differences, but little attempt has been made to suggest a satisfactory reason for them. It seems very likely, however, that the presence or absence of pelagic birds is regulated by the oceanic currents, as S. C. Brooks suggests in the *Condor* (September 1934, p. 185). Oceanographers have shown that where the Arctic Current meets the North Atlantic Drift, there arise complexes of eddies and upwelling of the under waters, and that at the margin of contact there is a surface display of abundant organisms which attract fishes and other predators. This congregation of plenteous foodstuffs in limited areas may well attract pelagic birds, and Jespersen has already shown that there is a general connexion between the numbers of birds seen in a particular area at sea, and the quantity of macro-plankton in the surface waters. Pushing the probabilities further, it is likely that the migrations of oceanic birds may be related to the movements of plankton, by whatever determined, and tentatively Brooks makes the very interesting (but quite untested) suggestion that one of the factors which guided the homing terns of Bird Key from Cape Hatteras, to which they had been conveyed, back to the Tortugas, may have been the rich feeding grounds along the margin of the Gulf Stream. He adds that perhaps other factors too must be considered, such as the density of the air, which has been regarded as determining the northern limit of the distribution of the southern Atlantic wandering albatross.

#### Flora of West Lancashire Dunes

FOR some time, increasing concern has been felt amongst the botanists and Nature-lovers of this area for the dangerous position of the unique flora of the dunes of west Lancashire, particularly around Ainsdale. Recently two representatives of the Flora's League—a society for the preservation of wild flowers—

Dr. C. T. Green, president of the Liverpool Botanical Society and author of "The Flora of Liverpool", and Mr. Eric Hardy, librarian of the Liverpool Naturalists' Field Club, made a special survey of the present status of the flora, with the consent of the Royal Society for the Protection of Birds, to find whether the latter's sea-bird sanctuary on the dunes is also serving as a wild flower sanctuary. The dunes are unique for their profusion of *Pyrola rotundifolia* (round-leaved wintergreen) and *Parnassia palustris* (grass of Parnassus), probably more numerous there than anywhere else in England, and these flowers have been banned from the wild flower collecting sections of the Southport flower show in order to protect the dunes. The duneland orchid (*Epipactis dunensis*), which so far has not been recorded from any other part of the country, was found growing abundantly on the dry dunes, beside the pinewoods, and in the thinner pinewoods, its only enemy being the rabbits. The area is rich in Orchidaceæ. According to the records of the Liverpool Flora Committee, *Erythraea latifolia*, the broad-leaved centaury, which was first described from these sandhills by Shepherd and Bostock a century ago and has not been recorded from any other part of the country, is extinct, though profuse enough at the time of its discovery. The last specimen gathered from the sandhills at Formby is now in the collection at the British Museum (Natural History).

#### Electrical Calculating Machine for Simultaneous Equations

A MECHANICAL calculating machine for solving simultaneous linear equations up to ten in number under construction at the Massachusetts Institute of Technology by Drs. V. Bush and J. B. Wilbur was referred to in NATURE of December 8 (p. 877). An electrical machine designed for the same purpose, also working up to ten equations, has already been designed by R. R. M. Mallock and constructed by the Cambridge Instrument Co., Ltd. A full account of this machine has been published (*Proc. Roy. Soc., A*, **140**, 457; 1933) and a note on it appeared in NATURE of June 17, 1933 (p. 880). The machine itself is set up and at work in the Engineering Laboratory, Cambridge. It is stated that this machine can determine rapidly a set of roots to an accuracy represented by about 0.1 per cent of the largest root in favourable cases when the equations are well conditioned. The fundamental principle of the machine is to use a number of alternating current transformers, the coils of which are coupled up to such numbers of turns as to represent a set of equations of condition for the fluxes through the transformers which are the linear simultaneous equations to be solved. Such machines promise to be of great value in the very large number of problems which can be reduced to the solution of such sets of equations.

#### Physiographic Map of Japan

AN instructive physiographic map or diagram of Japan on a scale of about 80 miles to an inch is published by Dr. G. T. Trewartha in the *Geographical Review* of July. Japan lends itself to this treatment

since about seventy-five per cent of the land is mountainous and the lowlands are mainly peripheral. The diagram brings out in a striking way the contrasts between the main structural regions of Japan, that is to say, the inner and outer zones running the length of the islands and meeting in fault scarps and tectonic depressions, except in central Honshu where the great zone of depression cuts across the country and the rift is partly filled by later accumulations. The outer zone of Pacific fold mountains appears as a series of well-developed longitudinal ridges and valleys with few noteworthy plains, but separated in the south by subsidence into isolated mountain masses. By contrast the inner zone appears as a rugged hill country of dissected block plateaux, some upheaved and others depressed with much volcanic activity. The Inland Sea forms a notable area of depression in this zone.

#### Tibet Earthquake of January 3

AN earthquake of moderate intensity occurred in southern Tibet early on January 3. According to the report issued from Kew Observatory, the first movements were recorded there at 2h. 0m. 58s., G.M.T., and at Bombay at 1h. 54m. 23s. The epicentre was estimated to be 4,600 miles from Kew and 1,150 miles from Bombay, or in about lat. 30° N., long. 88° E., the time at the origin being 1h. 50m., G.M.T. The earthquake, though not of unusual intensity, is interesting as its epicentre lay about 120 miles to the south of that of the great earthquake of last December 15 (NATURE, **134**, 963, Dec. 22, 1934).

#### Third International Congress of Soil Science

THE Third International Congress of Soil Science will be held in Oxford, on July 30–August 7 this year, under the presidency of Sir John Russell. The two previous congresses of the series were held in Washington in 1927 and in Leningrad and Moscow in 1930, and were notable for the exceptionally international character of the personnel and the discussions. The Congress will meet as a whole in six plenary sessions, at which a general survey of recent advances in every branch of soil science will be made, and it will also work in sections or 'commissions' dealing specifically with (1) soil physics, (2) chemistry, (3) biology, (4) fertility, (5) classification, and (6) technology. Three sub-commissions will discuss problems relating to alkali, forest and peat soils respectively. A 16-day excursion round Great Britain leaving Oxford immediately after the Congress, and terminating in Cambridge on August 23, is being arranged for the benefit of members wishing to obtain first-hand knowledge of British agriculture and soils. Every member of the Congress will receive a copy of the official transactions, including the full text of papers read at the plenary sessions, and detailed reports of the discussions at the Commission sessions. The cost of the transactions will be included in the Congress fee (£2), payment of which will also entitle members to attend all meetings, receptions, etc., held in connexion with the Congress. College accommodation during the Congress can be

reserved through the Organising Committee. Intimation of attendance at the Congress should be sent as soon as possible to the Secretary of the Organising Committee, Mr. G. V. Jacks, Imperial Bureau of Soil Science, Harpenden, England, from whom all further information may be obtained.

#### International Botanical Congress

A PRELIMINARY programme has been circulated of the Sixth International Botanical Congress, to be held in Amsterdam on September 2-7 of this year, under the presidency of Prof. F. A. F. C. Went. An executive committee of Dutch botanists, with Dr. M. J. Sirks of Wageningen as secretary, has divided the Congress into ten sections: agronomy, cytology, genetics, geobotany, morphology and anatomy, mycology and bacteriology, phytopathology, palæobotany, plant physiology, taxonomy and nomenclature. The presidents and vice-presidents of sections are already announced, as well as the topics chosen for discussion in each section, and some of the principal speakers. The subjects for discussion include many of the current problems in all phases of botany, and some will be considered jointly by two or more sections. A number of excursions to various parts of Holland are being arranged to follow the Congress.

#### Announcements

THE second award, by the Wilhelm Roux Stiftung für Entwicklungsmechanik, of the medal founded in commemoration of Wilhelm Roux, who died on September 15, 1924, has recently been made to Dr. Jan Boeke, professor of histology in the University of Utrecht, for his researches on the development of the nervous system.

SIR LEONARD HILL writes: "In my letter on 'The 1933 Everest Climbing Expedition and Oxygen' [*NATURE*, Dec. 22, p. 969], I say 'animals cannot live for more than six weeks' in oxygen equal to 10 per cent of one atmosphere. The words 'without serious deterioration' should have been added."

THE Royal Photographic Society, 35 Russell Square, W.C.1, is now holding its sixth exhibition in the series, "Photography in the Service of Mankind". The present exhibition is devoted to exploration and travel, and includes records from most of the great expeditions which have taken place during the last fifteen years. The Exhibition will remain open to the public on week-days from 10 a.m. to 6 p.m. until January 31.

THE Iron and Steel Institute, in co-operation with other societies and technical institutions, will hold a symposium on the "Welding of Iron and Steel" on May 2-3. The symposium, which will be held in connexion with the annual meeting of the Institute, will take place in the lecture theatre of the Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1. Further information can be obtained from the Secretary, Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

THE annual general meeting of the Institute of Metals will be held in London on March 6-7. On March 5, there will be an additional session with other technical institutions when a discussion will take place on "Problems of Cold Presswork", to be opened by Dr. H. J. Gough. The discussion will be held at the house of the Royal Geographical Society. The annual May Lecture of the Institute will be delivered by Prof. W. L. Bragg, whose subject will be "The Atomic Arrangement of Metals and Alloys". The annual autumn meeting of the Institute will be held in Newcastle-on-Tyne. Further information can be obtained from the Secretary, 36 Victoria Street, London, S.W.1.

THE French Society for the Propagation of Cremation, founded in 1880, has nominated as its president Prof. G. Barrier, formerly president of the Academy of Medicine, in succession to the late Prof. Léon Bernard, and Dr. G. Ichok as general secretary. The offices of the Society have been transferred to 10 rue Fanny, Clichy, Seine.

A COURSE of six public lectures on different aspects of "Time" will be given at Bedford College, commencing on January 17. The lecturers will be Prof. F. C. Bartlett (January 17), Dr. J. K. Fotheringham (January 31), Lieut.-Comm. R. T. Gould (February 14), Dr. R. A. Sampson (February 28), Sir Arthur Eddington (March 7), and Prof. C. D. Broad (March 14). Cards of admission can be obtained from the Secretary, Bedford College, Regent's Park, N.W.1.

PROF. F. E. FRITSCH, of Queen Mary College, London, has completed the first volume of the first comprehensive account in the English language of the morphology of the Algæ. It is entitled "The Structure and Reproduction of the Algæ", and is designed for use by university students as well as by research workers. The book will be published this month by the Cambridge University Press.

A COMPREHENSIVE catalogue of zoological material for use in schools and colleges has been issued by Messrs. E. Gerrard and Sons, 61 College Place, London, N.W.1. The 64 pages contain very complete lists of stock species, from Protozoa to mammals, for examination or dissection, of mounted specimens, injected and dissected, cartilaginous skeletons, and life-histories. Prices are moderate, and our experience of the preparations, all of which are made by Messrs. Gerrard, is that they are of reliable quality.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in agriculture and warden at the Kent Farm Institute—The Principal, Kent Farm Institute, Borden, Sittingbourne (Jan. 21). A full-time physicist in the London County Council's Hospital Service—The Clerk of the Council, County Hall, Westminster Bridge, S.E.1 (Jan. 25). A keeper of the Department of Geology in the public museums of Liverpool—The Town Clerk, Municipal Buildings, Dale Street, Liverpool, 2 (Feb. 5). A University professor of physiology at St. Mary's Hospital Medical School—The Academic Registrar, University of London, S.W.7 (Feb. 15).

## 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.

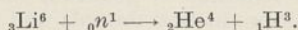
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 72.

## Disintegration by Slow Neutrons

FERMI and his collaborators<sup>1</sup> have reported that neutrons slowed down by collisions in substances containing hydrogen are captured by many nuclei very much more frequently than are fast neutrons. In the cases reported, the process is one of pure capture, resulting in the formation of a higher isotope. It is to be expected that slow neutrons may cause a nuclear transformation with the emission of heavy particles if energy can be released in the process. The probability of such a reaction will depend on the mutual kinetic energy and potential barrier of the resulting particles, and may be large when these quantities are of the same order of magnitude; this can in general only be expected for elements of low atomic number.

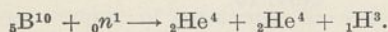
We have examined some of the lighter elements for such transformations. The general procedure was as follows. The element under examination was enclosed, as target or as gas, in an ionisation chamber connected to an amplifier and oscillograph and exposed to the bombardment of neutrons from a radon-beryllium source. A small number of ionisation 'kicks' was always observed, due mainly to recoil particles. The source and chamber were then surrounded by paraffin wax, thus exposing the target or gas to the bombardment of slow neutrons. In some cases, notably those of lithium and boron, a very large increase in the number of 'kicks' was observed, indicating that a nuclear transformation was taking place.

With lithium, the kicks observed were of two kinds, one due to doubly charged particles and one to singly charged particles. By covering the lithium target with aluminium foils we found that the singly charged particles had a maximum range of about 5.5 cm. in air, and that the range of the doubly charged particles was less than 1.5 cm. This suggests that the particles arise from the reaction



From the masses of the nuclei concerned, an energy release of about 5 million electron volts is expected, and a range of the  $\text{H}^3$  particle which agrees well with that observed.

In the case of boron, the majority of the particles appear to be doubly charged and to have ranges less than 5 mm. in air. The only reaction which appears to fit the facts is



A small but definite effect has been observed with nitrogen, and a rather doubtful effect with beryllium.

The most interesting feature of these reactions is their very high probability. The cross-section<sup>2</sup> for capture of a slow neutron by  $\text{Li}^6$  or  $\text{B}^{10}$  appears to be of the order of  $10^{-21}$  sq. cm., a magnitude which suggests that there is an attractive force between a

nucleus and a neutron at relatively large distances. The above reactions afford a convenient and sensitive means for detecting the presence of slow neutrons.

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Dec. 28.

<sup>1</sup> Fermi, Amaldi, Pontecorvo, Rasetti and Segrè, *Ricerca Scientifica*, V, 2, 282; 1934.

<sup>2</sup> cf. Fermi, Pontecorvo, Rasetti, *ibid.*, 380; 1934.

## Metaplasia of Uterine Epithelium Produced by Chronic Œstrin Administration

THE synthesis of polycyclic compounds possessing both oestrogenic and carcinogenic properties<sup>1</sup>, the finding of considerable amounts of Œstrin in cancerous tissue<sup>2</sup> and in the blood of tumour-bearing male mice<sup>3</sup>, and the demonstration in various ways of a correlation between the amount of Œstrin present in the body and the incidence of spontaneous mammary carcinoma (in susceptible strains of mice)<sup>4</sup> have led many students to suspect an interrelationship between epithelial growths and the female sex hormone. Metaplasia from columnar to stratified epithelium in the seminal vesicles and coagulating glands of male mice and rats treated with Œstrin has been noted<sup>5,6,7</sup>, but analogous effects in female animals have not been reported. Overholser and Allen<sup>8</sup> have found that treatment with Œstrin and corpus luteum hormone enhances the atypical epithelium proliferation produced by traumatization of the cervix uteri in monkeys; but since this proliferation occurred in a region in which squamous epithelium is normally present, it cannot be said whether metaplasia occurred or not.

Recently, a series of experiments were planned with the view of determining to what extent the 'anti-hormone' theory<sup>9</sup> might be found applicable. In one of these a group of eight female castrates were injected daily intraperitoneally with 30-60  $\gamma$  of Œstrone in oil (crystalline folliculin, kindly supplied by Dr. Girard) over a period of ten weeks. The mammary glands showed marked duct proliferation with some formation of alveoli; the degree of development was the same in biopsy specimens removed two weeks after the beginning of treatment as at the end of the experiment. Biopsy specimens also showed that the uterus and vagina preserved their oestrous development throughout the whole period. The experiment therefore confirmed the statement of D'Amour<sup>10</sup>, that loss of sensitivity to Œstrin does not occur. But when the animals were killed after ten weeks treatment, histological examination of their uteri showed in four cases a more or less complete metaplasia of the cylindrical secretory epithelium into a stratified squamous epithelium with cornification, from which irregular buds penetrated deep into the stroma.

In another experiment, 0.1-0.3 c.c. of 0.1 per cent oestrone in corn oil was placed in one horn of the uterus of each of six adult castrate female rats, escape of the oil being prevented by ligation of the uterus; the animals had previously been treated with moderate doses of oestrone intraperitoneally in order to distend the uteri. The animals were killed on the fourth day after filling the uterus; the oestrin-treated horn showed signs of commencing metaplasia in three cases and complete metaplasia to stratified squamous epithelium in one case.

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Dec. 18.

<sup>1</sup> Cook, Dodds, Hewett and Lawson, *Proc. Roy. Soc., B*, **114**, 272; 1934.

<sup>2</sup> Loewe Raudenbusch and Voss, *Biochem. Z.*, **249**, 443; 1932.

<sup>3</sup> Engel, *Z. Krebsforsch.*, **34**, 658; 1931.

<sup>4</sup> Lacassagne, *C.R.*, **195**, 630; 1932.

<sup>5</sup> De Jongh, *Acta Brevia Neerl.*, **3**, 112; 1933.

<sup>6</sup> Lacassagne, *C.R. Soc. Biol.*, **112**, 590; 1933.

<sup>7</sup> Burrows and Kennaway, *Amer. J. Cancer*, **20**, 48; 1934.

<sup>8</sup> Overholser and Allen, *Proc. Soc. Exp. Biol. N.Y.*, **30**, 1323; 1933.

<sup>9</sup> Collip, *J. Mount Sinai Hosp.*, **1**, 28; 1934. Collip, *Annals Internal Med.*, **8**, 10; 1934.

<sup>10</sup> D'Amour, Dumont and Gustavson, *Proc. Soc. Exp. Biol., N.Y.*, **32**, 192; 1934.

### Production of Electron-Positron Pairs

THE production of a pair of positive and negative electrons by two photons was one of the consequences of his theory of the electron first considered by Dirac. This effect is essentially at the basis of all pair production phenomena, and it may be of interest to point out that from the formula for it, recently given by Breit and Wheeler<sup>1</sup>, we may readily deduce, to a certain approximation, the probabilities for the production of pairs by high-energy photons and electrons in the field of an atomic nucleus. The correlation of these effects depends on the fact that for an observer moving relative to a nucleus with a velocity approaching that of light, the field of the nucleus is approximately equivalent to a radiation field. In the region effective for producing pairs—at distances from the nucleus of the order of and greater than  $\hbar/mc$ —the nuclear field corresponds, for an observer travelling with velocity  $v$ , to a distribution of photons the number of which in the frequency interval  $d\nu$  is given by

$$N(\nu)d\nu = (2/\pi)\alpha Z^2 \log(g\gamma mc^2/\hbar\nu) d\nu/\nu \quad (1)$$

$$\alpha = e^2/\hbar c, \quad \gamma = (1 - v^2/c^2)^{-1/2}, \quad g \sim 1.$$

The cross-section,  $\sigma$ , for pair-production by a photon,  $h\nu$ , of energy  $\xi mc^2$ ,  $\xi \gg 1$ , is now obtained by considering its interaction with the photons, which, according to (1), represent the nuclear field. For a system  $S'$ , moving with the incident photon with a velocity such that the energy of the photon is reduced from  $\xi mc^2$  to  $mc^2$ , the expression for  $\sigma$  thus obtained is

$$\sigma = \int_{h\nu=mc^2}^{h\nu \sim \xi mc^2} \sigma(\nu) \times (2/\pi) \alpha Z^2 \log(g\xi mc^2/h\nu) d\nu/\nu. \quad (2)$$

$\sigma(\nu)$  is the cross-section for pair-production by a photon of energy  $h\nu$  and a photon of energy  $mc^2$ , travelling in opposite directions. The second factor is the number of virtual photons in the nuclear field with frequency in the range  $d\nu$ . On substituting for

$\sigma(\nu)$  the expression given by Breit and Wheeler and integrating, this gives

$$\sigma = (28/9) \alpha Z^2 (e^2/mc^2)^2 \log g\xi, \quad (3)$$

which agrees with the result obtained by Heitler and Sauter by direct application of Dirac's theory. In this formula, and also the other formulae given in this note,  $g$  is used to denote a numerical factor of the order of unity. Its exact value in the different cases cannot be derived by the present method and this represents the degree of approximation involved.

The production of pairs in collisions between two electric particles may be deduced in a similar way, either by replacing the field of both particles by radiation and using the Breit-Wheeler formula, or only the field of one and using the Heitler-Sauter-Bethe<sup>2</sup> formula. Adopting the second procedure we obtain, as the cross-section for the production of a pair, of energy between  $\epsilon mc^2$  and  $(\epsilon + d\epsilon)mc^2$  (including energy of mass), by an electron of energy  $\xi mc^2$ , in the field of a nucleus,  $Ze$ ,

$$\sigma(\epsilon)d\epsilon = (28/9) \alpha Z^2 (e^2/mc^2)^2 \log(0.15\epsilon) \times (2/\pi) \alpha \log(g\xi/\epsilon) d\epsilon/\epsilon, \quad (4)$$

being simply the product of the Heitler-Sauter-Bethe formula and (1) (remembering that for an electron  $Z = 1$ ). If  $\epsilon \gg 137Z^{-1/3}$ , then in the first logarithmic term in (4) we must replace  $0.15\epsilon$  by  $179Z^{-1/3}$ , on account of the effect of shielding.

The cross-section for the production of a pair of any energy, according to (4), is

$$\sim \xi$$

$$\sigma = \int_2^{\xi} \sigma(\epsilon)d\epsilon = (28/27\pi) \alpha^2 Z^2 (e^2/mc^2)^2 (\log g\xi)^3. \quad (5)^*$$

Regarding the pair-production by a high energy photon, it is of interest that, in the system  $S'$ , to which (2) explicitly refers, the pair-production is practically all due to the interaction of photons of energy of the order of  $mc^2$ . This results from the fairly rapid convergence of the integral in (2), the integrand being asymptotically proportional to  $\nu^{-2}$ . This is quite analogous to the state of affairs in the problem of radiative collisions, where the use of the Klein-Nishina scattering formula on the same lines as the present use of the Breit-Wheeler formula, shows that the emission of radiation by a high energy electron in a nuclear field may be reduced to the scattering of radiation of quantum energy<sup>3</sup>  $\sim mc^2$ . Both the pair-production formula and the radiative formula have thus a very simple theoretical basis.

A fuller discussion of the contents of this note and of other effects of charged particles which may be correlated with radiation effects will shortly be published in the *Proceedings* of the Danish Academy.

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Nov. 13.

\* (4) gives only the order of magnitude of  $\sigma(\epsilon)$  if  $\epsilon \sim 1$  or  $\epsilon \sim \xi$ . These regions of  $\epsilon$  are, however, not important to the integrated cross-section. It might be remarked that (5) is in harmony with the results for pair-production by 2 particles obtained by Landau and Lifschitz by direct application of Dirac's theory, in so far as their calculations are published (*NATURE*, **134**, 109, July 21, 1934).

<sup>1</sup> *Phys. Rev.*, **45**, 766; 1934. The value given must be divided by 4 for use in the present connexion, according to a communication from the authors.

<sup>2</sup> *Proc. Roy. Soc., A*, **146**, 83; 1934.

<sup>3</sup> Compare v. Weiszäcker, *Z. Phys.*, **88**, 612; 1934; and E. J. Williams, *Phys. Rev.*, **45**, 729; 1934.

Absolute Value of the X-Unit

In order to determine the ratio between the X-unit and the absolute unit of length, I have registered certain X-ray lines in high orders with a concave glass grating ( $R = 5$  m.) and determined their wave-lengths by comparing them with known spark lines in the first order, registered on the same plate<sup>1</sup>. The X-ray line which turned out to be most suitable for such relative measurements was the aluminium  $K\alpha_1\alpha_2$  line, which has been determined very accurately by Larsson<sup>2</sup> with a crystal grating. From nine different plates I have found the values given in the accompanying table. The value found by Larsson is  $Al K\alpha_1\alpha_2 = 8322.48$  X.U., or, corrected for the refraction in the crystal,  $8321.35$  X.U. The difference  $\Delta\lambda$  between the measured values and the crystal determination is given in the second column. For every value found for the  $Al K\alpha_1\alpha_2$  line I have computed the corresponding value for the electronic charge  $e$ .

$Al K\alpha_1\alpha_2$	$\Delta\lambda$	$e$
8.3405 A.	+ 2.3 per thousand	$4.807 \times 10^{-10}$ E.S.U.
3406	+ 2.3	807
3399	+ 2.2	806
3410	+ 2.4	808
3373	+ 1.9	802
3406	+ 2.3	807
3393	+ 2.1	805
3397	+ 2.2	806
3423	+ 2.5	811
8.3401	+ 2.25	4.806

As these measurements are based on a direct comparison of X-ray wave-lengths with optical lines of known wave-lengths, the values ought to be free from systematic errors. The accuracy can be estimated from the different values given in the table. The final result is:

$$Al K\alpha_1\alpha_2 = 8.340 \pm 0.001 \text{ A.}$$

$$1,000 \text{ X.U.} = (1.00225 \pm 0.0001) \times 10^{-8} \text{ cm.}$$

$$e = (4.806 \pm 0.003) \times 10^{-10} \text{ E.S.U.}$$

Further details as to the method and the apparatus will be published elsewhere.

MARTIN SÖDERMAN.

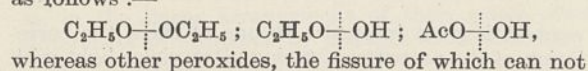
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Uppsala.  
Nov. 25.

<sup>1</sup> See also Siegbahn and Söderman, NATURE, 129, 21, Jan. 2, 1932.  
<sup>2</sup> Larsson, Diss. Uppsala, Univ. Årsskr., 1929.

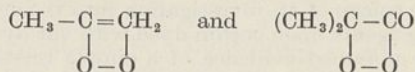
Significance of Proknocks in Hydrocarbon Combustion

OWING to the complicated nature of hydrocarbon molecules with several carbon atoms, it is difficult to obtain precise evidence as to the nature of the chain mechanisms controlling combustion. Further results have been obtained which throw some light on these processes<sup>1</sup>.

A large number of substances have a mild pro-knock effect as can be measured in knock rating tests; a special class of substances, however, have a pronounced effect in concentrations as low as  $10^{-5}$  and  $10^{-6}$  mol fraction. These organic compounds are so constituted that they can disrupt to give radicals as follows:—



take place in this way, show no marked knocking effects; for example:—



Similarly the knocking characteristics of various nitrogen compounds fit in with this, for organic nitrates and nitrites show this same fissure; Steacie<sup>2</sup> has shown that ethyl nitrite decomposes thus,  $C_2H_5O \begin{array}{c} \vdots \\ \vdots \\ \vdots \end{array} NO$ . These compounds have a pronounced pro-knock effect of the same order as alkyl peroxides. Nitro compounds on the other hand, such as nitromethane and nitrobenzene, possess only a slight pro-knock effect, because fissure does not occur in this manner.

These remarks also bear relation to the observations of Hinshelwood, Williams and Wolfenden<sup>3</sup> who show that chain branching in the combustion of hydrogen is due to a similar type of fissure to that discussed above, namely,  $HO \begin{array}{c} \vdots \\ \vdots \\ \vdots \end{array} OH$  and  $DO \begin{array}{c} \vdots \\ \vdots \\ \vdots \end{array} OD$ .

Amongst many apparently conflicting phenomena associated with combustion, it would seem that this disruption of an already oxygenated molecule may be common to many explosion processes which depend on chain branching. The "centres of high energy from which reaction can spread quicker", to which mention was made in some former investigations<sup>4</sup>, become the regions where disruption occurs. It is interesting to find that the concentrations required for the pro-knock effect is smaller than  $10^{-5}$ , since concentrations of antiknock of about the same order are required to prevent it.

The significance of these and other facts relating to the effect of various substances on knocking and on ignition will be discussed elsewhere.

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<sup>1</sup> cf. Egerton and Ubbelohde, NATURE, 133, 179, Feb. 3, 1934.  
<sup>2</sup> Proc. Roy. Soc., A., 146, 388; 1934; and J. Chem. Phys., 2, 345; 1934.  
<sup>3</sup> Proc. Roy. Soc., A., 147, 48; 1934.  
<sup>4</sup> See supplement to NATURE, July 7, 1928.

The Thermal Decomposition of Acetaldehyde

NATURE of October 13 and October 27 contain criticisms by Prof. M. W. Travers of work from this laboratory on the thermal decomposition of acetaldehyde. I had already expressed disagreement with similar criticisms at a meeting of the Royal Society in May, and did not wish to enter into a controversy in the columns of NATURE. Lest, however, absence of any comment be interpreted as acceptance, may I be allowed to state quite briefly that fresh experimental work by Dr. Winkler (in process of publication elsewhere) fully confirms that the reaction under the conditions of our previous work is almost entirely homogeneous, and shows by direct chemical analysis that the pressure increase gives a reliable measure of the actual rate of disappearance of acetaldehyde?

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### Oxidising Agents and Vat-dyed Cotton

IN the course of an investigation into the action of oxidising agents upon cotton dyed with vat dyestuffs, we have obtained evidence of a simple relationship between the stable potential set up when a platinum electrode is dipped into a dilute solution of sodium hypochlorite, and the amount of chemical modification produced when this solution acts, under standard conditions, upon pure cotton cellulose dyed with the reduced or leuco form of certain vat dyestuffs. These results may prove of interest to those engaged in a study of the chemistry of cellulose and similar poly-molecular compounds and also to those who are working on phenomena of oxygen transfer facilitated by a chemically labile substance.

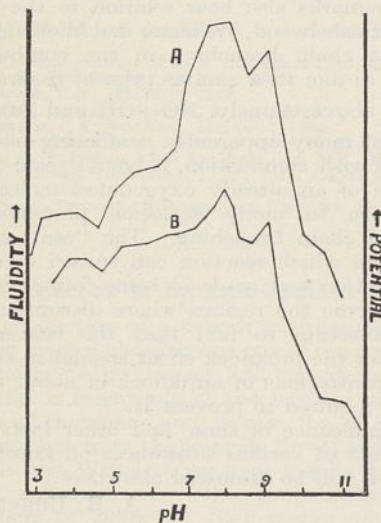


FIG. 1.

Certain vat dyestuffs exhibit great resistance to the action of chemical reagents in dilute solution, except that they are readily reduced at the essential quinone groups. The reduction- or leuco-compound is usually unstable, reverting easily to the vat dyestuff on contact with atmospheric oxygen or upon treatment with dilute aqueous solutions of oxidising agents. The presence on the cotton fibre of this reduced form of some vat dyestuffs causes a remarkable acceleration in the rate of chemical modification of the cellulose by dilute sodium hypochlorite. If this modification is measured by the increase in the fluidity (reciprocal of viscosity) of standard solutions of the treated cellulose in solutions of cuprammonium hydroxide, it can be shown that more modification is accomplished in a few seconds in the presence of reduced dyestuff than is brought about over a period of some hours by hypochlorite acting in the presence of the fully oxidised form of the dyestuff, or in the complete absence of vat dyestuff. In all these experiments light is excluded.

In a series of experiments, cotton dyed with a reduced vat dyestuff was treated, in the dark, for 10 minutes with dilute sodium hypochlorite solutions, maintained at a number of different hydrogen ion concentrations by a procedure in which the sodium hypochlorite is employed as its own buffering electrolyte. The connexion between the chemical modification of the cellulose (as measured by its fluidity)

and the pH of the hypochlorite solution is given in curve A on Fig. 1. In curve B is shown the connexion between pH of the hypochlorite solution and the potential set up by it at a clean platinum electrode. This potential was measured in the usual way by forming a cell with the platinum electrode and a saturated calomel half element and measuring the E.M.F. of the cell potentiometrically. The potential at the platinum electrode is expressed by comparison with the hydrogen electrode in a solution of the same pH as the solution under examination.

The remarkable agreement between these two curves is not found in the unaccelerated oxidation of cellulose in the absence of reduced vat dyestuff. The agreement appears to indicate (a) simple relationship between the cuprammonium fluidity and the mean molecular size of cellulose modified by accelerated hypochlorite oxidation, (b) a consistent and uncomplicated mechanism for the oxidation of cellulose by hypochlorite over a considerable range of hydrogen ion concentration, when the oxidation is accelerated by reduced vat dyestuff.

The use of reduced vat dyestuffs or analogous accelerating substances may lead to a simplification of the study of the oxidation of cellulose and similar compounds.

A fuller account of this work will appear in a forthcoming issue of the *Journal of the Society of Dyers and Colourists*.

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### Vision in the Ultra-Violet

IN a letter in NATURE of November 10 (p. 736) Prof. Fabry mentions two publications by Saidman on this subject, hitherto unknown to me, which I

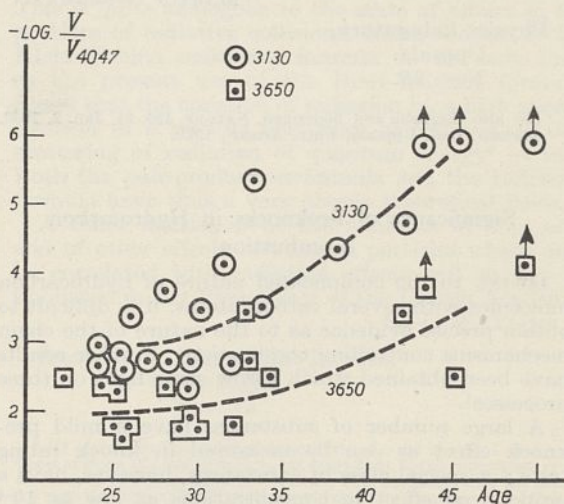


FIG. 1. Visibility for  $\lambda 3130$  and  $3650$  relative to  $\lambda 4047$  plotted against age. The points marked by arrows mean that the value of  $-\log (V/V_{4047})$  is certainly larger than indicated.

read with great interest. In one of them the correlation of the property of seeing ultra-violet light with



age is discussed. As I measured quantitatively  $V_{3650}/V_{4047}$  and  $V_{3130}/V_{4047}$ , it seemed to me of some interest to publish a graph (Fig. 1) of these quantities against age, which confirms well that there is a general decrease of visibility between thirty and forty-five years of age, as affirmed by Saidman. Indeed, also in my case no one older than forty-three could perceive light of wave-length 3130.

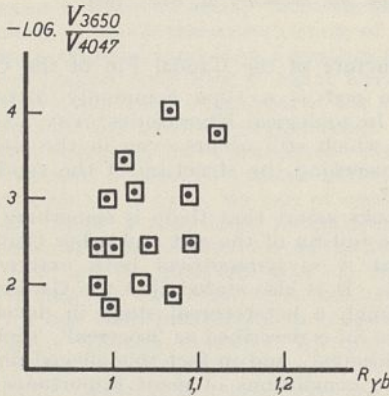


FIG. 2. Visibility ratio  $V_{3650}/V_{4047}$  plotted against yellow-blue ratio  $R_{yb}$ . No apparent correlation.

The general behaviour of younger and older people was very well confirmed by many tests, which were not worked out quantitatively. I have also tried to plot the quantity  $V_{3650}/V_{4047}$  against the yellow-blue ratio. It happened that many of those who underwent the ultra-violet test were measured as to  $R_{yb}$  according to Ives (ratio of candle power of specified carbon filament lamp viewed through potassium bichromate and copper sulphate filter). From this graph (Fig. 2), it is seen that this correlation is very poor. This emphasises that the question of vision in the ultra-violet is more determined by accidental properties of the eye (colouring of liquids) than by a certain disposition of receptors.

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Nov. 21.

Origin of Variations within Species

In the salivary glands of the larvæ of *Drosophila*, the chromosomes, which are of immense size, about seventy-five times the length of those in other tissues, show a banded structure. This can be seen in living cells stained with methylene blue and in permanently fixed preparations. The width and spacing of the bands are characteristic and constant for each part of the chromosomes, as was found by Painter<sup>1</sup>.

The homologous chromosomes in the salivary glands undergo somatic pairing, hence the number appears to be haploid, each thread actually representing two closely fused chromosomes. This pairing is evidently conditioned by homology in the same way as pachytene pairing. Individuals, heterozygous in respect of the structure of the chromosomes, that is, in the linear arrangement of their genes, show differences of sequence by changes of association.

In *Drosophila pseudo-obscura* there are several

geographical lines and races which do not differ in gross morphology, but can be distinguished by the shape and size of the Y chromosomes in the males, and by sterility and other abnormalities in their male hybrids (Koller<sup>2</sup>, Dobzhansky<sup>3</sup>). La Grande 2 (weak race A, Dobzhansky and Boch<sup>4</sup>) and Texas 1 (strong race A) are two such races. In the salivary glands of the hybrid from the cross between these races, the sex chromosomes pair as in pure races, which indicates complete homology in their internal structure. Three out of the four autosomes pair regularly throughout their length, but in the remain-

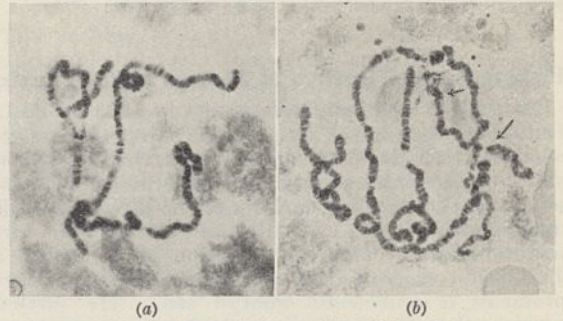


FIG. 1. (a) Complete and (b) incomplete pairing of chromosomes in the salivary glands of *Drosophila* carrying inversion.

ing one an intercalary segment of one member pairs in an inverted sense with respect to the segments on either side of it. When pairing is complete, these intercalary segments form a characteristic loop (Fig. 1, right). When it is incomplete, either the intercalary segment or one or both of the ends remain unpaired (Fig. 1, left). Diagrams of the four possible types of pairing are shown in Fig. 2.

The cross is therefore a structural hybrid and the two races differ not only in regard to the structure of their Y chromosome but also in regard to the structure of one pair of the autosomes. An inversion of a segment has occurred in the history of one of them since their separation from a common stock.

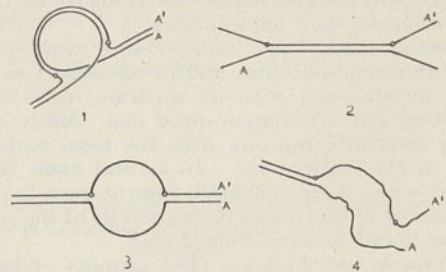


FIG. 2. Diagram illustrating the different types of pairing of chromosomes heterozygous for inversion. A' indicates the chromosome with an intercalary inverted segment. 1, complete, 2, 3, and 4, incomplete pairing.

Differences in abnormality which occur between males in the crosses involving these races and race B cannot be due to the Y chromosome alone. There must also be differences between the X chromosomes or between the autosomes. In view of these observations, it seems probable that the genetic behaviour is associated with the structural differences found in the autosomes.

Incidentally, it may be noted that it is possible to

analyse variations rapidly by cytological technique, which could only be detected by the experimental breeder with considerable difficulty.

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Dec. 1.

P. CH. KOLLER.

<sup>1</sup>Painter, Th. S., "The Morphology of the X-Chromosome in the Salivary Glands of *Drosophila melanogaster* and a new Type of Chromosome Map for this Element", *Genetics*, 10, 448-469; 1934.

<sup>2</sup>Koller, P. Ch., "Spermatogenesis in *Drosophila pseudo-obscura* Frol. II. The Cytological Basis of Sterility in Hybrid Males of Races A and B", *Proc. Roy. Soc. Edin.*, 54, 67-81; 1934.

<sup>3</sup>Dobzhansky, Th., "Studies on Hybrid Sterility. I. Spermatogenesis in Pure and Hybrid *Drosophila pseudo-obscura*", *Z. Zellf. u. mik. Anat.*, 21, 169-323; 1934.

<sup>4</sup>Dobzhansky, Th., and Boch, R. D., "Intersterile Races of *Drosophila pseudo-obscura* Frol.", *Biol. Centr.*, 53, 314-320; 1933.

### Embryo Sac and Embryo of *Moringa oleifera*, Lamk.

This plant was first investigated in 1923 by F. L. Rutgers<sup>1</sup>, who makes some astonishing statements regarding the development of the embryo sac and embryo. He states that the archesporial cell is deep-seated in the nucellus, and functions directly as the megaspore mother cell without cutting off any parietal tissue. This on reduction gives rise to a T-shaped tetrad of megaspores of which the lower produces a 5-nucleate embryo sac. He further remarks that the fertilised egg undergoes several free nuclear divisions and wall-formation starts only after sixteen nuclei have been formed.

As my results are very different from these, I think it worth while to record them briefly.

The young nucellus usually shows a single hypodermal archesporial cell. This cuts off a primary parietal cell which by further divisions forms three or four wall layers. The megaspore mother cell divides in the usual manner to form four megaspores which may either be arranged in a single linear row or in the form of a T.

**Embryo Sac.** The nucleus of the functioning megaspore divides three times to form a normal 8-nucleate embryo sac. The antipodals are ephemeral, but in some cases they may persist for quite a long period. In the former case an older embryo sac would appear to be only 5-nucleate, and it is just possible that Rutgers based his conclusions on the observation of such embryo sacs.

In some cases, two embryo sacs were present within the same nucellus, and in one case I saw two paired nucelli each with its separate inner integument, but with a common outer one. Many irregularities exist in connexion with the total number of nuclei in the embryo sac. In several cases the egg apparatus was seen to contain four or even five cells. The number of free nuclei in the middle of the embryo sac was found to vary from 2 to 6.

**Endosperm and Embryo.** The primary endosperm nucleus divides rapidly forming a mass of nuclei specially crowded at the micropylar end. In poorly fixed material some of these nuclei become arranged in such a way that the whole body appears to be a free-nucleate egg. A careful study of serial sections reveals, however, that the fertilised egg is situated just above this mass of nuclei and divides much later. The first separating wall is transverse, as in other Angiosperms. The upper cell divides to form a massive suspensor. The mature embryo is dicotyledonous, but in some cases it may become tricotyledonous due to a split in one of the cotyledons.

I wish to express my sincere thanks to Dr. P. Maheshwari for guidance and suggestions throughout

the course of this investigation. I am also grateful to Prof. K. Schnarf, of Vienna, who took the trouble of examining some of my slides and confirmed my observations.

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Agra. Oct. 28.

<sup>1</sup>Ann. Jard. Bot. Buitenzorg, 31, 1-66; 1923.

### Structure of the Caudal Fin of the Cod

As the cod is a type commonly dissected by students in zoological laboratories, may I point out an error which still occurs even in the latest textbooks concerning the structure of the caudal fin of this fish?

Textbooks assert that there is something peculiar about the tail fin of the cod and other Gadidae, and state that it is symmetrical both externally and internally. It is also stated that the Gadidae do not pass through a heterocercal stage in development. Hence the fin is described as 'isocercal', 'diphycercal' or 'pseudocercal', and in fact this alleged diphycercy has led to conclusions of great importance such as phylogenetic relationship and the composition of the present fin.

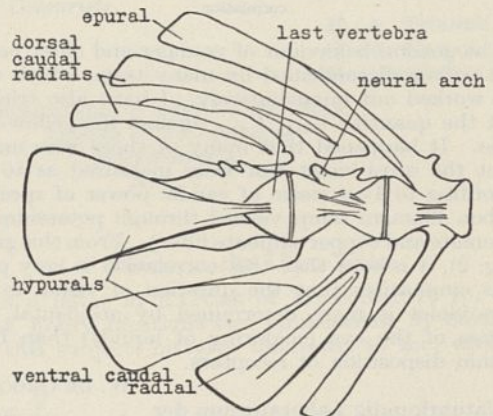


FIG. 1. Skeleton of the caudal extremity of the cod.

However, I merely invite the attention of teachers of zoology to the accompanying sketch (Fig. 1) of the extremity of the caudal fin skeleton of the cod, from which they can draw their own conclusions. It can be easily verified by dissection and clearing in xylol. It is scarcely possible to call the fin anything else but heterocercal, as in the majority of Teleosts. There is clearly nothing peculiar whatever about the structure. Moreover, in *Gadus minutus* at least, and doubtless in every other Gadid, a heterocercal stage is very obvious in specimens one inch long.

An exactly similar error appears constantly in regard to the caudal fin of the eel, which is also homocercal. For those interested, I venture to direct attention to my previous papers on caudal fin structure in fishes<sup>1</sup>.

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<sup>1</sup>"The Caudal Fin of Fishes", *Proc. Roy. Soc.*, B, 82; 1910. "The Caudal Fin of the Teleostomi", *Proc. Zool. Soc.*; 1910. "The Caudal Fin of the Eel *Chaudhuria*", *Rec. Ind. Mus.*, April 1918. "The Evolution of the Caudal Fin of Fishes", *Rec. Ind. Mus.*, August 1918.

Estimation of General Ability

IN statistical theory it has been for some time a discipline for statisticians to distinguish by appropriate notation a population parameter that is being estimated and the measure obtained from a sample that is to be its estimate. It is now, for example, common for a true population correlation coefficient to be denoted by  $\rho$ , and  $r$  to be our sample estimate of it.

In Spearman's theory of ability there are sufficient real difficulties, without the introduction of one or two of a more artificial kind that I venture to comment on here because they seem to me to have arisen mainly owing to the non-recognition of the value of this discipline in the psychological domain. If, as a convenient notation in Spearman's two-factor theory, we denote a person's general ability by  $G$ , and our estimate of it by  $g$ , we can at once realise certain facts about  $g$  that have nevertheless been put forward in rather an obscure way in the literature.

Thus  $g$  will not be identical with  $G$ , and consequently it may be said that  $G$  is indeterminate. A quantity  $i$  has been introduced to represent this indeterminacy. Though, however, we may choose to write a formal equation relating  $g$ ,  $G$  and  $i$ , this will not tell us qualitatively more than we already know, that  $g$  in general differs from  $G$ . The difference may be regarded statistically as the error of estimation; actually it must be a function of the specific abilities corresponding to the tests used. This has been pointed out recently by Prof. Godfrey Thomson<sup>1</sup>.

Further, it has been stated that  $g$  is not conserved by linear transformations of the test scores. A transformation in general, since it implies that the same test score will contribute to more than one of the new test scores, will introduce group factors where none might have existed before, and correlations among the new test scores will not therefore satisfy the tetrad criterion: yet we can always regard any new value  $g'$ , say, obtained from them as an estimate of  $G$ . We shall expect  $g'$  to differ from  $g$ , but this would appear to have little relevance to what value we ascribe to Spearman's theory.

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<sup>1</sup> *Brit. J. Psychol.*, 25, 92-99; 1934.

Measuring General Intelligence by Tests which break the  $g$ -Hierarchy

IN an article in the current number of the *British Journal of Psychology*, I have shown that two tests which fit separately into a hierarchy, but the correlation of which with one another breaks it, can under certain conditions be weighted so as to form a team of two tests correlating perfectly with  $g$ . The object of the present note is to point out an extension of this principle. If  $k$  tests each fit separately into a hierarchy, but cannot co-exist in it, their correlations with  $g$  ( $r_{1g}, r_{2g} \dots r_{kg}$ ) can be separately found. A team of these  $k$  tests can then be formed, with weights proportional to  $(-)$  the co-factors of  $r_{1g}, r_{2g} \dots r_{kg}$  in the determinant

$$\Delta = \begin{vmatrix} 1 & r_{1g} & r_{2g} & \dots & r_{kg} \\ r_{1g} & 1 & r_{12} & \dots & r_{1k} \\ r_{2g} & r_{12} & 1 & \dots & r_{2k} \\ \dots & \dots & \dots & \dots & \dots \\ r_{kg} & r_{1k} & r_{2k} & \dots & 1 \end{vmatrix},$$

to give an estimate of  $g$ , and this estimate will correlate perfectly with  $g$  if the value of the above determinant is zero. If the latter is the case, the  $k$  non-conforming tests may be represented as containing among them  $k-1$  group components in addition to the general component  $g$ .

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Dipole Moment of Iodine

THE problem of the dipole moment of iodine is of considerable interest. Some years ago, Williams<sup>1</sup> and Müller and Sack<sup>2</sup> measured the moment of iodine in benzene and carbon disulphide solutions and obtained a value of  $1.1 \cdot 2 \times 10^{-18}$  c.g.s. units. It is well known, however, that the iodine molecule should have a symmetrical structure. It is scarcely likely that iodine would react chemically with benzene under the conditions of their experiments. The moment observed was due to some interaction between  $I_2$  and  $C_6H_6$ . It seemed strange to us that a moment of the order of magnitude of 1 Debye, that is, a moment characteristic of a molecule of a marked polarity, should arise through the influence of Van der Waals' forces. The discrepancy between the value observed and that to be expected from theoretical considerations can be attributed to the imperfection of the method of measurements.

The authors mentioned above determined the dielectric constant at one temperature and calculated the moment by subtracting the electronic part, obtained from refraction data, from the total polarisation. This method is not sufficiently precise because the atomic polarisation is neglected. We have measured the dielectric constant of solutions (1-6 per cent) of iodine in benzene and carbon disulphide at different temperatures from 15° to 70° in the case of benzene and from 15° to 35° for carbon disulphide by the heterodyne beat method.

Our experiments show that iodine has no dipole moment in benzene or in carbon disulphide. The probable error of our method of investigation is not greater than 0.1 Debye. The electric moment of iodine is, therefore, within the limits of this error, equal to zero.

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<sup>1</sup> *Phys. Z.*, 29, 204; 1928.

<sup>2</sup> *Phys. Z.*, 31, 821; 1930.

Designation of Logarithms to Base  $e$

IN a short review in *NATURE* of November 3 (p. 684) it is remarked that "The notation 'ln' for 'log<sub>e</sub>' will probably be somewhat strange to British readers".

This notation was used by Jahnke and Emde "Funktionentafeln", and even in the first (1909) edition they did not deem it necessary to explain

the meaning of 'ln', so that it was presumably familiar on the Continent twenty-five years ago; it is also used by Milne-Thomson and Comrie in their "Standard Four Figure Tables" (1931), but they thought it desirable to explain in a conspicuous position that:

Logarithms to base 10 are denoted throughout by 'log',  
Logarithms to base  $e$  are denoted throughout by 'ln',

thus confirming your reviewer's opinion that the notation is "somewhat strange" in Great Britain.

It is to be hoped that this use of 'ln' and 'log' in the latter tables, which are bound to be used more and more as their advantages are recognised, will soon familiarise users with this notation, which appears to possess at least two obvious advantages: it reduces the cost of printing by eliminating the subscript  $e$  or  $10$ , and it reduces the risk of confusion or error if the hurried user does not notice the subscript.

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### Large Telescope Mirrors constructed by Dr. J. Peate

IN the years 1895-98 the Rev. Dr. John Peate, of Greenville, Pa., ground and polished a 62 in. diameter telescope mirror for the American University of Washington, D.C. Prior to that time he had made thirteen other reflectors, in the years 1879-95, which are said to have gone to "all parts of the world, including India". The whereabouts of only two of these thirteen mirrors seem to be known, these being at Thiel College, Greenville, and Allegheny College, Meadville, Pa.

I am endeavouring to compile an accurate account of the making of the 62 in. mirror (the largest glass reflector in the world at that time) which was cast in Butler, Pa., in March 1895, and of Peate's activities as a mirror-maker generally. May I ask that if any readers of NATURE know the whereabouts of the missing mirrors, and what use has been made of them, they will be so good as to write to me?

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### Points from Foregoing Letters

WHEN the lighter elements are bombarded with slow neutrons, atomic transmutation may occur with release of energy. Dr. J. Chadwick and Mr. M. Goldhaber, by the bombardment of lithium with neutrons from a radon-beryllium source slowed down by passage through paraffin wax, find that helium and triple-weight hydrogen ( $H^3$ ) are produced, about five million electron volts of energy being released at the same time. Boron gives a similar result, and these elements are therefore indicated as sensitive detectors for slow neutrons.

From the similarity in chemical constitution of certain substances producing cancer and of the female sex hormone, oestrin, it has been inferred that the latter may be able to produce cancer, and some experimental evidence has already been brought to support this view. Prof. J. B. Collip, Dr. H. Selye and Prof. D. L. Thomson now report cancer symptoms in castrated female rats injected with oil-solutions of the sex hormone.

The transformation of radiant energy into 'matter' was deduced theoretically by Dirac, who showed that two units of radiant energy (quanta) may give rise to a pair of positive and negative electrons (having mass). Dr. E. J. Williams now calculates the probability of a similar pair being formed from a quantum and an electron within the atom's nucleus (this electron being equivalent to a quantum or photon, from the point of view of an observer approaching it with a velocity nearly that of light).

A discrepancy exists between the charge of the electron computed from the rate of fall of electrified droplets ( $4.77 \times 10^{-10}$  E.S.U.) and that calculated from the wave-length of X-rays determined by the ruled-grating method ( $4.80 \times 10^{-10}$  E.S.U.). This would lead to a corresponding difference in the unit used in measuring X-rays, namely, the X-unit ( $= 0.001$  A. or  $10^{-11}$  cm.). This will have to be increased, according to Mr. M. Söderman, by about 0.2 per cent (or the numerical value of the X-ray wave-lengths correspondingly changed).

Messrs. A. R. Ubbelohde and A. Egerton put forward the view that the presence of organic molecules which, when disrupted, give rise to radicals ( $HO\cdot$ ,  $C_2H_5O\cdot$ , etc.), increases the amount of knocking in the internal combustion engine and plays an important part in many explosive processes.

A fairly close parallelism between the electromotive force of a platinum electrode in solutions of hypochlorite and the action of the latter upon cellulose fibres dyed with a reduced vat dyestuff, is reported by Mr. H. A. Turner, Mr. G. M. Nabar and Prof. F. Scholefield. The extent of the action was determined from the change in fluidity observed when the cellulose fibre was dissolved in cuprammonium hydroxide solution.

The order of arrangement of genes (carriers of hereditary traits) along the chromosome threads may give rise to peculiar loops, when chromosomes coming from unlike parents (heterogeneous as regards structure) are paired. Mr. P. Ch. Koller submits photographs and diagrams of such abnormally paired chromosomes in the cells of the salivary gland of the fruit fly (*Drosophila*). He points out that they can help in the rapid determination of variations within a species.

A description of the development of the embryo in the seeds of *Moringa oleifera* (from which oil of ben, similar to olive oil, is extracted) is given by Mr. Vishwambhar Puri. It differs from that given by F. L. Rutgers in 1923.

Prof. C. Spearman postulates that ability is made up of a factor due to training in the particular field under consideration, and another factor due to intelligence or general ability,  $G$ . Mr. M. S. Bartlett states that the latter quantity is indeterminate; it differs from the experimentally estimated ability,  $g$ , by a factor which depends upon the specific abilities corresponding to the tests used in measuring intelligence.

ERRATUM.—The value of the E.M.F. obtainable from xanthine-uric acid, as obtained by Miss Filitti, was given in this column last week as  $-0.113$ ; it should have been  $+0.113$ .

## Research Items

**Domestic Fowl in Britain.** A collection of antiquities from York made by the late William Hewitt of York when excavations were being carried on in High Ousegate in 1903 was acquired by the Municipal Museum, Hull, and has recently been placed on exhibition in the Mortimer Museum. Among the objects in the collection, described with illustrations by Mr. T. Sheppard in the *Naturalist* of December, were twenty-one needles, principally of bone and occasionally of ivory, varying from  $5\frac{3}{8}$  in. to  $2\frac{5}{8}$  in. in length. Some of the bone needles are curved and possibly were made from the ulnar bone of a hare. There were also fifteen pins of bone or ivory, varying in length from  $4\frac{1}{2}$  in. to  $1\frac{1}{2}$  in. A hollow tube  $5\frac{1}{4}$  in. long may be a comb case. It has a deep groove cut in the centre, as though it had been used as a holder. This, and a smaller tube, are made from a mammal bone. With these objects were two hone-stones or sharpeners, with perforations for hanging, a tine of red deer antler, sawn off and sharpened to a square point and an amber pendant. Of the spindle whorls, one of slate is elaborately decorated with concentric rings on the convex side. There are two massive jet rings and a terra-cotta mask with a face and head-dress almost Egyptian in style. Among the bones of pig, ox, red-deer and horse, were two specimens which are the tibia and femur of the domestic fowl, *Gallus domesticus*. In a recent discussion in the *Ibis* on the domestic fowl in Britain in pre-Roman times, Dr. P. R. Lowe argues, against the previously accepted view, that it was indigenous. These two bones from York would appear to confirm his observation.

**Bird Sociology.** So many anecdotes have been circulated about the attentiveness of individual birds to others of their kind in difficulties, that a light on the other side of bird relationships should not be out of place. Eric C. Kinsey has studied in California the habits of the long-tailed yellow-breasted chat (*Icteria virens longicauda*). He trapped the female of a pair, and on the following day the male appeared with a new mate and immediately started nesting operations within a few feet of the old nest, notwithstanding the fact that his old mate was anxiously calling to him from a trap placed alongside the old nesting site. He appeared to be indifferent to her presence in the immediate neighbourhood and entirely heedless of her difficulty. Indeed, it was found to be a rule for this species that a captured individual, male or female, of a pair, never succeeded in decoying its mate into the same trap. Mating seemed to be casual: of another pair, the male was first trapped; two days later the female appeared with a new mate, whereupon she was trapped, and on the following day the same male appeared with a new female (*Condor*, 36, 235; 1934). The regardlessness and fickleness of this chat is in marked contrast to the habits of some other passerine birds which are devoted mates.

**Indian Leafhoppers or Jassidæ.** Dr. H. S. Pruthi has published a second contribution to the above subject (*Mem. Indian Mus.*, 11, No. 2, July 1934). In the present work he describes the genotypes of some of the genera erected by the late Mr. W. L. Distant, and also revises the genus *Moonia*, Dist. Dr. Pruthi

remarks that Mr. Distant is the author of more than 60 per cent of the genera and species of the family described from India. Unfortunately, both the descriptions and illustrations of most of the new forms described by this author are very inadequate. The need has consequently arisen for a thorough revision and redescription of most of Distant's material in order that progress may be made in the further study of the Indian forms. The present work is a contribution towards that end, and Dr. Pruthi's careful figures, especially of the male genitalia, together with the insect species portrayed on the accompanying plates, should prove of definite value to students of the family in question. The Indian species of Jassidæ, it might be added, constitute an important component of the Jassid fauna of the world, and these memoirs will interest specialists in this large and rather neglected group of insects.

**Results of Nerve Grafting.** Sir Charles Ballance has recently published a short monograph ("The Conduct and Fate of the Peripheral Segment of a Divided Nerve in the Cervical Region when united by Suture to the Central Segment of another Divided Nerve". London: Macmillan and Co., Ltd., 1934. 7s. 6d. net) dealing with his more recent work on nerve grafting. He finds that when the cervical sympathetic trunk is made to supply a voluntary muscle, the motor end plates have the normal structure and the sympathetic fibres increase in diameter as the end plate is approached. According to Langley and Anderson, it is only the preganglionic fibres of the sympathetic system which can be made to supply voluntary muscle; the post-ganglionic can never take the place of somatic fibres. This distinction agrees with the modern pharmacological grouping of nerve fibres for (in Dale's terminology) the somatic and preganglionic fibres are 'cholinergic' whilst the post-ganglionic fibres are 'adrenergic'. There are, it is true, considerable differences both in the structure and speed of reaction of somatic and preganglionic fibres, but Ballance's work shows that after the substitution has been made, the preganglionic fibres retain their characteristic size in the nerve trunk down which they have grown, but become modified in the muscle as they approach their destination in the motor end plate.

**Elm Disease in Great Britain.** A brief memorandum issued by the Forestry Commission gives a review of the seventh annual survey of the extent of the attack of the insidious and at times highly virulent malady of the elm genus. During last summer, the disease is said to have made definite progress in nearly every area examined, but the severity of the attack is below the peak year of 1931. Infected trees have been recorded in three new counties, Lancashire, Merionethshire and Cornwall. The classification of the counties of England and Wales shows nine where the attack is frequent and often serious, sixteen where it is sporadic, sixteen seldom found and eleven in which the disease has not yet been reported. It is considered that a more widespread survey would almost certainly add to the numbers in the classes 'sporadic' and 'seldom found'. The nine counties where the pest is worst all lie to

the north and east of London, save the Isle of Wight. It is said that there is no indication as yet of the disease extending westwards. The point of interest which is being studied is what proportion of attacked trees recover partially, but still remain in a condition where the infestation may restart; and what proportion recover entirely. In a case in Kent, known to the writer, three young vigorously growing trees, two standing within ten yards of one another, the third a hundred yards away, were attacked some four or five years ago. Of the two standing close together the first attacked appeared to have recovered and then died within a year. The second has entirely recovered. The third tree lost its leader, then died rapidly from the top, and was then felled and burnt. The fungus had penetrated into some of the branches half way down the stem. The elm bark beetle is said to be a chief carrier of the disease. No beetles or their galleries were found in any of the three trees. No definite record of the elm disease has yet been reported from Scotland.

**Specific Heats of Gases at High Temperatures.** G. G. Sherratt and Ezer Griffiths, working at the National Physical Laboratory, have measured the specific heat of carbon monoxide at temperatures of the order  $2,000^{\circ}\text{C}$ ., using the velocity of sound measured in a graphite tube (*Proc. Roy. Soc.*, Nov. 15, 1934). Previous attempts to measure the specific heats of gases at high temperatures have been made by the explosion method, involving great experimental difficulties and large uncertain corrections. The train of sound waves was set up by a quartz piezo-electric crystal, the effective length of the tube was varied by moving a carbon piston, and the condition of resonance was indicated by changes in the plate current of the oscillator maintaining the vibration of the quartz crystal. Temperatures were measured by a disappearing filament pyrometer. Since the velocity of sound in a gas shows a dispersion effect, being different for different frequencies, the velocity was measured at several frequencies and a correction applied, using a theoretical result of Kneser. The specific heat finally deduced was in good agreement with that deduced from band spectroscopic data.

**Molecular Clustering in Fluids.** R. S. Krishnan (*Proc. Indian Acad. Sci.*, Oct. 1934) has made optical experiments to test for the presence of molecular aggregates in liquids and liquid mixtures. A beam of polarised light was passed through the liquid, and the 'depolarisation' (that is, the ratio of the intensity of the horizontal to the vertical components of polarisation) of the light scattered at right angles is observed. If the scattering particles are comparable in size with the wave-length of light, this depolarisation may be observed. Negative results were obtained with a number of organic liquids. Positive results were obtained with a binary liquid mixture (carbon disulphide + methyl alcohol) and this effect persisted at temperatures lying within a considerable range around the critical solution temperature.

**Exploration of the Upper Atmosphere by Self-Recording Balloons.** E. Regener and his co-workers (*Phys. Z.*, Oct. 1, 1934) have obtained further information on cosmic rays and on the absorption of light in the atmosphere by the use of beautiful self-recording instruments carried by sounding balloons. E. Regener and G. Pfozter sent up a Geiger-Müller counter,

which with its high-tension battery and counting mechanism gave a load for the balloon of about 6 kgm. The apparatus attained a height of 28 km. and the impulses counted gave a variation with height practically identical with that formerly observed with ionisation chambers. The readings at the highest altitudes show a transition effect due to the formation of secondary radiations as the radiation enters the atmosphere. Measurements were made by E. Regener and R. Auer with a large, open ionisation chamber connected to a self-recording electrometer, the chamber being in some experiments lined with paraffin or celluloid. The experiments showed that no large part of the cosmic ray intensity was due to neutrons. E. Regener and V. H. Regener sent a quartz spectrograph to a height of 30 km. with a balloon. In order to avoid setting the spectrograph to point at the sun, the slit was directed towards a white disc illuminated by the sunlight. The camera took a number of spectrograms on a rotating plate, the height being indicated on each by the shadow of an aneroid pointer. The plates were measured in a photometer at two different wave-lengths lying in the region where the absorption of ozone sets steeply in, and the results used to obtain the distribution of ozone in the atmosphere. The maximum concentration of ozone appears to lie in the region 24 km. high, and at 30 km. height 70 per cent of the ozone lies below the apparatus. This result agrees with the estimates of Goetz, Meetham and Dobson, rather than with the earlier view that an ozone layer existed at 40-50 km. height.

**Activity Coefficients of Sulphuric Acid.** Most of the measurements of the activity coefficients of sulphuric acid have been made with the Hg/Hg<sub>2</sub>SO<sub>4</sub> type of electrode. The solubility of mercurous sulphate, however, prohibits its use in acid concentrations below 0.005 molal. The cell containing two-phase lead amalgam, with lead sulphate as depolariser, is free from this objection and has been used by J. Shrawder and I. A. Cowperthwaite (*J. Amer. Chem. Soc.*, 56, 2340; 1934) in measurements of the activity coefficients of sulphuric acid from  $0^{\circ}$  to  $50^{\circ}$  over the concentration range 0.02 to 0.001 *m*. The calculations are somewhat difficult, since the degree of ionisation of the acid, involving the two ions HSO<sub>4</sub>' and SO<sub>4</sub>"', has to be taken into account, and some assumptions are required. The results at  $25^{\circ}$  are compared with the La Mer, Gronwall and Greiff extension of the Debye-Hückel theory on the assumption of an ionic size of 1.75 Å. The results are also applied to the calculation of the heats of dilution of sulphuric acid. The results are widely divergent from those obtained by the calorimetric method, particularly at low concentrations. When plotted against the square root of the molality, the calorimetric heats of dilution provide a curve which becomes linear below 0.001 *m*. The electro-chemical values indicate a curve which exhibits a point of inflexion such as would be required to bring the curve into the limiting Debye-Hückel slope. A large part of the difference is shown to be due to the different methods of extrapolation used, and adequate agreement is obtained above 0.0036 *m*. The calorimetric data are, however, shown to be in disagreement with several independent results of electromotive force measurements, so that there is at present a real discrepancy between the values of the heat of dilution determined by the two methods which is not explained.

## Experimental Work on Cancer

IN the recently issued annual report of the Imperial Cancer Research Fund<sup>1</sup>, Dr. J. A. Murray records the main properties of twenty-eight different strains of animal tumours which are maintained in the laboratories of the Imperial Cancer Research Fund. He appeals to other institutes to publish similar "statements of the significant characteristics of the tumour strains maintained by them so that investigators throughout the world may more easily compare their material and results".

Rous and Murphy showed that fowl tumours transmissible by cell-free material retain their individual properties, in appearance, rate of growth and distribution of secondary tumours. In the first paper of the scientific report<sup>2</sup>, Dr. Foulds describes such characteristics for six different chicken tumours, and concludes that the behaviour of these tumours is parallel to that of metastases in human cancer. In a supplement to the report<sup>3</sup>, Dr. Foulds gives a detailed summary of the work on the properties of the filtrates which produce tumours in fowls and on the characteristics of such growths. The specificity of the malignant tissue produced by filterable agents and the multiplication of such agents with the growth of the tumour differentiates them from the chemical carcinogenic agents. On the other hand, the 'organisers' induce embryonic structures, the growth of which then appears to increase the amount of organiser.

The fourth and fifth papers of the report deal with investigations carried out by Dr. A. F. Watson on the effect of liver diet on tar cancer. Maisin showed that when either fresh or cooked liver was fed to mice, they became more susceptible to painting with carcinogenic tar. Watson has shown that a preparation of hog's stomach containing the hæmopoietic factor did not have the same effect as liver. The results of liver feeding show that the mortality of the control mice is much higher than that of the liver-fed animals; this effect seems to be greater than the influence on tumour production.

Dr. E. S. Horning has developed a technique by means of which the distribution of inorganic matter in tissues can be studied. The fixed and sectioned tissue is heated to 650° C., after which the distribution of the ash can be seen by means of dark-ground illumination. From this, the form and character of the original cells can be seen. Hypertrophied stroma and most malignant cells appear to contain more inorganic matter than normal cells; in this respect,

however, tar tumours seem to differ from other tumours. The method has shown that radium treatment causes redistribution of the inorganic matter; changes are shown within six hours of irradiation and continue for six days. There seems no doubt that micro-incineration is a valuable histological and chemical method.

Mr. H. G. Crabtree and Dr. W. Cramer show that treatment of transplantable tumour tissue with the maximum concentration of poisons producing reversible inhibition of the respiration will also allow the tissue to grow when implanted in a host. If the poison is used in a higher concentration, the tissue will not grow on transplanting. They also show that the physiological environment affects the susceptibility to radium; in general, lowered respiration causes increased susceptibility. Dr. Cramer has been able to demonstrate that the differences in sensitivity to radium of spontaneous mammary carcinomata in mice are partly due to variations in the extent of macrophage invasion. He points out that effective radiation need not kill all the cells directly, but only cause temporary but specific damage.

The last two papers of the report are by Dr. R. J. Ludford and deal with the structure and behaviour of cells in tissue cultures of tumours. Macrophages, polyblasts, lymphocytes, giant cells, fibroblasts and malignant cells, all of which occur in such cultures, are described. Apart from their morphology, the cells can be differentiated by their movements and reactions to vital stains. Careful subculture has given almost pure cultures of malignant cells. Ludford has been able to use colloidal solutions of fat-soluble dyes as a vital stain for the fatty parts of cells. All cells are stained by such dyes, but as malignant cells are not stained by the water-soluble trypan blue, it is suggested that the plasma membrane of malignant cells is relatively rich in fatty substances. In this respect, the membrane resembles that of the tubercle bacillus.

Many of the papers are fully and beautifully illustrated, and the descriptions immediately below the plates themselves are a great help to the reader.

<sup>1</sup> Thirty-second Annual Report (1933-1934) of the Imperial Cancer Research Fund.

<sup>2</sup> Eleventh Scientific Report on the Investigations of the Imperial Cancer Research Fund. Pp. ix+177+58 plates. (London: Taylor and Francis, 1934.) 30s.

<sup>3</sup> Supplement to the Eleventh Scientific Report on the Investigations of the Imperial Cancer Research Fund. The Filterable Tumours of Fowls: a Critical Review. Pp. ii+42. (London: Taylor and Francis, 1934.) n.p.

## Annual Meeting of the Science Masters Association

THE thirty-fifth annual meeting of the Science Masters Association was held on January 1-4 at Oxford under the presidency of Prof. N. V. Sidgwick. Some three hundred members were present, a number slightly less than the usual number for an Oxford meeting, although the membership of the Association has risen to within the region of two thousand.

A full programme of lectures, visits and demonstrations was arranged, together with the usual exhibits by manufacturers and publishers. Various departments of the University were open for inspection and special demonstrations were staged, par-

ticularly in the Astronomical, Biochemical, Botanical, Electrical and Chemical Departments.

The presidential address, under the title of "Real Molecules", was a lucid account of the modern physical conceptions of atoms and molecules developed as the result of the applications of the ideas of wave mechanics, which, in the opinion of Prof. Sidgwick, affect only to a slight degree the dimensions of atoms and their orbits as deduced from the classical theory, but give a much clearer conception of the mechanism of covalency. By assigning to every nucleus a sphere of influence, the dimensions

of which can be ascertained by X-ray methods and spectroscopy, and by defining the size of an atom as that portion of space into which other atoms cannot enter, it is possible to avoid the difficulty created by wave mechanics of a cloud of electrons of indefinite size surrounding the nucleus. Using this conception of the size of atoms, combined with a knowledge of the angles between the valencies, a molecular model can be built up. This model, however, has a volume much less than the molecular volume obtained in other ways. Hence it becomes necessary to assume the existence of an envelope (due to the electrostatic repulsion of the electrons of different atoms within the molecule) surrounding an atom in combination, the thickness of the envelope being dependent on the various types of linkage. The effects of molecular collisions on molecular change were also discussed, with particular reference to the possibilities of twisting component parts of the molecules round the valency bonds, the compression and rarefaction of the bonds, and the alteration of their angular values.

Mr. C. N. Hinshelwood gave a lecture on "Some Aspects of Modern Physical Chemistry", discussing the significance to chemistry of quantum mechanics, which, he said, has added new laws and methods of calculation in physical chemistry without disturbing existing laws to any great extent. Zero point energy, chain reactions, structure of liquids, and heavy hydrogen were topics included in this survey.

An evening lecture was given by Prof. H. H. Plaskett on the "Physics of Astronomical Vacua", with special reference to the density and source of luminosity of gaseous nebulae. The lecture was followed by an inspection of the University Observatory. "The New Aspect of the Elementary Theory of Organic Chemistry" was taken by Prof. R. Robinson as the subject of another evening lecture, in which, using the conception of anionoid and cationoid reagents, he showed how the electron theory is resulting in a unification of physics and organic chemistry. Other lectures were "Plant Respiration" by Dr. W. O. James, "Ionisation by Collision" by Prof. J. S. E. Townsend, "Tissue Respiration" by Mr. R. B. Fisher. All these lectures were much appreciated by members of the Associa-

tion, for whom much of the value of these annual meetings lies in the lucid résumés of modern work by experts in their various subjects.

A lecture-demonstration which attracted much attention was given by Dr. K. J. Franklin on "X-ray Cinematography". This was illustrated by films of the circulation of the blood and respiratory movements of various mammals.

Sound film demonstrations formed a large and interesting part of the general programme of the annual meeting. Three films were shown, suggested as suitable films for class science teaching by the British Film Institute, on which body the Science Masters Association has representatives. The films were "The Molecular Theory of Matter", "Sound and its Production", and "The Cathode Ray Oscillograph". While all these films did not find favour in every particular (indeed humour was provoked in unexpected places), it was realised that here is a valuable addition to teaching technique, particularly as a method of revision. Difficulties in the matter of cost, standard projectors, silent versus talking films, were raised and discussed at the demonstrations.

At the business meeting, the following elections took place: *President*, Sir William Bragg; *Secretary*, S. V. Brown (Liverpool Institute); *Annual Meeting Secretary*, R. E. Williams (Repton); *New Committee Members*, Dr. W. G. Davis (Newcastle Grammar School), L. G. Smith (Marylebone Grammar School), F. R. Snell (Eastbourne College). Changes were made in the rules to permit of the election of honorary members, and all past presidents were elected to that dignity. The annual report showed that the Association has now 1921 members representing 797 schools, an increase in the year of 109 members and 40 schools. The branch organisation of the Association is proceeding apace. The North Eastern, South Wales and North Western branches have been in existence for several years. Other branches in Yorkshire, East Anglia and possibly Middlesex are in process of formation. This branch organisation, it is realised, is likely to involve difficulties of representation.

The annual meeting for 1936 will be held in London under the presidency of Sir William Bragg.

## Periodic Variations in the Mean Focal Depth of Japanese Earthquakes

By DR. CHARLES DAVISON

**D**URING the last ten years, many estimates have been made of the focal depths of earthquakes in Japan. They depend on the duration of the preliminary tremors at three or more neighbouring stations. Two lists have been published, one by Mr. N. Nasu of the after-shocks of the Tango earthquake of March 7, 1927 (*Earthq. Res. Inst. Bull.*, 6, 245-331; 7, 133-152; 1929), the other of ordinary earthquakes felt in Tokyo from 1924 onwards, now issued quarterly by the Earthquake Research Institute.

*After-Shocks of the Tango Earthquake of 1927.*—Mr. Nasu has determined the position of the epicentre and the depth of the focus of 482 shocks from March 11, 1927, to July 16, 1928. The values obtained for the depths range from 0 to 44 km., the mean of all being 15.4 km. or, excluding zero estimates, 15.9 km. The after-shocks are subject to several well-marked periods—of one day, 29.6, 14.8 and 7.4 days, and 42 minutes.

From March 14 to August 31, the focal depths of 438 after-shocks are given. The maximum epoch of the diurnal period in the frequency of these shocks occurs at 3 a.m., the amplitude of the period being 0.24. During the same interval, the mean depth of the foci was 14.9 km., and the mean depth during successive hours is also subject to a diurnal period with its maximum at 3 a.m. and its amplitude 0.03, that is, the oscillations in mean depth due to this period range within about 0.45 km. of the mean.

The lunar periods are more clearly marked. During the 16 lunations from April 2, 1927, to July 17, 1928, the depths of 247 foci were estimated, the mean of all being 16.7 km. For both frequency and mean depth, the maximum epoch of the 29.6 day period falls not far from the time of full moon, the amplitudes being 0.37 and 0.09; the epochs of the 14.8 day period fall close to the times of first and last quarters, with amplitudes of 0.39 and 0.09, and those



of the 7.4 day period about the times of the four principal phases, with amplitudes of 0.16 and 0.11. The ranges about the mean depth for the three periods are, respectively, 1.50, 1.50 and 1.84 km.

The 42-minute period affects both the frequency and the mean focal depth of the Tango after-shocks until the end of May. During March and April, the minima of the periods for both frequency and depth coincided approximately with the return movements from the antipodes of the focus, the amplitudes being 0.25 and 0.06 in March and 0.33 and 0.10 in April, while, in May, the maxima coincided closely with those returns, with amplitudes of 0.54 and 0.13. The ranges about the mean depth during the three months are, respectively, 0.97, 1.64 and 1.91 km.

*Ordinary Earthquakes felt in Tokyo.*—The lists of such earthquakes, with their estimated focal depths, are given from 1924 to 1933. In the results that follow, the earthquakes for the year 1924 are omitted on account of the unusually large number felt in January of that year. Of 564 shocks felt during the remaining nine years, the focal depths of 388 are determined. The variations in mean depth show periods of one year, one day, and 14.8 and 7.4 days.

The maximum epoch of the annual period in the frequency of the earthquakes occurs at about the end of March, the amplitude being 0.11. The mean focal depth of the earthquakes is 46.7 km., and the maximum epoch of the variations in monthly mean depth occurs in the middle of March, the amplitude being 0.08, that is, the range on either side of the mean is 3.7 km.

The diurnal period in the variation of mean focal depth is less pronounced. For the same earthquakes, the maximum epoch of the variation in frequency occurs at 2 a.m., the amplitude being 0.28. The maximum epoch for the mean focal depth occurs at about 11 p.m., the amplitude being 0.05, that is, the range of variations about the mean is 2.3 km.

For the lunar periods, the number of earthquakes of known focal depth from January 25, 1925, to December 17, 1933, is 372. For both frequency and depth, the maximum epochs of the 14.8 day period fall near the times of new and full moon, the amplitudes being 0.16 and 0.03, and the range on either side of the mean depth 1.4 km. The epochs of the 7.4 day period fall near the times of the four principal phases, the amplitudes being 0.14 and 0.04, and the range on either side of the mean depth 1.9 km.

### University and Educational Intelligence

CAMBRIDGE.—The Adam Smith Prize offered annually for an essay on some unsettled question in economic science or in some branch of economic history or statistics subsequent to the year 1800 selected by the candidate himself has been awarded to Mr. W. B. Reddaway, of Oundle and King's College, who was placed alone in Division I, Class I, in Part II of the Economics Tripos last June. The prize is valued at £40.

The governing body of Emmanuel College invites applications for a research studentship which will be awarded in July 1935. Preference will be given to candidates who have already completed one but not more than two years of research. The studentship has a maximum annual value of £150, and is awarded and normally held for two years. The studentship is not open to a woman or to a graduate of the University. Further

information can be obtained from the Master, Emmanuel College, Cambridge.

ST. ANDREWS.—R. A. Smith has been appointed Carnegie teaching fellow and assistant in applied mathematics in the United College, St. Andrews, in succession to Dr. D. E. Rutherford, who has been promoted to the post of lecturer in mathematics and applied mathematics.

PROF. F. E. WEISS, formerly Harrison professor of botany in the University of Manchester, has been appointed to take charge of the botanical department of the Egyptian University at Abbassia, Cairo, from February 1 until the end of May, in succession to Prof. F. W. Oliver, who is retiring from the professorship.

### Science News a Century Ago

#### Faraday's Eyesight

Faraday's "Diary" is strictly a laboratory record of experiments, and from end to end there are very few references in it to matters outside his experimental work. One of these personal entries occurs on January 15, 1835:

"Within the last week have observed twice that a slight obscurity of the sight of my left eye has happened. It occurred in reading the letters of a book, held about 14 inches from the eye, being obscured as by a fog over a space about half an inch in diameter. This space was a little to the right and below the axis of the eye. Looking for the effect now and other times, I cannot perceive it. I note this down that I may hereafter trace the progress of the effect if it increases or becomes more common."

It does not seem that the obscurity occurred at all frequently, for no further reference to it in the "Diary" has been traced. None of Faraday's biographers makes any reference to defective eyesight. The thick glass spectacles used by him, which are preserved at the Royal Institution, were worn only to protect his eyes from the effects of explosions during the experiments on the liquefaction of gases. Among the numerous portraits of him one photograph has been found, taken probably after 1860, in which he is holding a pair of spectacles in his hand; and it would appear that he used glasses for reading in his later years; but apart from this, it is evident that he retained his sight practically unimpaired to the end.

#### Geographical Exploration

On January 15, 1835, *The Times* said: "A lecture interesting both to the friends of science and the friends of commerce was last night delivered at the London University by Captain Maconochie. The lecturer commenced by saying two expeditions of discovery were now being sent out by the efforts of the Royal Geographical Society. One of these expeditions was to explore the interior of Southern Africa and the other to explore the regions to the south and south-west of British Guiana. The Geographical Society had done much to further discovery and their exertions had been most beneficial to the promotion of geographical science." Referring to the expedition to Africa, Capt. Maconochie said: "The continent of Africa had already been penetrated 1,400 miles from the Cape of Good Hope. The countries further north were found to be the furthest advanced in the arts of civilised life. At the distance

of 1,400 miles from the Cape the arts of smelting iron and copper, and of carving in ivory were known. Commerce had penetrated in that direction nearly 1,400 miles, and a trade to the amount of 1,600£ had been carried on in one expedition. Captain Alexander had volunteered to explore these regions. He had sailed from England in September last." As regards the expedition in British Guiana: "The French nation had sent out two gentlemen for the purpose of making discoveries, and from the funds of the Geographical Society 500£ had been given towards sending out from this country a gentleman for the same purpose. The Government of the country had contributed 1,000£ to forward his exertions in so laudable an enterprise."

#### The Eastern Counties Railway

By 1835, plans for railways to connect London with the north, south, west and east of England were being prepared, and on January 17, 1835, the *Mechanics' Magazine* said that the "Eastern Counties Railway which is to run from London to Yarmouth, by way of Chelmsford, Colchester, Ipswich and Norwich will be one of the most level, for its length, yet laid down in the whole kingdom. According to the report of the engineers, there will be nowhere a greater rise than 1 in 400; no embankment of more than 28 feet high; and not a single tunnel throughout its whole length. The average cost per mile will, in consequence of these singularly favourable circumstances, be less than any other railway constructed, or in progress of construction, in Great Britain. The estimates of revenue are also extremely encouraging. From there being no canal communication between the metropolis and the counties of Essex, Suffolk and Norfolk, there is a greater waggon traffic on this line than on any other in the kingdom. The passenger traffic is also so considerable, that it would of itself suffice to pay all the expenses of the railway, and leave a handsome profit to the proprietary."

#### Volcanoes of South America

On January 18, 1835, for the second time, H.M.S. *Beagle* anchored in the bay of San Carlos in Chiloe. "On the night of the 19th," wrote Darwin, "the volcano of Osorno was in action. At midnight the sentry observed something like a large star, which gradually increased in size till about three o'clock, when it presented a very magnificent spectacle. . . . I was surprised at hearing afterwards that Aconcagua in Chile, 480 miles northwards, was in action on this same night; and still more surprised to hear that the great eruption of Coseguina (2,700 miles north of Aconcagua), accompanied by an earthquake felt over a 1,000 miles, also occurred within six hours of this same time. This coincidence is the more remarkable, as Coseguina had been dormant for twenty-six years; and Aconcagua most rarely shows any signs of action. It is difficult even to conjecture, whether this coincidence was accidental, or shows some subterranean connection. If Vesuvius, Etna, and Hecla in Iceland (all three relatively nearer each other than the corresponding points in South America) suddenly burst forth in eruption on the same night, the coincidence would be thought remarkable; but it is far more remarkable in this case, where the three vents fall on the same great mountain-chain, and where the vast plains along the entire eastern coast, and the upraised recent shells along more than 2,000 miles on the western coast, show in how equable and connected a manner the elevatory forces have acted."

## Societies and Academies

### DUBLIN

Royal Dublin Society, November 27. E. J. SHEEHY: A crate for the collection of faeces and urine adjustable for metabolism experiments (solid and liquid) with pigs, sheep and cattle of various sizes. J. HARDIMAN, J. KEANE and T. J. NOLAN: The chemical constituents of lichens found in Ireland. *Lecanora gangaleoides* (1). This lichen contains, besides chlor-atranorin, a chlorinated depsidone of constitution  $C_{16}H_8O_5Cl_2(OCH_3)_2$  closely allied in structure to diploicin,  $C_{15}H_7O_4Cl_4(OCH_3)_3$ , previously found in the lichen *Buellia canescens*. H. H. POOLE and W. R. G. ATKINS: The measurement of the current generated by rectifier photo-cells. A modification of the method recently described by Campbell and Freeth has proved very suitable for photometric measurements over a very wide range of illumination, and is especially adaptable to marine work (see NATURE, Nov. 24, p. 810). THOMAS DILLON and TADHG O'TUAMA: The cellulose of marine algæ. Cellulose was obtained from species of *Laminaria* (1) by successive extraction with ammonia and with caustic soda and (2) by a process of retting followed by extraction with soda. The methyl and acetyl derivatives and the thiocarbonate of this cellulose resembled in properties the corresponding derivatives of the cellulose obtained from land plants. When the cellulose was hydrolysed with sulphuric acid, glucose was obtained, which was identified by the osazone. Failure to obtain glucose from algal cellulose reported by other authors may have been due to the impurity of the cellulose, which in the plant appears to be closely associated with a substance corresponding to the lignin of land plants. VINCENT BARRY and THOMAS DILLON: Preparation and properties of alginic acid and the extraction of marine algæ with various solvents. High viscosity has always been regarded as the most characteristic property of solutions of the alkali alginates. It has now been found that, if the fronds of *Laminaria digitata* are extracted with boiling water and then with ammonia, the ammoniacal solution which contains the alginic acid is not highly viscous, and filters easily. Extraction with a series of solvents in the order mentioned gave approximately the following extracts expressed in percentages of the dry plant: water 40, industrial alcohol 10, industrial alcohol containing a little hydrochloric acid 2, ammonia 20, boiling caustic soda 20, residue of cellulose 8.

### PARIS

Academy of Sciences, December 10 (C.R., 199, 1345-1463). The president announced the death of Adrien de Gerlache de Gomery, *Correspondant* for the Section of Geography and Navigation. MARCEL BRILLOUIN: The Planck quanta and the field of atomic force. A development of the hypothesis that Planck's constant should appear as a fundamental constant of the atomic field which governs the motions of the electrons and the mutual actions of the atoms. CHARLES NICOLLE and MME. HÉLÈNE SPARROW: Some experiments on the virus of the river fever of Japan (*Tsutsugamushi*). This belongs to the class of exanthematic fevers and is distinct from typhus. It is propagated by animal parasites, ticks. The rat acts as a carrier for the disease. In this animal there is no fever, and the disease is

clinically unrecognisable. H. DEVAUX: The action of carbon dioxide on the extension of egg albumen on the surface of water and the variations of the thickness of its films in monomolecular layers. ROBERT LESPIEAU was elected a member of the Section of Chemistry in succession to the late C. Matignon. HENRI EYRAUD: A new representation of continuous correlations. GEORGES DARMOIS: The theory of two Spearman factors. PAUL DELENS: Congruences of curves in affine varieties. PIERRE BERGEOT: The convergence of the developments in series of Legendre polynomials of functions with limited variation. JULES SCHAUDER: Linear equations of the elliptic type with continued coefficients. TULLIO VIOLA: The trend of curves on which holomorphic functions of a uniformly converging suite take the same values as the limit function on a given curve. V. GANAPATHY IYER: A problem of Carleman. G. DELANGHE: The study of the balancing of machines with pistons by means of symmetrical rotating vectors. GEORGES MANEFF: The displacement of the perihelion of Mercury. The author's calculations lead to the same figure as those of Le Verrier and Grossmann (solution B). J. ELLSWORTH: The mass luminosity relation and double stars with eclipses. LOUIS LONGCHAMON: The mechanical properties of glasses. The method used is based on a study of the effects caused by the fall of a steel ball through different heights on to a plane horizontal sheet of glass. ERNST BAUMGARDT: A new optical method for the study of the absorption of ultrasound waves by liquids. The method is based on the theoretical interpretation of diffraction phenomena proposed by R. Lucas and P. Biquard. EDMOND ROUELE: The influence of the initial charge of the condenser on the transitory phenomena obtained on closing a ferro-resonant circuit. P. BERNARD: The reversibility of piezoelectric phenomena. The results given show, in the case of variations of the order of 0.001 second and for pressures on the quartz up to 289 kgm./cm.<sup>2</sup>, the reversibility on compression and decompression of the charges developed in the quartz. THÉODORE IONESCU and CONSTANTIN MIHUL: The propagation of electric waves: the explanation of echoes. PIERRE BRICOUT: The calculation of the perturbation of a hydrogenoid atom by a free electron. GEORGES LIANDRAT: The use of boundary type selenium photo-elements for the measurement and registration of very intense illuminations. G. LEJEUNE: The mode of action of controllers in scouring. Study of the effect of the addition of gelatine to acid solutions used for the removal of scale from iron. M. HAÏSSINSKY: The applicability of Nernst's electrochemical law to extremely dilute solutions. A study of the critical potentials of the cathode deposit of very dilute solutions of bismuth nitrate using the isotopes radium E and thorium C as radioactive indicators. A. HAUTOT: The structure of the K line of beryllium and conductivity electrons. PAUL GAUBERT: The anisotropy and structure of window glasses. WENLI YEH: Radioactivity induced by neutrons.

(To be continued.)

#### CRACOW

Polish Academy of Science and Letters, November 5. B. KAMIENSKI: Electric tensions of solutions of alkaloids, physiological agents. MLE. R. LUDWICZAK and J. SUSZKO: Studies on the relation between the rotatory power and atomic spatial

dispersions in the molecules of the cinchona alkaloids. J. FIEDZUSZKO and J. SUSZKO: Spatial transformations of the cinchona alkaloids into epimer bases. T. GIZA: Studies on casein. MLE. M. BREM: The distinction between the wood of spruce and larch by the anatomical method. A. BURSA: *Hydrurus fatidus* in the Polish Tatra. J. ZACWILICHOWSKI: The nerve elements of the haltere and the homology of the haltere and of the wing in *Tipula paludosa*.

#### PRAGUE

Czech Academy of Sciences and Arts, January 12, 1934. B. NĚMEC: Heterophily and heterotropy of ivy (*Hedera helix*). F. A. NOVÁK: *Pinus pindica* and *Pinus magellensis*. JAR. PETRBOK: *Corbicula fluminalis*, Müller, and the fauna of the Třebestovice pleistocene terrace in Čilce near Nymburk (paleontological part). V. SMETANA: *Corbicula fluminalis*, Müller, and fauna of the Třebestovice pleistocene terrace in Čilce near Nymburk (geological part). JAR. KLIKA: Plant societies on the travertine of Stankovany and their succession.

March 2. B. NĚMEC: Wood from the peat-bog at Františkovy Lázně. J. MATEJKA and J. MALÝ: The physique of Albrecht of Valdštejn, Duke of Frydland. JAN WOLF: Polarity of the covering of cartilaginous cells. OT. PANKRAZ: The unification method of actuarial science.

April 13. FRANT. PATOČKA: Experimental study of the pathogenic possibilities of microbes such as bacillus anthracis. K. HRUBÝ: Contribution to the cytology and embryology of *Erythronium*. F. TOUL: Catalysis of the polymerisation of acetylene by ultraviolet radiation from mercury vapour. R. KOŠTÁL: Oscillations of conjugated undamped torsion pendulums. JAR. PETRBOK: Molluscs of the Slovakian quaternary.

May 4. J. KOMÁREK: The luminescence of the Carpathian rain-worm and its cause. K. DUSL: Stability of the solution of Mathieu's differential equation. K. HRUBÝ and V. GOTTHARD: Biometry of the needles and cones of *Larix decidua*, Mill., *L. sudetica*, Dom., and *L. polonica*, Racib. J. H. KŘEPELKA and J. CHEMLAŘ: Phosphorus poisoning and its detection by the Dusart-Blondlot test.

June 15. F. NĚMEJC: Some critical remarks on the Sternberg *Lepidodendron dichotomum*. V. RYPÁČEK: Contribution to the ecology of the Cladonia family. F. KRATOCHVÍL: Prehnites from the vicinity of Čáslav. J. JELÍNEK: Contribution to the question of the differentiation in the granite massifs of Central Bohemia. A. KLEČKA and V. VUKOLOV: Contribution to the question of the mycorrhiza of grass and other meadow plants and its physiological significance. E. VOTOČEK and S. MALACHTA: A new transition from the sugar series to the furane series. F. VALENTIN: Anhydromannose, a new sugar anhydride. R. ŘETOVSKÝ: Uranyl nitrate and the energy of germination of old seeds of barley.

October 19. V. JIRÁSEK: Distribution of members of the *Poa*, L. family in the Czechoslovakian Republic. R. PEXIEDROVÁ: Projection of the accessory nasal cavities on the medial wall of the eye. R. LUKÁČ: Chemical and physical properties of some tremolites from the vicinity of Tábor and their genetic relations to the mother rock. FR. VYŮCHLO: Linear straight-line complex as a three-dimensional variant.

## Forthcoming Events

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

## Sunday, January 13

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—  
Dr. Susan Finnegan: "Scorpions".\*

## Monday, January 14

VICTORIA INSTITUTE, at 4.30.—Sir Ambrose Fleming:  
"Modern Anthropology versus Bible Statements on  
Human Origin".

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Dr. H. C. Darby:  
"The Domesday Geography of Norfolk and Suffolk".

UNIVERSITY OF GLASGOW, at 8.30.—Sir John Stirling-  
Maxwell: "National Progress in Forestry".\*

## Tuesday, January 15

BRITISH INSTITUTE OF PHILOSOPHY—(at University Hall,  
14 Gordon Square, London, W.C.1).—Prof. H. Levy:  
"Science and Philosophy in Nature".\*

## Wednesday, January 16

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—Prof. W. A. F.  
Balfour-Browne: "Species Characteristics" (Presi-  
dential Address).

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Annual  
General Meeting.  
Lieut.-Col. E. Gold: "Fronts and Occlusions"  
(Presidential Address).

ROYAL ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.  
Dr. S. A. Neave: "The Development of Biblio-  
graphical Work relating to Entomology" (Presidential  
Address).

ENGINEERS' STUDY GROUP ON ECONOMICS, at 8.—Maj.  
Attlee: "The Engineer's Place in the Socialist State".\*

## Thursday, January 17

REDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. F. C.  
Bartlett: "Time from the Point of View of the Psycho-  
logist".\*

## Friday, January 18

ROYAL INSTITUTION, at 9.—Sir William Bragg: "The  
Theoretical Strength of Materials and their Practical  
Weakness".

## Official Publications Received

## GREAT BRITAIN AND IRELAND

Bibliography of the More Important Metals occurring in Food and  
Biological Material (for the Years 1921 to 1933 inclusive). Compiled  
for the Society of Public Analysts and other Analytical Chemists.  
Pp. 30. (London: The Analyst.) To Members, 2s.; to non-Members, 3s.  
University College of North Wales. Calendar for Session 1934-35.  
Pp. 442. (Bangor).

The National Institute of Poultry Husbandry. Bulletin No. 10:  
Table Poultry Production. By A. J. Macdonald and M. R. McMurray.  
Pp. 26. (Newport, Shropshire: Harper Adams Agricultural College.)  
6d.

Air Ministry: Aeronautical Research Committee: Reports and  
Memoranda. No. 1598 (S. and C. 496, 563, 582, 599): The Landing  
of Aeroplanes. Part 1, by R. P. Alston; Part 2, by L. W. Bryant  
and I. M. W. Jones. Pp. 16+18 plates. 1s. 3d. net. No. 1599 (T.  
3508): Resistance of certain Strut Forms. By Dr. R. Warden. Pp.  
31+11 plates. 1s. 9d. net. (London: H.M. Stationery Office.)

Imperial Bureau of Plant Genetics. Herbage Publication Series,  
Bulletin No. 16: The Theoretical Significance of Vernalization. By  
Prof. N. A. Maximov. Pp. 14. (Aberystwyth.) 2s. 6d.

Proceedings of the Royal Irish Academy. Vol. 42, Section B, No.  
5: A Contribution to the Flora of Ireland. By Dr. R. Lloyd Praeger.  
Pp. 55-86. 1s. Vol. 42, Section B, No. 7: The Glaciation of the  
Wicklow Mountains. By A. Farrington. Pp. 173-209+plates 4-5.  
1s. (Dublin: Hodges, Figgis and Co.; London: Williams and  
Norgate, Ltd.)

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