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TELEVISION AFTER THE WAR

ONE of the most remarkable achievements in the application of science to the everyday life of the community was the development of television before the War. The first public service of high-definition television, in Great Britain or any other country, was inaugurated at the British Broadcasting Corporation's station at Alexandra Palace in November 1936. Prior to the closing down of the station for military reasons in September 1939, the television service had reached a high standard; the programme technique had made great progress, and the result was a service of considerable entertainment value. Some twenty thousand television receivers were in use by the general public, and although the service was confined to the London area, it is probable that several hundred thousand persons were more or less regular 'viewers' either in their own homes or elsewhere. These and many others have probably been wondering for some time past exactly what are the prospects of television after the War, and to what extent the lead which Britain established in this field nearly ten years ago will be maintained in the future. There has naturally been some cause for anxiety in this matter, since the United States had the advantage of more than two years of continued development on an almost peace-time basis after the outbreak of war in Europe; and even to-day there are in the United States a number of television transmitting stations in operation on an experimental or other basis.

Although for some years past the entire technical resources of Britain have been mobilized for the provision and operation of radio equipment required for the conduct of the War, a few members of the industry, Government establishments and the B.B.C. have been able to give some thought to matters concerning the future organization of a television service. For example, a paper entitled "A Survey of the Problem of Post-war Television" was read by Mr. B. J. Edwards before the Radio Section of the Institution of Electrical Engineers last year; and the paper, with the extensive discussion which followed it, have recently been published in the *Journal* of the Institution (**91**, Part III, 163; December 1944). Technical discussions before the same Institution on matters affecting the improvement of television were also held in the previous year (*J. Inst. Elec. Eng.*, **90**, III, 147 and **91**, III, 11). More recently, Mr. H. L. Kirke, of the B.B.C., has given a discourse on the subject before the Royal Institution; an abstract of this will be found on p. 621 of this issue of *Nature*.

In the meantime, the Television Committee, appointed in 1943 under the chairmanship of Lord Hankey, has completed its duties; and its report, issued a short time ago, provides a very careful and authoritative review of the whole subject*.

The Television Committee was charged with the duties of preparing plans for the reinstatement of the

* Report of the Television Committee. Pp. 26. (London: H.M. Stationery Office, 1945.) 6*d*. net.

television service of Great Britain and its extension to the larger centres of population, and of considering the provision to be made for research and development and the guidance to be given to manufacturers, with a view especially to the promotion of the export trade. The report opens with a reference to the first Television Committee under the chairmanship of the late Lord Selsdon, and to the installation of the Alexandra Palace station after the report of this committee (Cmd. 4793) was published in 1935.

It is now generally recognized that past research work on television contributed very materially to the successful and rapid development of radiolocation; but the Committee finds that war research has produced little information and no discovery of a fundamental character bearing directly on television. War demands and activities have, however, greatly extended the technique of the radio engineer, and increased the number of skilled men and women who will eventually be available in all grades for the work of development, design and maintenance of television.

With these considerations in mind, the Committee's first and foremost recommendation, which is supported by the majority of the witnesses from whom it received information and advice, is that the pre-war system of television on the basis of 405-line definition should be restarted in London (Alexandra Palace) as soon as possible after the cessation of hostilities in Europe. An appendix to the report gives a description of this London Station and of the Marconi-E.M.I. system used there; it is believed that the service could be restored to operation within nine to twelve months of the release of the requisite staff. Next, with the view of securing a full development of the television industry and making a larger section of the population television-minded, it is recommended that an extension of the existing system to the provinces should be planned, essentially for the dissemination of the same programmes over a larger area of the country. Thirdly, the Committee recommends that vigorous research work on a radically improved system of television should begin immediately staff can be made available; and that the objective in this case should be the cinema standard of definition of the order of 1,000 lines with, if practicable, the introduction of colour and stereoscopic effects. The scope of the extension of the existing system to provincial centres should be kept under review, so that any improvements, resulting from the research work suggested, may be introduced as early as possible to the public service.

Having stated in the above general manner the policy recommended by the Committee for the provision and development of a post-war service, the report then proceeds to a discussion of some details of the plans required to put these proposals into effect. It will be necessary to obtain agreement with the various interests concerned on the allocation of appropriate frequencies for television transmission both in the immediate and more distant future. Associated with this problem is that of electrical interference, which to a considerable extent hampered or restricted the successful reception of pre-war television programmes. As the potential sources of such interference are likely to be far more numerous after the War, it is considered to be vital to the success of television that the Postmaster-General should be granted the necessary powers to enforce suppression of such interference.

On the question of research, two entirely different courses have been considered, neither of which is considered to be likely to lead to the most efficient and economical progress. It has been suggested that there should be complete unification of research effort of all interested firms in the formation of a research association: and alternatively, that the development of an improved system should be left to free competition between large firms, apart from research on certain fundamental problems on radio wave propagation, which would probably be undertaken in any event by Government institutions. In place of these suggestions, the Committee recommends that, while individual effort should receive all possible encouragement, television research should be co-ordinated, with the collaboration of all the interests concerned. It is understood that the Government research organizations of the Department of Scientific and Industrial Research would be prepared to assist the industry in any way possible in the development of television. The British Broadcasting Corporation will doubtless be able to assist considerably in co-ordinating effort in the development of an improved system, while the Post Office will assume responsibility for the outstanding problems of relaying programmes by cable and radio links. Since the ultimate aim of all interested parties is the establishment of the best television service, and as it is probable that only one transmitting system—as distinct from receiving apparatus—will be chosen for the new British service, the problem of patents becomes one of special difficulty. This problem appears to be essentially one for the industry, and it is recommended that the main manufacturing firms should be encouraged to pool their television patents with the view of ensuring that they are made available for use as the national interest may demand.

The Committee gave special consideration to the item in its terms of reference concerned with the development of the export trade, an aspect of television to which the industry appears to be thoroughly alive. General agreement was found in the fact that the first step in this direction is to popularize television at home, since a flourishing home market in suitable receivers is an essential pre-requisite of an export trade. While the industry itself must be responsible for the development of such trade, it should keep a close watch on possibilities and prospects; and arrangements should be made for the Government to be advised of developments in the television system so that these may be brought to the notice of Dominion and foreign Governments. Partly in this connexion, the Committee has given much thought to the question of bringing the British television standards into line with the American pre-war standards based on 525 lines per picture. It is implicit in the recommendations already described to re-establish the London station on its previous basis of 405 lines that such a change is considered to

be not worth while at the present time. It is urged, however, that the ideal of international standardization should be kept constantly in mind, not only for the line and picture details, but also for the bands of frequencies of radio carrier waves allocated to television.

An important section of the Committee's advice is concerned with the organization and administration of the television service and with the financial arrangements involved therein. Before the War, the Minister responsible for television on behalf of the Government was the Postmaster-General. The question of future arrangements is part of the wider subject of the relations between the Government and the British Broadcasting Corporation, which is a matter outside the terms of reference of the present Committee; it is suggested, however, that the Minister responsible to Parliament for sound broadcasting should also be responsible for television. In the same way, it is considered desirable that the B.B.C. should operate the television service, owing to its close connexion with sound broadcasting. After making estimates of the cost of re-opening the London service and its extension to the provinces, it is recommended that domestic television viewers should be required to have a special licence at a fee of £1 a year. It is also suggested that a cinema television licence might be introduced in the future, and this might become an important source of revenue. The interests concerned have, however, intimated that except possibly in the case of isolated events, they will not desire to embark on the use of television in cinemas until a new and improved system has been adopted. The report also refers to the possibility that an appreciable amount of revenue might be derived from the inauguration of sponsored television programmes with appropriate advertising material paid for by commercial interests. It is recognized that this question raises wider issues than purely financial ones, and it is felt to be premature to come to a conclusion thereon at the present time.

Much of the success of the development of television before the War was due to the activities of the Television Advisory Committee, which was set up in accordance with the recommendations of Lord Selsdon's Committee. The present Committee endorses this procedure by recommending that the Minister responsible for broadcasting should appoint a corresponding committee to fulfil a similar purpose, at any rate until the service is more or less stabilized. It is suggested that this advisory committee should include representatives of the Treasury, the General Post Office, the Department of Scientific and Industrial Research and the British Broadcasting Corporation; its function would be generally to advise the responsible Minister on questions of major policy and on any problems arising from the development of television both at home and abroad.

Under the guidance of such a body, which would carefully consider all phases of the report recently published and, where necessary, ensure that the recommendations are implemented in the most expeditious and efficient manner, it can confidently be anticipated that television will develop on sound lines in Britain and maintain the position and prestige which had been so well established some six years ago. There is no doubt that television has come to stay, and has already reached a stage that gives satisfactory results in the home. British science, engineering and industry, working in co-operation with the B.B.C. on the lines suggested in the present report, can be trusted to produce an improved system which will contribute worthily to the progress of an art the significance of which for international understanding can even now scarcely be exaggerated.

THE MOTOR AREA OF THE BRAIN

The Precentral Motor Cortex

By Charles D. Aring, Percival Bailey, Gerhardt von Bonin, Paul C. Bucy, Charles Davison, Theodore C. Erickson, John F. Fulton, Marion Hines, Margaret A. Kennard, Paul M. Levin, Warren S. McCulloch, James L. O'Leary, Wilbur K. Smith, Sarah S. Tower, A. Earl Walker. Edited by Paul C. Bucy. (Illinois Monographs in the Medical Sciences, Vol. 4, Nos. 1–4.) Pp. xiv+605. (Urbana, Ill.: University of Illinois Press, 1944.) 4.50 dollars.

THE opening pages of this book are a sharp reminder of the misfortunes of Europe. It is dedicated to Otfrid Foerster, the great neuro-surgeon of Breslau, and the foreword by John Fulton recalls the work of Dusser de Barenne at Utrecht. Dusser de Barenne left Utrecht for Yale in 1930, and the main development of his new methods took place there. But to many members of the Physiological Society his name will recall their visit to Holland in 1925, where they saw Einthoven at Leyden with his string galvanometers, Dusser de Barenne, Zwaardemaker and de Kleijn at Utrecht, and Magnus with his team of neurologists in the old plague hospital of the town. They will remember the cheerful and almost overwhelming hospitality of their Dutch colleagues, the fine buildings and the prosperous countryside.

The precentral motor cortex certainly deserves a volume to itself, for most of our knowledge of the brain has been derived from its study. When Fritsch and Hitzig found in 1870 that electrical stimulation of this part of the cerebrum would produce localized movement of the limbs, an entirely new chapter of cerebral physiology was opened. It became possible to trace the pathways of conduction, to map the excitable areas in different animals, and to analyse the movements caused by stimulation. No other part of the brain surface could yield such a rich harvest, for in no other part would electrical stimulation give such obvious results. The maps have become more and more detailed, with the inclusion of the anthropoid apes and of man in the series, and the method now seems to be reaching the limit of its usefulness. Indirectly, however, there is no field of research on cerebral localization which is not derived from these early studies of the motor area.

Otfrid Foerster was the first to make extensive use of electrical stimulation of the human brain in the course of neuro-surgical operations. Dusser de Barenne introduced the use of strychnine instead of the electric current to stimulate the cerebral nerve cells. He employed it originally in investigations of the sensory area, applying it locally to the cortex and

judging the results by the disturbance of sensation which it seemed to induce. The results were striking, but it was not until he began to record the electrical activity of the cortex that the full possibilities were evident. Strychnine is a convulsant drug which produces an explosive discharge of the nerve cells, and this gives rise to characteristic electrical activity wherever the axons of these cells are to be found in sufficient numbers. Thus the axons leading from any point on the cortex can be followed to their destination by applying strychnine to the point and finding what other regions give the large 'strychnine spikes' in an oscillograph record. We have therefore a new and very effective way of tracing the intricate pathways from cell group to cell group in the cerebral cortex as well as those between the cortex and other parts of the nervous system. In this volume the application of the method to the study of the precentral area is described by Warren McCulloch, who has worked in close collaboration with Dusser de Barenne and is now the chief exponent of his ideas.

This is the most recent method of tracing cerebral connexions; but the study of the motor area has progressed on many other lines. To deal with them the editor has assembled a team of neurologists, each of whom is an expert in his or her field (for Sarah Tower, Marion Hines and Margaret Kennard have contributed some of the most interesting chapters). The structure, pathology, somatic and autonomic functions are all dealt with, and the editor describes the results of his own operations on the motor area in man.

The volume gives a clear survey of work which is rapidly filling in the blank spaces and giving fresh detail to the neurologist's picture of this part of the brain. It may be that the picture when completed will not be much more than an elaborate railway guide with all its maps and time-tables, and we may not be much nearer to an understanding of the way in which the rest of the brain makes use of its motor area. But this could be said of most neurological research nowadays. It does not make the picture less necessary, and it does not lessen our gratitude to the editor and to the University of Illinois for such a valuable monograph. E. D. ADRIAN.

RUSSIAN APPRECIATION OF THE NEWTON TRICENTENARY

Isaac Newton. 1643–1727

The Third Centenary of his Birthday. Symposium edited by S. I. Wawilow. Pp. 437. (Moscow and Leningrad: Academy of Sciences of the U.S.S.R., 1943.) 25 roubles.

THIS book, containing eighteen articles, each concerned with a different aspect of Newton's work or influence, is an important contribution to 'Newtoniana'. Being written in Russian, it is not easily accessible to English readers. The nature of these articles and their total bulk make it impossible in a review to do more than list and classify them, and to indicate some of the more interesting or outstanding features.

First, however, the title "Isaac Newton. 1643–1727" calls for comment. The date 1643 is based on the new or Gregorian Calendar which was introduced into England in 1752, twenty-five years after Newton's death. According to the old or Julian Calendar, Newton was born on December 25, 1642.

The collection is edited by S. I. Wawilow, a great authority on Newton in the U.S.S.R. He has recently published a book on Newton and translated his "Optics" into Russian. A characteristic common to all the articles in the symposium is the profound admiration for and understanding of Newton's work shown by the contributors. But the articles are not confined to eulogisms or to the giving of information. Each is a study in criticism and interpretation.

Some of the articles, particularly those dealing with the progress of Newtonian philosophy in Russia and with Newton's influence on the development of European thought, would be of a particular interest to an English reader. Such is the article by T. P. Kravetz, in which he traces the progress of Newton's views in Russia. In the minutes of a meeting of the newly founded Russian Academy of Sciences held on November 13, 1725 (the first to be recorded) is an account of a disputation held about Newton's work on the figure of the earth. During the following year there were public lectures devoted to the exposition of the natural philosophy of Newton. From this date Newtonian mathematical methods were taken over and developed by such outstanding mathematicians as L. Euler and the brothers Daniel and Nicholas Bernoulli, at that time attached to the Russian Academy. At a slightly later date the first outstanding Russian man of science, M. V. Lomonosov (1711–65), was influenced in some degree by Newton; but the greatest development took place in the nineteenth century when Newton's views passed into the main stream of European scientific thought. It is interesting to note that D. I. Mendeleev was greatly influenced by Newton and even called his hypothetical proto-element 'newtonium'. A new phase of Newtonian study began during the present century, especially after the appearance of an excellent Russian translation of the "Principia" by A. N. Krylov in 1916 and "Optics" by S. I. Wawilow in 1927. The account of the progress of Newtonian studies in Russia is continued in the article by T. I. Rainov, in which the author deals mainly with certain aspects of scientific work of M. V. Lomonosov, D. I. Mendeleev and A. N. Krylov, and traces the development of the mechanistic interpretation of natural phenomena. The influence of Newtonian philosophy on French thought, and especially the conflict between the Cartesians and the Newtonians, is very ably discussed by A. D. Liublinskaia. Taking a wider view, A. M. Deborin traces the influence of Newtonian ideas on the development of European philosophy and culture in relation to the changing social background. The important position of Kant as the transformer of the Newtonian structural scheme into a genetic scheme is emphasized, and this is linked up with the evolutionary idea which became so prominent in the nineteenth century.

The articles dealing with the scientific aspects of Newton's work are probably the most important in this symposium, but only a list of their titles can be given in this review. They are as follows: A. N. Krylov, Sir Isaac Newton and his role in science; S. I. Wawilow, ether, light and matter in Newton's physics; G. G. Sliussarev, Newton's works on geometrical optics; I. A. Khvostikov, Newton and the development of the theory of refraction of light in the atmosphere; N. I. Idelson, the law of universal gravitation and the theory of the motion of the moon; L. N. Sretensky, Newton's theory of tides and the

figure of the earth; A. D. Dubiago, the comets and their significance in the general system of Newton's "Principia". The same, unfortunately, must be done for the mathematical articles, which are as follows: N. N. Luzin, Newton's theory of limits; S. Y. Luria, Newton's forerunners in the philosophy of the infinitesimals; N. G. Tschebotarōw, Newton's polygon and its role in the present development of mathematics; M. V. Kirpichev, Newton and the theory of similarity.

Finally, there are three articles, which cannot be classified with the others. One, by P. M. Dulsky, is on the existing portraits of Newton. Another, by S. Y. Luria, on Newton as an historian of antiquity, is a most interesting article giving a detailed account of Newton's work on chronology and criticism of the Scriptures, and discussing the importance of this work in the development of historical science. Finally, there is a very vivid account by E. Ch. Skrjinskaia of Newton's life and work in Cambridge. The author duly records the influence of Barrow's teaching on the development of Newton's thought, and after discussing the Cambridge environment, raises the question: How much did Cambridge contribute to Newton's development? This question, she suggests, should really be inverted and put this way: How much did Newton contribute to the development of Cambridge? "The answer is self-evident: Newton brought to the University the glory of being the greatest scientific centre, Newton raised the University to an unprecedental height of scientific achievement by the mere fact that he was there—a student, a fellow of one of its Colleges and its professor. Finally, it was from this Cambridge retreat that the world received the greatest achievement of human thought, it was here indeed that in a modest room of Trinity was written the 'Mathematical Principles of Natural Philosophy'. The words of its author flared up with such brilliant light that even now, two and a half centuries after Newton was associated with Cambridge, this University has neither lost nor diminished its brilliant reputation—the source of great and progressive ideas in natural science and mathematics."

S. I. TOMKEIEFF.

A THEORY OF TELEPATHY

Telepathy

An Outline of its Facts, Theory and Implications. By Whately Carington. Pp. xiii+176. (London: Methuen and Co., Ltd., 1945.) 12*s*. 6*d*. net.

THE timely appearance of this volume is an indication that the more serious among experimental psychical researchers are beginning to feel the necessity of fitting the facts they have so far amassed on telepathy into a theory which may at least be capable of stimulating further thought, if not of explaining some of the facts which seem to them indisputable.

Mr. Whately Carington sets out by briefly summarizing the results of earlier experiments; and shows how development has proceeded in a direction in which statistical analysis has played an increasing and important part. He then passes on to a consideration of the objections and resistances which have been encountered; although in this section he seems rather too much inclined to attribute the hesitancy of scientific men to accept the findings of himself and others to "a fear of finding something they cannot explain away" (p. 42), or to a haunting fear that the facts, if confirmed, might "weaken the status of Causality and Law" (p. 44).

It is in Part 2 of his book, however, that the author embarks on his theoretical treatment, which must prove of considerable interest both to psychologists and philosophers. Briefly stated, Mr. Carington's view of the mind seems to approach that held by Bertrand Russell, and lies in the direction of a theory that the 'mind' consists solely of sensa and images, which are "real entities existing in their own right". These constituents he calls 'psychons'; and each mind consists of clusters of these psychons gathered around certain nuclei; the moods, etc., within each individual mind being considered as smaller and weaker clusters grouped around other nuclei. Thus in Mr. Carington's view the mind is really a kind of system of psychons held together by associative linkages; and it is in this idea of *association* that he sees a fruitful theory developing, which, he thinks, will go far to explain such phenomena as telepathy, extra-sensory perception, and so forth.

The basic principles of this law of association are easy to grasp and, as Mr. Carington says, have the merit of simplicity as well as of close connexions with psychological processes already fairly well known. Thus if two ideas, A and B, are presented together, or in close succession, to any mind and later one is re-presented, then the other is more likely to accompany or follow it than if they had not been so previously presented. In telepathy, an idea A may be associated with an idea K in the mind of the experimenter or agent: then, if K is presented to the percipient's mind, A is more likely to come into it than it would be if A had not been associated with K in the mind of the agent.

In his account of his theory, Mr. Carington shows how many of the facts become more easily explicable if it be used, and how later research may amplify and modify his basic conception of it. Nevertheless, he does not hesitate to discuss such problems as survival in the light of his ideas regarding the stability of the psychon systems under post-mortem conditions. Recognizing that such systems might be imagined as persisting after the death of the body, he sees very clearly that the problem of their stability is crucial. What guarantee, he asks, have we that they will stick together and not disintegrate when the influx of sensory stimuli ceases? The question of the breakability or otherwise of the links in each psychon system must determine the survival or disintegration of each personality after death. To suppose such breakability to be a fact would, Mr. Carington insists, be a conception "much too material and quite illegitimate", and, moreover, contrary to every indication. Yet this was precisely the suggestion put forward forty-one years ago by Dr. Walter Leaf when reviewing Mr. W. H. Myers' great work on "Human Personality". Much of the evidence from trance mediumship suggests it. Dr. Leaf postulated the existence of surviving 'memory groups' undergoing a slow process of dissolution; and indeed he declares that, judging from the history of the various mediumistic trance personalities, their mental attitude "seems distinctly to point to the cluster of memories disintegrating—full of the gaps and vaguenesses which we should expect to find as the forerunners of ultimate dissolution".

However this may be, the present contribution to theory, as apart from mere presentation of experimental data, is to be welcomed; and doubtless will

not only excite much controversy among those at present in the field, but also stimulate others to take a more serious view of what is one of the most exciting and intriguing problems involving, as it does, psychological, philosophical and religious speculation. E. J. DINGWALL.

AMERICA'S MINORITY PROBLEM

The Navaho Door

An Introduction to Navaho Life. By Alexander H. Leighton and Dorothea C. Leighton. Pp. xviii+149 +36 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1944.) 22*s.* 6*d.* net.

DRS. A. H. and D. C. LEIGHTON are deeply concerned that the United States may be truly prepared to play the great part which she inevitably must in building international peace, and they see clearly that this preparation must begin at home. "We cannot hope to be on proper terms with Russians, Argentinians, Peruvians, British and Chinese, if we are unable to understand the cultural groups who are much more easily within the range of our comprehension." By a happy chance, the Navaho Indians, whose reservation lies in the States of Arizona, Utah and New Mexico, came to their attention, and they decided to live and work among them, and try to see things through Navaho eyes. This book is a measure of their success, and is a notable contribution to the sympathetic understanding and fair treatment of the Indian. "It was obvious that we could not study all the world, but we could study the Navahos," and they did so in the hope that the principles which they learnt might have an application to a much wider circle. It is natural, in a book written by physicians, that much space should be devoted to medicine, but this, not less than the remainder of the book, will be of value to the anthropologist and of interest to the general reader.

Owing to the accidents of history, there came a time in the nineteenth century when the Navahos were outcasts and every man's hand was against them. Finally they came to terms with the U.S. Government, which established them on their reservation and put them under the enlightened administration of the Indian Service; but even then their troubles were not ended. There are always white men who are ready to take the Indian's land and exploit his labour, excusing themselves on some fair-sounding pretext, and the Government has not consistently set its face against political pressure designed to this end. The danger is not past, and to counteract it is one of the objects of the book.

The most illuminating parts of the chapters on medical treatment and education are the specimen speech on health and the examples of interviews with Indians suffering from various diseases, which give an insight into the way in which the medical man must approach these matters if he is to get any response from his patients. Great emphasis is laid throughout on the help which can be got from native religion and the methods of treatment which are so intimately bound up with it. One chapter is devoted to the life-stories of three Navahos, told as nearly as possible in their own words. The remaining chapters, on history, environment and society, religion, the Indian Service, and future prospects, are informative and sufficient to give a background to the main purpose of the book; but anthropologists must not expect full and detailed descriptions of customs and material culture like, for example, the works of Leslie White on the Pueblos. The production of the book leaves nothing to be desired; the illustrations are superb.

In spite of the poverty of much of the land on their reservation and the uncertainty of the harvests, the Navaho population has increased threefold under the Indian Service. The head of this service, the Commissioner of Indian Affairs, at whose request the book was written, pays handsome tribute in a foreword to the practical help which its administrators have already received from the Leightons' studies, and workers in other fields will doubtless derive like benefit from them. G. H. S. BUSHNELL.

SOME TICKS OF NORTH AND CENTRAL AMERICA

The Argasidæ of North America, Central America and Cuba

By R. A. Cooley and Glen M. Kohls. (American Midland Naturalist, Monograph No. 1.) Pp. v+152. (Notre Dame, Ind.: American Midland Naturalist, University of Notre Dame, 1944.) 2 dollars.

THE Argasidæ are an important family of ticks and several of their species are of medical or veterinary significance. In so far as the North American kinds are concerned, five species of *Ornithodoros* are proved carriers of the spirochætes of relapsing fever. Rocky Mountain spotted fever has been experimentally transmitted by *Ornithodoros parkeri* and *O. hermsi*. *Argas persicus* is a widespread notorious pest of poultry: the birds may become weakened owing to loss of blood and, when large numbers of ticks are involved, the effects often cause death of the hosts. This tick may also be the carrier of avian spirochætosis, at least in Texas. The spinose ear tick of cattle, *Otobius megnini*, is a serious enemy of young animals in particular, causing much irritation and loss of condition. This species, however, has not been shown to be concerned with the transmission of any specific disease organism.

Messrs. Cooley and Kohls' monograph is a competent taxonomic study of the species affecting the areas under consideration. The classification of ticks is beset with difficulties and not the smallest of these is, as the authors point out, the lack of adequate characters upon which the genera are to be founded. So far, no genera have been synonymized, but with the increasing numbers of new species that are being discovered it has become more and more difficult to separate the genus *Argas* from *Ornithodoros*. This difficulty has resulted in the authors meeting it by modifying the diagnoses in the two genera just quoted. Host specificity varies a good deal among different species and a surprising number of North American kinds have been found on bats. The authors recognize four genera of Argasidæ, and these include at least twenty-five North American species. Two of these species belong to the genus *Argas*, *Ornithodoros* includes nineteen species and there are two species each in *Otobius* and in *Antricola*.

Wherever possible, descriptions are given of the adult, nymph and larva in each case. A classified list of hosts is given together with a glossary of the terms used and a bibliography. The work is illustrated by fourteen plates and fifty-seven text-figures (including maps).

TELEVISION—PAST AND FUTURE

AS we are able to look forward to conditions of peace in Europe, it is natural for our thoughts to turn towards the resumption of many of the amenities of civilized life, which has been so seriously restricted during the War. Among these amenities is the reception of television programmes for instructional and entertainment purposes, a service which was provided by the London Television Station over a limited area of Great Britain for a year or two preceding the outbreak of war. In view of the widespread application of radio technique to military purposes, and the outstanding advances made in various directions during the past five years, it is natural to inquire in what way and to what extent radio broadcasting and television will benefit when this technique and the personnel trained in its use are directed to the exploitation of these peace-time pursuits. It is therefore relevant to refer in some detail to an address entitled "Some Aspects of Pre-War and Post-War Television" given to the Royal Institution on March 2 by Mr. H. L. Kirke, head of the Research Department of the British Broadcasting Corporation.

This address surveyed the general principles of modern television practice and the technical features and requirements; Mr. Kirke also directed attention to the various problems which must be solved before certain developments and improvements, which have been foreshadowed in some quarters, can be incorporated in a reliable service for the public needs.

Picture Scanning

Whatever system is employed for the transmission of a television picture, basic necessities are the analysis of the picture or scene at the transmitting end, and its synthesis at the receiving end. Thus the picture or scene is broken down into a number of small elements, so that the degree of light or shade, or even colour, of each element can be transmitted independently and reassembled in the correct order at the receiving end. The degree of distortion of the picture, or its complement the definition, will depend upon the number of elements into which the picture is divided, and the size of the resultant received picture as it appears to the eye of the viewer.

The usual arrangement for scanning a picture is to divide it in effect into a number of horizontal lines, each of which is scanned or seen by the television apparatus, element by element, usually from left to right. The scanning of a picture in this way can be visualized by imagining it to be divided into a number of strips, the right-hand end of one strip being joined to the left-hand end of the strip below to form one continuous strip. This strip can now be considered as passing a slit through which elements of the picture can be exposed to a photo-electric cell as the strip passes by. The current output from the photo-electric cell at any instant is a function of the average amount of light falling upon the cell at that instant, so that the definition in the horizontal plane depends upon the size of slit or aperture, while the definition in the vertical plane is a function of the line width and therefore of the number of lines. When the scanning is done with a square or round aperture, the definitions in the vertical and horizontal directions are the same, and this is the usual arrangement. For the transmission of moving pictures, the whole field of view must be repeatedly scanned at a rate exceeding twenty-five pictures per second, in order that the eye shall not be conscious of flicker, a condition corresponding to practice in cinematography.

The sharpness or definition of a picture depends upon the number of elements into which it is divided for scanning purposes; and the radio-frequency band width occupied by the transmission of a picture depends upon the number of picture elements per second. The London Television Station at Alexandra Palace, before the War, transmitted pictures divided into 405 lines at the rate of twenty-five pictures per second, and these occupied a radio-frequency channel of 5 megacycles per second wide. By the use of a device known as interlaced scanning, it is possible to transmit a 405-line picture with only twenty-five complete pictures per second in such a manner that the flicker corresponds to fifty pictures per second. Interlaced scanning is achieved by scanning alternate lines of a picture in sequence followed by the scanning of the remaining intermediate lines. The repetition rate or flicker frequency is therefore twice the actual number of complete pictures per second. Thus alternate 'frames', as they are called in Britain, consist of 202½ lines each, while a complete picture of two frames comprises 405 lines. Interlace ratios other than two are possible but not usual in black and white television.

Electron Cameras

Although mechanical scanning systems have been developed and may still have possibilities, the more usual method makes use of a beam of electrons for the scanning process. The picture or scene to be transmitted is focused on a plate which comprises a mosaic of minute photo-electric cells, each of which acquires a positive charge to an extent depending upon the amount of light falling upon it. A beam of electrons is caused to traverse this mosaic in the scanning process, and at every point the current in the beam is proportional to the amount of light falling upon the corresponding photo-electric element. The resulting electric impulses are used to modulate the radio-frequency carrier wave of the television transmitter. The electron camera tube, particular versions of which are known as the 'emitron' in Britain, and the 'iconoscope' in the United States, is thus the link that converts the visual picture into electric signalling impulses. There have been a number of developments in electron devices and electron optics both in Britain and in the United States during and before the War which will undoubtedly be of considerable value in the further development of television camera tubes, and it is to be hoped that the considerable development of miniature components will enable the size of mobile television cameras to be reduced, as well as the size of apparatus for use in connexion with outside broadcasts.

Reception

At the receiving end the impulsive modulation is extracted from the incoming carrier wave, and used to vary in some way the intensity of light falling upon the viewing screen. The most widely used method of display before the War was the cathode ray tube, and it is probable that for a considerable time this will prove to be the cheapest and most popular form for home-viewing. The amount of development and the knowledge which has become available during the War will undoubtedly be of assistance in the improvement of the performance of cathode ray tubes, and

mass production methods should be effective in reducing the cost.

The main limitation of the cathode ray tubes is the size of pictures which can be obtained. Pictures ranging from 5 in. × 4 in. to 10 in. × 8 in. were normally obtainable in commercial receivers, the former on cheaper sets and the latter on the more expensive sets. Even larger tubes have been made and used, and it is of interest to note that one firm in the United States has advertised that cathode ray tubes suitable for pictures nearly double that size will be available after the War. Whether these will be a commercial proposition remains to be seen. For large-screen operation a number of methods have been used. Most of these employ some form of small cathode ray tube with high intensity beam and a fluorescent screen from which the picture is projected on to a larger screen. Such devices have the disadvantage of being more costly and require very high voltages for their operation.

Programme Distribution

Now, it has already been explained that the radio-frequency band-width required for an effective television transmission is about ± 2·5 Mc./s., as compared with ± 10 or 15 kc./s. for good-quality sound broadcasting. To transmit the larger band required for a medium definition television system necessitates the use of a carrier frequency in the neighbourhood of 50 Mc./s., corresponding to a wave-length of 6 metres. The use of such a short wave-length restricts the range of reliable reception to some 30–50 miles, depending upon the height of transmitter and receiver and the existence of intervening hills, trees and buildings. With such a limitation on the range of transmission, it is clearly necessary to have several transmitting stations if the programmes are to be received in various parts of Britain.

The problem of communicating programmes from one station to another has received considerable attention, since the use of ordinary telephone cables to transmit the wide band of frequencies required is not very practicable. Special co-axial cables have been developed for this purpose, and preliminary work has also taken place on the use of radio links for point-to-point transmission. In each case, however, it is necessary to have amplifiers or repeater stations at five to thirty miles apart, so that the problem of relaying programmes over a distance of four hundred miles, such as from London to Glasgow, is quite a formidable one. Both cable and radio link methods had, however, been in successful use in Great Britain before the War, for supplying outside broadcast television features from a mobile transmitter developed by the B.B.C.

Future Developments

There is no doubt that a high-definition television system can be developed, and it would be possible to provide a service for the whole of Great Britain by such a system. Whether this could in fact be done is mainly an economic question. The cost of television programmes is many times that of sound programmes. The cost of television transmission apparatus is considerably greater than that for sound. The number and cost of technical, operational and programme staff is also considerably greater. The cost of distribution, whether by line or radio, will also be greater, and last but by no means least, the cost of the receiver is perhaps one of the most important factors.

Higher Definition

Mr. Kirke then discussed the question of the definition that is satisfactory for a television service, particularly in connexion with the possible future increase in size of picture for home-viewing. The present American system uses 525 lines and 60 frames per second, but the resulting increase in band width is accommodated in about the same frequency channel of 4–5 Mc./s. by the use of asymmetric side-band transmission. It is doubtful, however, if it is worth while considering an alteration in the British system unless a change is made to 600, or even 800 lines, with a corresponding increase in horizontal definition. In any event, much experimental development work is required, and it cannot be expected that any new system can be made available as a public service for several years after the end of the War.

One aspect of the subject that may settle the future trend of development is that of the size of picture required for normal home-viewing. At present this size is limited to 10 in. × 8 in.; but it seems reasonable to anticipate the desirability of increasing this to 20 in. × 16 in. For the same viewing distance, this will involve an increase in the definition in both the vertical and horizontal directions, and the resulting increase in scanning speed will require a band-width four times as great as at present. The carrier frequency will have to be correspondingly increased to at least 200 Mc./s., a wave-length of one and a half metres or less. The propagation characteristics of such short wave-lengths have certain disadvantages from a general reception point of view: the effect of ground contours and the shadows of hills and trees are more marked; and interference effects by waves reflected from buildings and other objects are more severe. Also, in general, the sensitivity of receivers would be less and the cost probably greater, although by development and mass production this cost might be reduced.

Colour

Demonstrations have already been given in Great Britain and in the United States of the possibilities of transmitting pictures in colour, which requires the use of two or more basic colours. At the transmitter, filters can be used to separate the colours. In a mechanical system, as used in the United States, a rotating set of colour filters permits the projection of the various colour elements of the scene in turn on one photo-electric screen. The pictures containing the different colour elements are each scanned, and in some cases there is interlacing of the dif erent colours. At the receiving end a similar rotating colour disk is used in conjunction with a cathode ray tube. In the electronic system demonstrated by Mr. J. L. Baird in Great Britain, a two-colour and a three-colour process have been used experimentally. In effect, a separate screen is used for each colour, each screen being scanned by a separate electron beam. In colour television the total number of pictures transmitted per second must be increased as each colour requires a separate scansion; and the increase in number of pictures per second requires a proportional increase in band-width. If the practical limit is the band-width employed, it is necessary to compare the advantages of colour with the disadvantages of lower definition.

There is no doubt that colour does give a considerable improvement to the picture. It appears to add another dimension, and provided a certain standard of definition is achieved in any event, then colour is a

great advantage. This is the experience of those who have experimented with colour photography, and it is certainly true of the cinema, although there are still many who say they prefer black and white.

If it be assumed that for a three-colour system the total number of pictures per second is doubled instead of trebled, then double the band-width is necessary. If the band-width is 10 Mc./s., corresponding with 800 lines for monochrome, then a colour picture could be produced having 565 lines approximately; and a decision as to which was the better would be difficult, for a 565-line picture with colour would give an agreeable degree of definition and a pleasing result.

This point was demonstrated by Mr. Kirke by displaying two still pictures obtained in the United States about a year ago and taken with a mechanical colour switching system using 375 lines and 120 frames per second, the whole picture being accommodated in the standard American band-width of 4 Mc./s. The 375 lines in colour therefore correspond with 525 lines in monochrome: the pictures show that the apparent definition is rather surprising, and the compensating effect of colour is quite noticeable.

FORMATIVE EFFECTS OF ENVIRONMENTAL FACTORS AS EXEMPLIFIED IN THE DEVELOPMENT OF THE ONION PLANT

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DURING the last two decades, discoveries of great importance have been made in the field of plant morphogenesis, and the predominant part played by the external factors of day-length and temperature has been established. Applications of this knowledge to the control of plant growth in agricultural and horticultural practice have led to important results, for example, in the forcing of bulbs (Blaauw, Van Slogteren and their associates[1,2]) and the development of vernalization as a practical technique in the U.S.S.R.[3,4,5]. In both these cases temperature effects are concerned; with regard to the length of day effects ('photoperiodism') the ample empirical knowledge we owe to Garner and Allard and subsequent investigators[6] has so far yielded fewer practical results than might have been anticipated. The work dealt with in this article has brought to a focus these lines of research in an attempt to elucidate the behaviour of the onion plant.

The physiological investigation of the onion plant in this Institute began five years ago with the primary object of discovering the causes of 'bolting' (flowering) in onions grown from sets and the most satisfactory methods of control. As the work has developed, investigations on the mode of production, storage and use of onion sets have been carried out. The practical recommendations arising from this work are being dealt with elsewhere; the present account is concerned with the physiological effects of the factors of day-length and temperature, and their interactions, in controlling the developmental morphology of the onion plant—especially the processes of bulb formation, and flower initiation and development.

Onions are grown in practice from seed sown in the open, from transplanted seedlings, or from sets. The latter are small bulbs, produced from seed in one season, stored dry through the winter and planted out in a second season to give a usable crop of large onions. Before the War, considerable quantities were imported, mainly from southern Europe. Their chief disadvantage is their marked tendency to bolt; the bulb produced is then generally small and of little value. In this work, therefore, the practical interest centres on preventing flowering, rather than hastening it as, for example, in vernalization. Bolting may be prevented in a number of ways, but there is little doubt that the most practical method lies in the use of suitable varieties[7,8] and sets of suitable size[7,8,9]. Selection of low-bolting strains has been carried out[8] and re-selection work is being continued.

To provide a background for discussion, a brief description will first be given of the normal life-history of an onion plant, covering the whole growth and development from seed to mature harvested bulb, through two growing seasons and the intervening storage period; some of the experimental results will be intercalated as seems appropriate. Except where other references are given, the whole account is based on our own observations; but the development of the seedling (before bulb development) has also been described by Hoffman[10] and that of the flower by Jones and Emsweller[11].

Development from Seed to Set

At germination of the seed the cylindrical cotyledon emerges, and through a pore near the bottom the first foliage leaf later protrudes. Each foliage leaf in turn emerges through a similar pore in its predecessor; the pore thus marks in each leaf the junction of the cylindrical leaf 'blade' and the cylindrical sheathing leaf-base. During development, the first formed portion of the leaf initial gives rise to a pointed structure, the embryonic leaf-blade. This expands both longitudinally and centripetally, over-arching the axis; at the same time the embryonic leaf-base extends round the growing point and completely surrounds it at a very early stage. The pore is thus left on the side of the axis opposite the tip of the leaf blade, and as the phyllotaxy is alternate, is thus in the correct position for the emergence through it of the next leaf in succession (Fig. 1). The leaf blade is at first solid, and only becomes hollow after emergence by the formation of a lysingenous cavity.

Before the onset of bulbing, new leaves emerge about once a fortnight, at ordinary summer temperatures, and there are generally three unemerged leaf initials to be seen at the growing point on dissection (Fig. 1). Under short-day conditions (less than about twelve hours) the plant can apparently continue growing and producing new leaves indefinitely in this way without bulb formation. The older leaves die off; the pseudo-stem or neck, formed of thin concentric leaf-bases enclosing a practically solid core of growing leaf-blade, becomes gradually thicker and longer; the short basal stem tends to rot away below but grows gradually at the upper end, where new adventitious roots emerge. After a time (eighteen months of artificially shortened days in one experiment) an inflorescence emerges; further leaf production is then carried on by an axillary bud: this mode of growth without bulb formation has continued for more than three years in the experiment cited.

Under natural conditions, however, the day-length ultimately attains a critical value at which a bulb begins to form; that this is a response to the

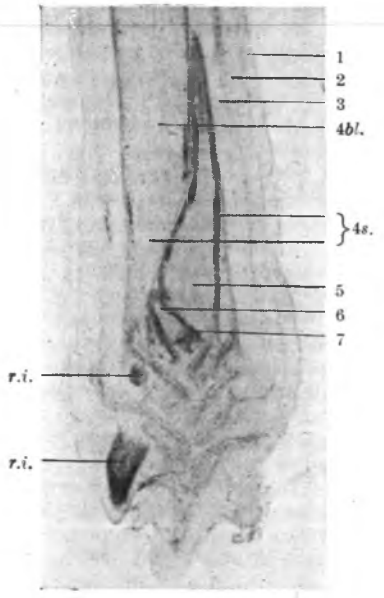

Fig. 1. LONGITUDINAL MEDIAN SECTION OF A 4-LEAVED ONION SEEDLING BEFORE BULB DEVELOPMENT. × 12. LEAF NUMBERS: 1 TO 4, EMERGED LEAVES (*4bl.*, BLADE; *4s.*, SHEATH); 5 TO 7, UNEMERGED LEAF INITIALS: *r.i.*, ROOT INITIALS.

stimulus of long days is well established[7,12,13,14,15]. The critical day-length varies for different strains of onion between about twelve hours and sixteen hours[13] at ordinary temperatures. The effect of temperature on the photoperiodic requirements of seedlings is similar to that described below for plants grown from sets. With the onset of bulbing the sheathing bases of one or more of the *innermost of the emerged leaves* begin to swell, and this is either accompanied or followed by the swelling of the sheathes of usually three of the *outermost unemerged leaf initials*. This swelling occurs by increase in cell size and development of intercellular spaces, and without cell division.

When these unemerged initials swell to form bulb-scales they apparently suffer some irreversible change, for they lose the capacity ever to develop a leaf-blade, and this also applies to one or two of the adjacent unswollen initials. Furthermore, it has been found that when definite bulb development occurs, the emergence of further leaves normally ceases, immediately or soon according to the temperature[9,14]. This observation has proved of the greatest value in accounting for the behaviour of the onion plant under various conditions[14,16].

Although no more leaves emerge after onset of bulbing the production of leaf initials at the growing-point goes on very rapidly until there are about nine unemerged leaves, of which the outermost 2–4 are swollen (Fig. 2). Some 4–6 of the unswollen leaf initials are available to produce foliage leaves in the next growing season; this number varies but little with set size[17] and hence the higher yields obtained with large sets, in the absence of bolting[7,8], is due to large size of parts rather than to a greater number of leaf initials ready for emergence[17].

In this condition the neck of the onion plant collapses, the leaf blades falling over on to the ground while several of them are still green and turgid. This collapse can occur with abundant soil moisture, though hastened by drought, and is due to the cessation of emergence of new leaves at bulbing. When the blade of the last leaf has fully emerged, the neck no longer has a solid core (as in Fig. 1) and thus becomes a thin-walled hollow tube formed of concentric leaf-bases. This tube readily buckles under the weight of the green leaf-blades, especially in wind or drought[16].

Following the collapse of the neck the leaves die and the bulb enters upon a dormant period, which can also occur with plentiful soil moisture; if the bulb has been kept small by late sowing and close spacing it now constitutes an onion set, which is normally lifted and stored dry through the winter.

The processes of bulb development and ripening normally follow the course outlined above, once bulbing has begun. But if plants that have recently begun to form bulbs are again subjected to short days, although some individuals complete their bulb development and ripen satisfactorily, in others the process of bulbing is arrested and the emergence of new leaves begins again, some of these leaves then showing transitional forms between true foliage leaves and bulb scales; lowering the temperature may have similar effect. There thus appears to be a critical stage in bulbing beyond which the process becomes irreversible. The practical interest lies in the similar reversal of the bulbing process which sometimes occurs, under field conditions during August or September, in onion plants which have bulbed late owing to very late sowing or low temperature. The longer the harvest of such plants is delayed the worse they become.

Development during the Dormant Period

With ripening, activity at the growing point almost ceases; during storage at ordinary temperatures only one to two more leaf initials are formed, and these mainly during the latter part of the winter[17]. Then, in March or April, the central axis bearing the terminal growing-point begins to elongate, as the first stage in the development of a scape. At the same time a spathe develops, and a lateral bud appears in the axil of the last leaf initial (Fig. 3). This stage of inflorescence development seems to be reached rapidly, but no further development occurs until after the set has been planted out.

Inflorescence initiation only occurs in bulbs above a certain size which varies with the variety of onion and is of the order of 2 gm. weight or 1½ cm. diameter. Inflorescence initials have only been found where a

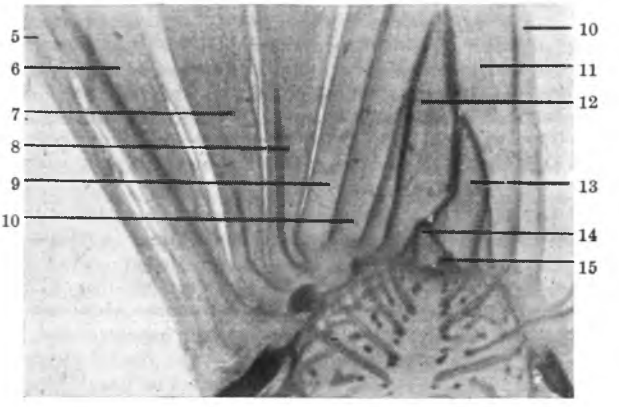

Fig. 2. LONGITUDINAL MEDIAN SECTION OF AN ONION SET IN THE VEGETATIVE CONDITION. × 8. LEAF NUMBERS: 5, EMERGED, UNSWOLLEN; 6, EMERGED, SWOLLEN BASE; 7, 8, UNEMERGED, SWOLLEN BASES (BULB SCALES); 9, 10, UNEMERGED, UNSWOLLEN BASES (BULB SCALES); 11–15, UNEMERGED INITIALS (NEXT SEASON'S LEAVES).

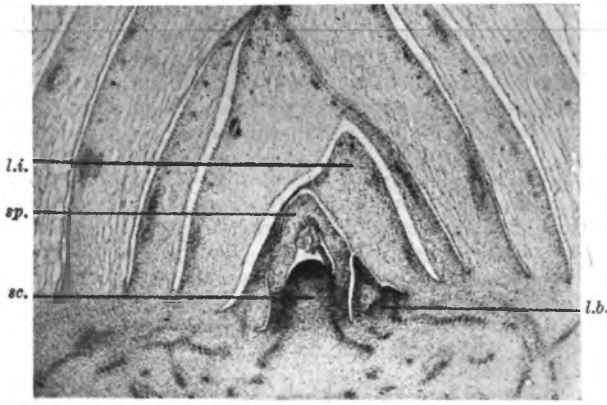

Fig. 3. LONGITUDINAL SECTION OF AN ONION SET AFTER INITIATION OF AN INFLORESCENCE. × 10 APPROX. *l.b.*, LATERAL BUD; *sc.*, SCAPE; *sp.*, SPATHE; *l.i.*, INNERMOST LEAF INITIAL.

total of at least thirteen leaf initials has been formed at the growing point[17] and this may represent the stage of 'ripeness to flower'[18]. The mode of operation of this 'size effect' is under investigation.

When inflorescence initiation occurs in a bulb as described above, the plant has necessarily been exposed to long days to enable a bulb to form. The flowering of plants kept in short days throughout, described earlier, shows that at no stage of ontogeny are long days (> 12 hours) *essential* either for initiation or emergence of inflorescences. Short days (< 16½ hours) have similarly been found to be unessential.

Development from Set to Mature Onion

When the set is planted out, the eight or nine unswollen leaf initials begin to elongate, all except the outermost one or two having leaf-blades; the swollen scales shrivel and later rot away. During a period of about a month at ordinary temperatures three or four leaf-blades emerge in rapid succession. Thereafter the leaves emerge in serial order about once a fortnight. In due course, in the absence of bulbing and if the set was large enough to have formed an inflorescence initial, the inflorescence emerges from the sheathing base of the last leaf.

Under long-day conditions, however, renewed bulb development occurs. The critical day-length for plants grown from sets is almost certainly lower than for seedlings[14], which perhaps accounts for the earlier crops from sets[19]. For a given day-length, bulbing is accelerated by high temperature and greatly delayed or prevented by low temperature[7,14,15]; thus at lower temperatures longer days are needed. There appears to be a minimum time-lag of about three weeks between the first application of the long-day stimulus and the first external appearance of bulb development (21–27° C. and 16½ hours).

If conditions are such as to produce early and rapid bulbing, inflorescence *emergence* is suppressed[17]. This appears to be a consequence of the stimulus to bulb formation, for at temperatures low enough to prevent or greatly delay bulbing, long days actually accelerate inflorescence emergence[15]. The acceleration is thought to be brought about mainly by a great increase in the rate of scape elongation, associated with more rapid emergence of the surrounding leaves; inflorescence initiation is apparently independent of day-length[15]. This effect of long days on elongation of the scape resembles their effect on the 'shooting' of spring cereals[20]. It would appear that long days always promote cell extension in the onion plant. At moderate and high temperatures long days promote radial extension (bulbing) and limit longitudinal extension (emergence of new leaves and inflorescences); at lower temperatures such longitudinal extension is enhanced and radial extension inhibited.

Since long days combined with high temperatures prevent inflorescence emergence, late planting of sets in the field should reduce bolting, and this actually occurs[8]. Unfortunately, this advantage of late planting is more than offset by the great reduction in yield[8], which is probably mainly due to the reduced leaf area caused by the cessation of leaf emergence with rapid bulbing. The small yields often given in warm seasons in Great Britain by 'early' strains of American origin, which are likely to have a low photoperiod for bulbing, may be similarly explained. Conversely, the large bulbs commonly produced by autumn sowing or spring sowing under glass may be attributed to the large leaf area produced before bulbing puts an end to the emergence of further leaves. The effects of day-length[13,14] and temperature[14] upon ripening intensify those upon bulbing onset.

Very high temperature (21–27° C.) during the second season's growth not only prevents flowering by accelerating bulb development; it also exerts a direct effect even in the absence of bulbing (short days), suppressing both inflorescence initiation[15] and the emergence of initials already present[17]. Such suppression without bulb development is unlikely to be of importance under field conditions in Great Britain, since high temperatures seldom occur except during the long days of summer.

Further Temperature Effects

Some further temperature effects may now be considered. Attempts to vernalize onion seed have so far given negative results, but the exposure of the seedlings to relatively high temperatures (mean about 21° C.) throughout the first season's growth results in sets which do not form inflorescence initials in the following spring[17] and fail to flower when planted[9,14]. In the data so far obtained this effect is, however, inseparable from a size effect, for owing to more rapid bulbing such sets are smaller than those produced at lower temperatures out of doors[9].

The effects of high or low temperature during the whole or part of the storage period have proved somewhat complex. The effects upon flowering may be considered first. High temperature (30° C.) throughout the storage period (twenty-two weeks) not only inhibits inflorescence initiation during storage but also exerts a remarkable after-effect in preventing such initiation during the following season's growth[17]. Bolting may thus be almost completely controlled[9]. High temperature for the first eight weeks of the storage period also exerts an after-effect in delaying and greatly reducing inflorescence initiation and flowering; high temperature for the last eight weeks of storage, although it does delay initiation and flowering to some extent, is much less effective[9,17]. It was deduced from indirect evidence[14] that these effects of high temperature were not in the main brought about by the drying of the sets, and this has been confirmed by subsequent experimentation with controlled humidities. Cold storage (0° C.) for the first eight weeks exerts an after-effect in somewhat reducing inflorescence initiation and bolting; when given for the whole twenty-two weeks or the last eight weeks only, initiation is prevented

during treatment, but whereas in the former case subsequent initiation and flowering are reduced, in the latter they appear to be actually increased on return of the sets to normal temperatures[9,17]. This last suggests that the onion plant is adapted to climatic conditions in which a cold spell in January–February is frequent. Greater survival in the field of sets from the late cold-storage treatment points in the same direction. The greater effectiveness of early high- or low-temperature treatment in preventing inflorescence initiation is of theoretical interest since such initiation does not begin before March.

The formation of new leaf initials during storage is also affected by the temperature, but these effects are mainly direct; the only after-effect found was a tendency for sets from treatments preventing initiation to produce initials more rapidly on return to normal temperatures[17], thus resembling the effect of late cold storage on inflorescence initiation noted above.

High-temperature storage not only affects initiation of inflorescences and leaves, but also exerts remarkable after-effects in delaying bulbing and ripening[9,14]. Such delay of bulbing allows of the emergence of more leaves[14], the delay of ripening gives a longer growing season, and doubled or even quadrupled yields may result[9]. As in the case of flower initiation, the effects of early and late high-temperature storage (eight weeks) differ greatly, but here the difference is in the opposite sense: early heat treatment is almost without effect on bulbing and ripening, but the effect of late heat treatment is considerable; heat treatment throughout the whole twenty-two weeks period has a still greater effect. Recent experiments have shown that the increase in yield due to delay of bulbing and ripening is greater when drying of the sets in store is prevented by combining high humidity with the high temperature. The earlier deduction[14] that these effects of heat-treatment were not due to drying is thus confirmed. The disadvantage of high-temperature storage that it causes shrivelling may apparently be overcome by the use of high humidities, but the delay of ripening which causes the increased yield may itself be a disadvantage in some seasons, especially in Scotland and northern England.

The effects of the environmental factors on flowering may be summarized as follows:

First, a direct effect of high temperature on flowering may be distinguished. Inflorescence initiation *and* emergence are inhibited, partially or completely, by exposure of the plants to temperatures above about 21° C., either during the whole period of growth from seed to set, during the whole storage period (October–March) or the earlier part, or throughout the second season of growth from replanted set to mature onion. The effect from seed to set *may* be solely due to the reduction of set size consequent on earlier bulb development; the effect in the second season is independent of day-length and hence of bulbing. When high temperature is applied during the last part of the storage period, it delays but may not ultimately reduce flowering. The effects of high storage temperature are not in the main due to drying of the sets.

Very low temperature (0° C.) throughout the storage period, or for the first part only, reduces flowering; but low temperature for the last part only results in a sudden flush of inflorescence initiation on return to normal temperature and appears actually to increase flowering. Medium temperatures (10–15° C.) at any time during the life-history are apparently the most favourable to flowering, except for the accelerating effect of late cold storage.

On flowering, length of day has an indirect effect associated with bulbing as well as a direct effect. At temperatures high enough to encourage rapid bulbing in plants grown from sets, long days suppress inflorescence emergence; at temperatures low enough to prevent or delay bulb formation, long days accelerate the emergence of inflorescences by increasing the rate of scape elongation. The former effect of long days may thus be considered as indirect and due to the promotion of bulb development. Day-length is apparently without effect on flower initiation, and affects only the further development and emergence of the initials.

The more important effects on bulbing and ripening are these: The onset of bulbing is a response to the stimulus of long days and there is an interaction with temperature such that at lower temperatures longer days are needed. Seedlings apparently need a longer photoperiod for bulbing than do plants grown from sets. At high temperatures bulb development is rapid and the emergence of new leaves ceases abruptly with its onset; at lower temperatures one or occasionally several more leaves may emerge. With a return to short days and (or) low temperature, bulbing may be arrested and leaf emergence recommence without the usual dormant period. Long days and high growth temperatures not only stimulate rapid bulbing onset and development but also expedite ripening. Bulbing onset and ripening are delayed in plants grown from sets stored at high temperature, either throughout the winter (October–March) or for the last part only; heat treatment for the first part only of the storage period has little or no such effect. Such delay is increased if drying of the sets in store is prevented by high humidity.

It will be seen that a fairly comprehensive picture has been obtained of the control of development in the onion plant by the external factors of day-length and temperature. Further work is now being directed towards a more rigorous analysis of the internal rather than the external factors involved in bulb development and inflorescence initiation. The importance of such factors is indicated by the striking effect of size of set; large size is the outstanding characteristic leading to bolting, and the experimental fact that artificial reduction in size by the removal of swollen leaf bases prevents or delays bolting points the way to further progress in the analysis.

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OBITUARIES

Prof. Samuel J. Record

THE death on February 3 of Samuel Record at the age of sixty-three will be keenly felt by people all over the world who are interested in wood, for, if the name of any one individual deserves to be specially associated with the great revival of interest in wood anatomy during the past quarter of a century, it is his. He very early realized the possibilities of the then unknown woody species of the tropics and the fundamental importance of the wood sample backed by adequate herbarium material. When, therefore, he was appointed professor of forest products at Yale in 1917, he set out to build up a collection of timbers that was to become by far the most important collection in the world. What was perhaps equally important was that he deliberately aimed at making the collection available to any genuine research worker in any part of the world. A deep and sincere desire to further the general cause of wood anatomy in any way that he could was characteristic of him and partly explains his world-wide popularity. Much that he did to this end by means of encouragement and advice must disappear with him; but he leaves as more permanent memorials at least two of the instruments he used for carrying out this policy, the journal *Tropical Woods*, which he founded in 1925 and edited until he died, and the International Association of Wood Anatomists, for the creation of which he was very largely responsible and of which he was the first secretary-treasurer.

Record was an indefatigable worker, with a flair for seeing what most needed doing and an exceptional capacity for getting it done, either by his own labours or by interesting others. As examples of these talents one may cite first his books on the timbers of tropical America, the first of which, written with C. D. Mell and published in 1924, marked a tremendous stride forward in knowledge of the trees and the timbers of this vast area, and secondly the standardization of the terms used in wood anatomy, for which he was largely responsible as chairman of the committee of the International Association of Wood Anatomists that ultimately achieved this end. He was always specially interested in the taxonomic aspects of wood anatomy, and his exceptionally wide knowledge of woods enabled him from time to time to make striking suggestions, particularly with regard to the position or affinities of individual genera or the botanical identity of timbers previously known only by their vernacular names, such as the tulipwood of Brazil.

Record was educated at Wabash College, where he obtained the M.A. degree and where he was later, in 1930, given an honorary doctorate in science. In 1905 he took the degree of master of forestry at Yale University and entered the U.S. Forest Service. In 1910 he went back to Yale and joined the forestry faculty. In 1917 he became professor of forest products and in 1939 Pinchot professor of forestry and dean of the School of Forestry. L. CHALK.

IT is now nearly twenty-five years since I started a most interesting correspondence with Samuel J. Record. The correspondence continued without interruption until the end of January this year, when I received his last letter. He had mentioned his plans after his retirement from the University, which he said would be in June—how he was anticipating having time for further research and the writing of a new book, and both he and I were looking forward to his expected visit to London, when we could again discuss matters relating to forestry, nomenclature, identification of timbers, and other subjects of mutual interest. We had much friendly controversy on these subjects, but generally our conclusions coincided. His energy and great knowledge, and the fact that he had at hand the very exhaustive collection of specimens of wood (more than thirty thousand) at Yale University, the accumulation of which was largely due to his personal efforts, was a great advantage, and from him I gained much useful information.

It was not only in his professional capacity that he excelled: he had wide interests, an active and tireless brain, a keen and subtle sense of humour; and I shall always remember with pleasure the long personal talks which cemented our friendship on the two occasions when he visited Britain.

His work "Timbers of Tropical America", the quarterly journal *Tropical Woods* of which he was editor, and many others were invaluable, but his outstanding work, "Timbers of the New World", provides much needed authoritative information about the woods and forests of Brazil and southern America, and is of surpassing value to the student of forestry and botany.

His sudden death at such a comparatively early age is a great loss, not only to his friends, but also to the world in general. ALEXANDER L. HOWARD.

Colonel M. J. Godfery

WE regret to record the death at Torquay on April 9 of Colonel Masters John Godfery.

Colonel Godfery was a leading authority on European and especially British orchids. He carried out much research work in some of the more critical genera, including *Epipactis* and *Ophrys*. He contributed many papers to botanical journals, and in 1933 published his sumptuous "Monograph of Native British Orchidaceae", illustrated in colour by his wife. It will long remain the standard work on the group in Great Britain.

Colonel Godfery's most striking research related to the pollination of species of the genus *Ophrys*, much of which was carried out by watching cut flowers in vases on hotel verandahs in the Mediterranean region. He was able to confirm the observation, first made by M. Pouyanne of Algiers, that certain species are pollinated by the males of insects which mistake the lip of the orchid for the female and, in performing the motions of fertilization on the lip, effect the pollination of the orchid. The male insects pay attention to the orchid lips only during a short period before the females emerge from their pupæ; thereafter the orchid lips are left alone. This astonishing relationship between insect and flower has since been discovered also in an unrelated Australian orchid.

WE regret to announce the following deaths:

Dr. Stanley Wells Kemp, F.R.S., secretary of the Marine Biological Association of the United Kingdom and director of its Plymouth Laboratory, on May 16, aged sixty-two.

Prof. P. Pelseneer, honorary permanent secretary of the Royal Academy of Sciences of Belgium.

NEWS and VIEWS

Hydrographer of the Navy: Retirement of Vice-Admiral Sir John Edgell, K.B.E., C.B., F.R.S.

On April 30, Vice-Admiral Sir John Edgell retired from the post of Hydrographer of the Navy which he had held since 1932. Sir John has seen fifty-one years of service in the Navy, and had been in the Surveying Service for forty-three years. He held the post of hydrographer for longer than any other officer since Admiral Wharton (1884–1904) and had in fact done so for more than twice as long as any of his predecessors in the post save one. The work of the Surveying Service under Sir John in the major operations has been commented on again and again during the War, most notably perhaps by the late Admiral Ramsay in a report on the invaluable help given in the preparation for and the consummation of *D* day. But here it is more appropriate to refer to his interests in marine science generally. Sir John was elected F.R.S. in 1943, and was the first Hydrographer of the Navy to receive that high distinction since Sir Mostyn Field (1904–9). He has served as a member of the Port of London Authority since July 1941, and has now (it is understood) become acting conservator of the River Mersey. Shortly after he was appointed Hydrographer of the Navy, he became chairman of the Sub-Committee for Physical Oceanography of the National Committee for Geodesy and Geophysics, a position he still holds. It is well known that the "Discovery" Committee has, since its early days, had exceptionally valuable assistance from the Hydrographer of the Navy in the planning and running of its fine expeditions to high southern latitudes, and since Sir John succeeded Admiral Douglas on the Committee, his help has been very greatly valued.

Sir John Edgell also takes part in the Development Commission's work on fisheries research, and, by participation in the conferences of the International Council for the Exploration of the Sea, has become closely acquainted with foreign oceanographers. What has so far been said touches the past and the present, but it may easily be appreciated what great hopes British oceanographers have for the future, knowing that Sir John is applying his very best efforts to the end that Britain shall become possessed of a national institution of oceanography. He has already presided over meetings of scientific men working towards that goal, and prospects seem promising, largely thanks to his energetic interest; if Britain should once again take up a foremost position in the study of the sea, it will be greatly due to Sir John.

Rear-Admiral A. G. N. Wyatt

Rear-Admiral A. G. N. Wyatt, who succeeds Sir John Edgell, was born in 1893, being twelve years younger than his immediate predecessor. It is interesting to note that he is the first Hydrographer to enter the Navy after the withdrawal of H.M.S. *Britannia*, and, consequently, through the Royal Naval Colleges at Osborne and Dartmouth. He had the distinction of being selected as a chief cadet captain of his term, evidence that at an early age he displayed those qualities of leadership and character so noticeable in later life, and the award of the Royal Humane Society's medal for life-saving in a yachting disaster, when only in his early teens, was indicative of his courage and powers of endurance. He went to sea as a midshipman in 1910. During the War of 1914–18, he served in destroyers and in the battleship *Prince of Wales* as a watch-keeper, and, during the last year of the War, in command of a destroyer. As a young lieutenant, he was an expert boat-sailer, at which he excelled, even in a profession where a high standard of proficiency in that art is anticipated. It was not until 1918 that he decided, on joining H.M.S. *Melisande* as a fourth class assistant surveyor, to devote his life to that service of which he was destined, twenty-seven years later, to become the head.

A distinctive feature in the new Hydrographer's career is his long period of service in charge of surveys at sea: he has commanded six of H.M. surveying ships, extending over a period of fifteen years; in fact, except for a spell of eighteen months as superintendent of charts at the Admiralty and, early in the present War, an appointment for a similar term as assistant hydrographer, he has been in charge afloat since 1926, when he joined his first surveying command, H.M.S. *Ormonde*. His hydrographic services have taken him to such varied parts of the world as Labrador, the Persian Gulf, Australia and New Zealand. During the greater part of this War, Admiral Wyatt was in command of H.M.S. *Challenger* in eastern waters. On relinquishing this command to take over his new duties, he received a letter of appreciation from the Lords Commissioners of the Admiralty for his services "in the valuable work of surveys completed under your direction since your arrival in the eastern theatre of war".

Educational Plans and Purposes

In accordance with the general view that the study of education is a branch of sociology, *Nature* has duly reported to its readers the discussions that led to the Education Act of 1944, and those that have so far resulted from that event. A new step has now been taken. The Ministry is to publish a series of pamphlets, the first of which, bearing the title "The Nation's Schools: their Plan and Purpose", has just appeared (London: H.M. Stationery Office, 1945. Pp. 32. 6*d*. net). Here the Ministry comes to close grips with the facts, the object of the pamphlet being "to set out some reflections relating planning to purpose in terms, not of the legal 'child', but of living children". Each kind of school is tersely dealt with, beginning with nursery and infant schools. Here, by the way, a curious *lapsus calami* attributes to Margaret Macmillan the great saying, "Educate every child as if he were your own". It was Rachel's saying, reverently quoted by her sister Margaret. The section on junior schools touches a sore spot when it remarks that so far "the juniors have too often had to make do with the accommodation available after the seniors have been dealt with".

It is, however, when the pamphlet leaves the subject of primary and enters upon that of secondary education that the difficulties begin. The old identification of secondary and grammar-school education is traced to its historical causes, and blamed for its unfortunate consequences. The promising junior technical schools, now in wholly insufficient supply, are explained, their vitality and successful development being attributed in part to "their freedom from the ties of any external examination". In the section on modern schools we read again that "free from the pressures of any external examination, these schools can work out the best and liveliest forms of

secondary education suited to their pupils". In fact, the Ministry seems to entertain definite views as to external examinations. Cautious commendation is given to 'multi-lateral' experiments in organization. We note, however, that in the reconstructional plans of certain counties, the letters 'G. T. M.' frequently indicate that grammar, technical and modern education will be combined in one institution which will not be too large.

Survey of Technical Education, 1944–45

In his presidential address before the annual Whitsuntide conference of the Association of Teachers in Technical Institutions held in London, Mr. C. J. Tirrell referred to some of the major problems now emerging from attempts to implement the 1944 Education Act in the technical field. At the level of secondary education, past successful experience with junior technical schools will be of great value in the establishment of practical and realistic curricula, while the extension of the school-life under the Act to at least five years opens up a wide field of educational experiment in the technical secondary school, without prejudging the issue as to the extent to which the 'multi-lateral' idea may be applied. An extension of the system of part-time day release is essential if practical experience and theoretical study are to be properly correlated, and there is an obvious need for a central council to bring together the universities, technical colleges and industry, if higher technological education is to maintain contact with industrial practice in all its stages of development. Moreover, the great importance of craftsmanship to the many small industrial firms (some 100,000) seems to demand the establishment of new national certificates in craftsmanship which would ensure due attention being paid to the necessary technical background underlying all aspects of vocational training.

Vocational Guidance

The City of Birmingham Education Committee has issued a report of a research on "Scientific Vocational Guidance and its value to the choice of employment work of a Local Education Authority". The whole research, carefully and competently carried out, has extended over a period of no less than eighteen years, its general object being to ascertain what value there is in using psychological methods in aiding young entrants into industry, commerce and the professions, by showing clearly at the outset the likelihood of success or failure in certain branches of employment. The report suggests that on the staff of a secondary school there should be at least one teacher competent to apply psychological tests, and that he or she should work in close co-operation with a specially qualified officer. The resulting records should be used from time to time to enable decisions to be reached as to the course of a child's instruction, and towards the end of the child's school life to enable the juvenile employment officer, co-operating with the head and with the trained teacher, to give reliable vocational guidance. The report, which includes the most elaborate details, may be obtained from the City of Birmingham Education Committee for 2*s*. 6*d*.

British Council: Formation of Agricultural Department

An Agricultural Department, which will be advised by a panel presided over by Prof. J. A. Scott Watson, chief education and advisory officer of the Ministry of Agriculture, has been set up within the Science Department of the British Council, and Dr. W. T. H. Williamson has been appointed director of the new Department. Since the formation of the Science Department of the British Council in 1941, it has been found that many of the inquiries from abroad relate to agriculture. In consequence, the Department of Agriculture has been created to control, co-ordinate and extend the work already begun in this direction. Prominent agricultural scientific workers have made visits abroad under the auspices of the British Council and provided reports on the agriculture of some foreign countries. It will be one of the functions of the new Department to follow up these reports and to provide expert information on how far the agricultural needs of the countries concerned can be provided for by the nations of the British Commonwealth. It will present the achievements of British agriculture to other countries and keep them supplied with up-to-date information on all advances in practice and science. Experiments have already been made in the distribution of original articles for reproduction in the technical press overseas.

Dr. Williamson has been adviser in agricultural chemistry to the University College of South Wales and Monmouthshire. This post was a war-time creation, but he has built up a department which is now rendering valuable service to the farming community in South Wales and Monmouthshire. Before the War he was, for eleven years, chief chemist to the Egyptian Ministry of Agriculture. He was entrusted with the reorganization of the department and expanded it to more than three times the size of the original, housed in laboratories designed by himself and with greatly extended activities in the way of research, advisory work and routine analysis. In 1937, in recognition of his services, he was created a commander of the Order of the Nile by the King of Egypt. Dr. Williamson has also served on the staff of the Edinburgh and East of Scotland College of Agriculture and the University of Aberdeen.

Proposed North Polar Flights

Several flights over the north geographical pole have been made since Rear-Admiral R. E. Byrd, U.S.N., made the flight in 1926 using Spitsbergen as a base. Most important was the Soviet expedition of 1937–38, but more flights are required, not probably for geographical discovery but for magnetic and meteorological research. Flights over Arctic Canada have been made on several occasions. It is now announced that a series of flights over both the geographical and magnetic poles are being made by an expedition from the Empire Air Navigation School of R.A.F. Flying Training Command. The aircraft used is the Lancaster *Aries* which was flown round the world last autumn by Wing-Commander D. C. McKinley. Four new Rolls-Royce Merlin XXIV engines have been installed. The base of the expedition is in Iceland, at least for the flights over the geographical pole. A Canadian base will later be used for flights over the north magnetic pole in Boothia Peninsula. The objects of the flights are stated to be. to examine the behaviour of compasses and automatic dead-reckoning gear, and to collect data on engine handling as well as magnetism and meteorology. The plane carries food for four weeks, sledging gear and arctic kit. The crew, all told,

numbers eight and includes a medical officer, Wing-Commander R. H. Winfield.

Future of Base Metals

LIEUT.-COLONEL EDGAR PAM, president of the Institution of Mining and Metallurgy, delivered his presidential address at the annual general meeting of the Institution held on May 17. He pointed out that a not inconsiderable part of mankind as a whole depend for their living, or for their comfort and convenience, on base metals such as copper, zinc, lead and nickel; any important trend affecting their availability is therefore of great general interest. One effect of the War has been the concentration of a limited labour force on production at the expense of development work; the ore reserve of most important mines has been seriously depleted and, in spite of efforts intensified during the War, no ore bodies of real importance have been discovered for many years. Progress has been made in mining and metallurgical methods, but no epoch-making improvement stands to our credit since the development of flotation. With the relaxation of the demand for war uses, the supply in the near future should be ample; but within a few years a shortage seems indicated.

In order to help in the Colonies and even perhaps in Great Britain the opening up of new mines and industries, the Government should intensify activity along the following lines: (1) extend geological surveys, including the boring of promising regions; (2) support universities and technical schools by the equipment of laboratories, the provision of scholarships and, above all, by the assurance of such conditions of employment for staffs that the very highest grade engineers will be attracted to the posts; (3) improve transport facilities and help in building central power stations in selected areas; (4) improve the general education of the population, especially in the Colonies, with particular emphasis on health, safety and the dignity of labour; (5) give assistance in the development of promising new plant or processes which require finance beyond the power of industry to supply. The Institution has also a part to play. In the absence of a Chamber of Mines in London, it might consider setting up and fostering a permanent committee always available to help the Government or any other body at short notice by studying and reporting on technical, educational, health or welfare matters. Such a committee would also watch legislation and in some cases initiate discussion with the authorities in England or the Colonies.

Preventive Medicine in Mexico

DR. ANGEL DE LA GARZA BRITO, director of the Mexico School of Hygiene (*Bol. de la Oficina Sanitaria Panamericana*, **23**, 607; 1944), maintains that medical education in Mexico, while good on the whole, has failed to keep up with the rapid progress in medicine and especially its social aspects. He declares that medicine is tending to become a business rather than a profession. The only guide for the average student is the material success of men in certain fields. Public health is a neglected branch, and the time devoted to it in medical schools ranges from 43 to 100 hours, which is decidedly insufficient. An attempt should be made to correlate the clinical, medical and surgical aspects of disease with the preventive social aspect. The students, for example, should visit the homes of certain patients in company with a social worker to gain an insight into the influence of background upon disease.

Conference on Microfilm and other Documentary Reproduction

A CONFERENCE on microfilm and other means of documentary reproduction, organized by the Association of Special Libraries and Information Bureaux (ASLIB Microfilm Service, Victoria and Albert Museum, London, S.W.7), will be held at the Royal Society's Rooms, Burlington House, London, W.1, on June 1 at 10.30 a.m. and 2 p.m., and June 2 at 10.30 a.m. On June 1 there will be papers and discussions on methods of documentary reproduction and its scope and use; and on apparatus and its use in library services and training. On June 2, a 'brains trust' meeting will be held at which a scientific man, a humanist and a librarian will discuss with representatives of the legal profession, authors and publishers, the existing copyright legislation in connexion with documentary reproduction. Tickets of admission can be obtained from the ASLIB Microfilm Service: single session, 7*s*. 6*d*., whole conference, 15*s*. for members; 10*s*. and £1 for non-members.

The Night Sky in June

NEW moon occurs on June 10d. 04h. 26m. U.T. and full moon on June 25d. 15h. 08m. The following conjunctions with the moon take place: June 6d. 12h., Mars 4° N.; June 6d. 21h., Venus 3° N.; June 11d. 18h., Saturn 0·6° S.; June 16d. 21h., Jupiter 4° S. In addition to these conjunctions with the moon, Mercury is in conjunction with Saturn on June 24d. 11h., Mercury being 2·2° N. On June 11d. 18h. 38m., Saturn is occulted by the moon, reappearance taking place at 19h. 29·8m. No occultations of stars take place during the month. Mercury rises about 20 minutes before sunrise on June 1 and sets about an hour after sunset on June 30. The planet is in superior conjunction on June 16. Venus is a conspicuous object in the eastern sky in the morning hours, rising at 2h. 22m. on June 1 and 1h. 30m. on June 30. It attains its greatest westerly elongation on June 24. Jupiter sets about 1h. at the beginning of the month and at 23h. on June 30. Saturn is becoming difficult to observe and sets about an hour after the sun in the middle of June. There will be a partial eclipse of the moon on June 25, invisible at Greenwich, but visible in the antarctic regions, Australia and eastern Asia. Summer solstice is on June 21d. 19h.

Announcements

PROF. W. J. HAMILTON, professor of anatomy at St. Bartholomew's Hospital Medical School, has been appointed regius professor of anatomy in the University of Glasgow.

PROF. C. H. LANDER, professor of mechanical engineering at the Imperial College of Science and Technology, London, and formerly director of fuel research, Department of Scientific and Industrial Research, has been awarded the Melchett Medal for 1945 of the Institute of Fuel in recognition of his work on fuel during the past thirty years.

ERRATUM.—The new head of the Science Department at the South-East Essex Technical College, Dagenham, is Dr. J. F. J. Dippy, not Dr. Dipping as printed in *Nature* of May 12, p. 571.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Inheritance of Morphological Characters in the Sperms of Cattle

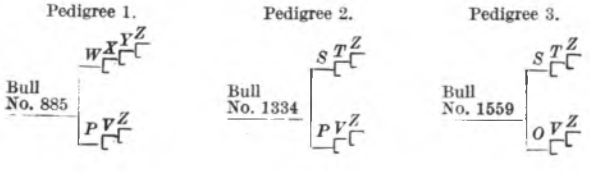
THE purpose of the present note is to record two findings which suggest the inheritance of certain morphological characters in bovine sperms as met in New Zealand.

(1) There is a fairly constant difference in the shape of the Friesian or Shorthorn sperm-head when compared with the Jersey. After a lengthy experience, I am able to distinguish between the two kinds of sperm-smears with a large measure of accuracy. In a recent test, sixteen samples were submitted by a supervising meat inspector, who stated that the samples were "Friesian and Jersey". Differentiation was correct in each of the sixteen smears. Friesian and Shorthorn sperms usually have wider heads than Jersey sperms. Recognition of differences in other breeds, such as Ayrshires, Herefords and Polled Angus, has not been sufficiently constant, so far, to warrant the statement that these breeds may be picked from Jerseys to any significant degree, although Herefords and Ayrshires have been separated from Jerseys occasionally. It is thought that Herefords might usually be thus differentiated from Jerseys by the slightly wider sperm-head.

(2) The possible inheritance of other morphological characters within the Jersey breed may also justifiably be reported because of their importance from association with poor fertility. I am convinced that the presence and abundance of sperms with the abnormal character of re-turned tails and of sperms with narrow heads are largely determined by heredity, the two types of abnormals being inherited separately. I am especially impressed by the fact that bulls, the ancestry of which led me to expect a certain sperm-picture, have shown the anticipated abnormality to a marked degree on examination. More particularly has this been the case in bulls which belong to the family known as the *Z* family and in the pedigrees of which bull *Z* figures on their sire's and dam's sides.

On occasion the sperm-picture has been foretold when the pedigree of a bull has been known; but the analysis of pedigrees so far performed does not entirely convince critical friends working in live-stock genetics. Many bulls prominent in pedigrees have long been dead and were never within range, and they stand far back in most pedigrees, though such bulls may appear several times in the same pedigree. These foundation bulls have many descendants; therefore any bull has a good chance of tracing back to one of these foundation sires, and I hear more readily of bulls of poor fertility than of good ones. Caution must therefore be exercised in claiming inheritance, but further investigation is now my main concern.

To show the origin of the suggestion of inheritance of certain types of sperms, the three pedigrees which pointed the clue are given below.



It was noticed that the sperm-pictures of these three bulls were similar and, on inquiry being made, it was found that they were closely related, the bull *Z* being a paternal and maternal ancestor, in direct male line, of the sire and dam of all three bulls. Bulls 885 and 1334 are half-brothers through their dam *P*, while bull 1334 is also half-brother to No. 1559 through their common sire *S*. The type of sperm notable in semen from these three related bulls is similar to that shown by Williams in "The Diseases of the Genital Organs of Domestic Animals" (1939 edition, p. 376, Fig. 125); this sample was collected by me, and the bull was in the same *Z* family as the three whose pedigrees are shown above. This type of abnormality is known here as 're-turned tails' because the tails are turned back past the head, but it is not suggested that this is the best possible terminology. Another family, prone to narrow heads as the particular sperm-type, is well depicted in the same work by Williams (pp. 380 and 381, figs. 128 and 129); both samples were collected by me and belong to the *D* family, the particular sperm-type of which, fortunately known to have been that of the foundation bull, *D*, himself, is narrow heads. It may be mentioned that the samples of which Williams gives photographs were collected in 1930 and 1933. Fig. 125 indicates a bad bull; Figs. 128 and 129 indicate total sterility. On the data analysed, it appears that bulls which have bull *Z* as paternal and maternal ancestor are eight times as likely to have a sperm-picture somewhat similar to Fig. 125 by Williams as are bulls not connected with *Z* for several generations back. Similarly, bulls which have bull *D* as paternal and maternal ancestor have five chances to one of showing many narrow heads when compared with the above-mentioned lot known as 'other bulls'. In the matter of fertility, of all bulls whose pedigrees are known, the *Z* family shows 29 per cent sterile and the *D* family 18 per cent sterile, as against the 'other bulls' group which shows 13 per cent sterile.

Certain important factors in this work, namely, the ages of the bulls generally, the ages of the sterile bulls, the methods of assessing fertility and the reasons for examination, as well as details concerning other related groups, are to be discussed in a later paper. It is agreed by the critical friends mentioned above that the slowness of breeding work with large domestic animals and the value of the economic stakes make it desirable to inform fellow-workers of strong suspicions when much time may be necessary for substantiation. The facts that different breeds of bulls can be recognized by their particular sperm-morphology and that the sperm-morphology of certain individuals of different families or strains in one breed can be anticipated seem to point to inheritance of those special types. During the past fifteen years it has not been possible for me to point to any other cause, which would bear criticism, for the lack of fertility shown by so many young bulls. The present contribution is the more permissible because of the rise of artificial insemination. By that means defective fertility might be spread widely. It is hoped that other workers may be stimulated to pay attention to the hereditary basis of abnormal sperm morphology or of some character of semen which can be correlated with impaired fertility.

T. A. BLAKE,
Ruakura Animal Research Station,
Hamilton, New Zealand.
Feb. 5.

Calculation of the Results of Microbiological Assays

IN view of the increasing use of microbiological methods for the assay of vitamins, amino-acids, etc., I think it important to direct attention to the fact that the method at present employed of computing from the experimental data an estimate of the potency of the material assayed not only is theoretically unsound, but also may in practice give a result which is materially in error.

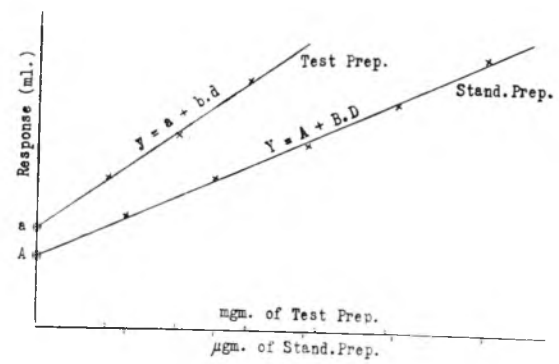
The procedure originally described by the pioneers in this field, and which has now become customary, is as follows. Tubes are put up containing several graduated doses of a dilution of the pure nutrient factor concerned (hereafter referred to as Stand. Prep.) and three or four different doses of the extract being assayed (Test Prep.), besides the 'blank', in which no addition to the basal medium is made. After the usual incubation, and estimation of the growth in all tubes in terms of a titration, turbidimetric reading, or other measurement—for the sake of generality this will be referred to as the 'response'—a curve is plotted relating the dose D of Stand. Prep. to the response Y. From this curve the amount of the nutrient factor corresponding to the response y obtained from each dose d of Test Prep. is read off. Three or four estimates of the potency of the Test Prep. are thus obtained, and provided these do not differ among themselves by more than a certain amount ($\pm$ 10 per cent is usually regarded as reasonable agreement) their average is taken as the final result.

It will be noted that the curve relating dosage of Test Prep. to response is not plotted—or if it is, it does not affect the final calculation. I therefore refer to this as the 'single-curve' method of calculation.

The relation between D and Y is, over a certain range of dosage-levels, very closely linear in many microbiological assays, so that this equation is true:

$$Y = A + B.D \quad . \quad . \quad . \quad . \quad (1)$$

B is the 'slope' of the line and A is the value of Y when $D = 0$, that is, the intercept on the Y axis made by the line when produced backwards. In some cases A practically coincides with the 'blank', which is then a point on the Stand. line; but in other assays the 'blank' is off the line.



Now if the response to the Test Prep. is due to its content of the pure nutrient factor provided by the Stand. Prep., without augmentation, diminution or modification by anything else—and this hypothesis lies at the root of all assays—the curve relating dosage d to response y must be identical with the Stand. curve except that the scale is different; and the ratio of the scales is the only sound measure of the relative potencies of the two preparations. Thus if (1) is true of the Stand. Prep., then the following form of equation must hold for the Test Prep.:

$$y = a + b.d \quad . \quad . \quad . \quad . \quad . \quad (2)$$

and four important conclusions may be drawn.

(1) If the Stand. points lie close to a line, so should the Test points also. Marked lack of linearity would render the assay suspect.

(2) The ratio of the potencies of the two preparations is given by b/B, the 'slope-ratio' of the two lines; and the potency of the Test Prep. calculated from the slope-ratio will be a valid statement of the mean potency, over the range of linearity of the Stand. Prep., irrespective of the shape of the curve outside these limits, provided that the hypothesis above referred to is true.

(3) Since the constants a, A, are independent of the kind or size of dosage given, they must in theory be equal. This means that if the Test and Stand. lines are plotted on one graph—the scales chosen for each being immaterial, so long as they have the same origin—they should intersect on the axis of response; and any difference between them, if greater than is to be expected from the chance operation of experimental error, casts doubt on the validity of the assay, that is, it suggests that the basic hypothesis is not true. Whether the difference $(A - a)$ found in any given assay is, or is not, big enough to cause suspicion can, and should, be tested statistically: but there is no space to go into this now.

(4) Mathematical investigation shows that unless $(A - a)$ is approximately zero, so that the two lines intersect on, or very close to, the axis of response, the 'single-curve' method of calculation may give results which, although they may agree with each other within 10 per cent, nevertheless differ from the 'slope-ratio' result by much more than this percentage. It is true that in such a case the whole assay is suspect and neither method may give a true result; but it is very likely (see below) that the 'slope-ratio' result is much nearer the truth than any other.

The following numerical example from one of several assays, the protocols of which were recently shown me, demonstrates that the matter is not merely of academic interest.

	Riboflavin (μgm.)					Test prep. (mgm.)		
Dose	Blank	0·05	0·10	0·15	0·20	3	4½	6
Mean response (ml.)	1·06	2·50	3·80	5·12	6·59	4·02	4·95	6·11

The Stand. points will be found to lie very close to a line which includes the 'blank'. The three Test responses, read off from the line, lead to riboflavin contents of 35·7, 31·6 and 30·7 μgm. per gm. respectively: mean 32·7 μgm. per gm. The three results are all well within 10 per cent of the mean.

The 'slope-ratio' method involves the plotting of the Test points as well. They also lie close to a line, but—unlike the Stand. line—it does not pass through the 'blank'; $(A - a)$ is, in fact, approximately 0·85 ml. The slopes of the two lines should be taken from the graph; but the following approximate computation gives in the present case an almost exact result. The increase in response from 0 to 0·20 μgm. of riboflavin is 6·59 − 1·06 = 5·53 ml., which is at

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the rate of 27·65 ml. per μgm. The increase in response from 3 to 6 mgm. of Test Prep. is similarly 6·11 − 4·02 = 2·09 ml., or 696·7 ml. per gm. The riboflavin content of the Test Prep. is given by the ratio of these two slopes, namely, 696·7/27·65 or 25·2 μgm. per gm. Thus the result obtained by the 'single-curve' method, 32·7 μgm. per gm., is nearly 30 per cent too high.

The explanation of the discrepancy is shown by further analysis of the data. The first and second additions of 2 μgm. of riboflavin produced increases in response of 3·80 − 1·06 = 2·74 and 6·59 − 3·80 = 2·79 ml. respectively, that is, nearly equal increments. But the first and second additions of 3 mgm. of Test Prep. will be seen to have given incremental responses of 2·96 and 2·09 ml., which are much too unequal for the difference to be due merely to random errors. It may be that the first 3 mgm. of Test Prep. provided the bacteria not only with riboflavin, but also with some other factor they needed which was *partially* deficient in the basal medium; while the second 3 mgm. provided riboflavin only, the deficiency in the other factor being now fully made up. This possibility is strengthened by the fact that the response to the second 3 mgm. can be subdivided by using the response to a dose of 4½ mgm., and the two 1½ mgm. increments are then seen to have produced increases in response of 0·93 and 1·16 ml. respectively—that is, the difference is now within the limits of experimental error; so that the disturbing influence, whatever it may be, ceases to have effect after the first 3 mgm. of Test Prep. have been added.

Mathematically, the assay as a whole is suspect; but if there is anything in this argument at all, the incremental responses to the second 3 mgm. of Test Prep. should be a fairly good measure of its riboflavin content, even when the incremental response to the first 3 mgm. is not. This is the reason why I state above that even in a theoretically invalid assay, the 'slope-ratio' result may be reasonably near the truth.

If other workers will go back through their records, plot their Test Prep. lines on the same graph as their Stand. Prep. lines, and recalculate their results by the 'slope-ratio' method, I believe they will find many cases where $(a - A)$ is suspiciously large; and I am sure that in such assays the 'slope-ratio' calculation will lead to a result markedly different from the old one. In any event, the use of the 'single-curve' method should be abandoned, as having no advantages and being inherently unsound; and the Test Prep. line should always be plotted, if only to give an 'eyesight' test of the validity of the assay.

ERIC C. WOOD.

Virol, Ltd.,
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Thiol – Vitamin K Mechanism in the Clotting of Fibrinogen

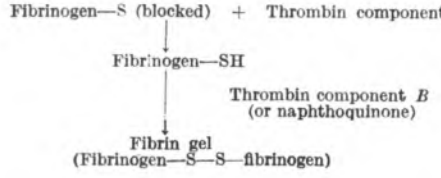
FROM an investigation into the chemical mechanisms involved in the conversion of fibrinogen into a fibrin gel, it appears that the conversion occurs in at least two stages. The first stage is marked by the liberation of thiol groups in the fibrinogen molecule. The second stage is an oxidation of these thiol groups, which unite to form disulphide linkages with adjacent molecules. It has been found possible to isolate three intermediate products which react when thrombin clots fibrinogen. Thrombin can be divided into two active components which have separate and distinct functions. Neither component will convert, *per se*, fibrinogen into fibrin; but the mixture of the two will readily clot fibrinogen.

Thrombin component *A* reacts with fibrinogen liberating thiol groups to form an intermediate, fibrinogen *B*, between fibrinogen and fibrin. This intermediate is formed during normal clotting in approximately a tenth of the time required to form a fibrin gel. The intermediate, when isolated, can be clotted by thrombin component *B*, or can be immediately converted into a fibrin gel by minute amounts of 2-methyl-1 : 4-naphthoquinone in 50 per cent alcohol solution.

Examination of the gels thus produced by either thrombin or 2-methyl-1 : 4-naphthoquinone using dark-ground illumination and a magnification of 900 diameters showed finely fibrillary gels, and no differentiation could be made between the two.

Evidence suggests that vitamin K is either a prosthetic part of thrombin component *B*, or that it converts a protein fraction into an oxidation reduction system with a potential in the vicinity of that of vitamin K. Sensitive colour reactions[1,2] suggest that a quinone structure is present in the thrombin molecule. Both reagents give a slight reaction when applied to the ether extract of thrombin which has been digested by trypsin.

The reaction between thrombin and fibrinogen can be illustrated by the following scheme:



Evidence in support of this scheme is both polarographic and chemical. (1) Polarographic analysis shows a relatively large number of thiol groups in fibrinogen B. (2) Similar analysis shows relatively few in native fibrinogen. (3) The isolation of thrombin component *A*, which will convert native fibrinogen into fibrinogen *B*, but will not clot it. (4) The isolation of thrombin component *B*, which has no reaction upon native fibrinogen, but which will convert fibrinogen *B* into a fibrin gel. (5) Addition of small amounts of thrombin to native fibrinogen temporarily increases the concentration of thiol groups. (6) Fibrinogen *B* will gel immediately upon the addition of 1 μgm. of 2-methyl-1 : 4-naphthoquinone in 50 per cent alcohol per ml. of fibrinogen solution, but not upon the addition of alcohol alone. Native fibrinogen is unaffected by an excess of 2-methyl-1 : 4-naphthoquinone. (7) When thrombin and fibrinogen have been reacting for at least a tenth of the normal clotting time, clotting is immediate if an excess of 2-methyl-1 : 4-naphthoquinone be added. (8) It is essential that the naphthoquinone be added after the thrombin, since the alcohol in which the naphthoquinone is dissolved inhibits the formation of fibrinogen B. (9) Thrombin digested with trypsin gives a colour-reaction characteristic for naphthoquinone with 2 : 4-dinitrophenylhydrazine. (10) The clotting of fibrinogen by thrombin is greatly accelerated by peroxidase (which could re-oxidize the naphthol form of naphthoquinone resulting from the oxidation of thiol groups). (11) Fibrinogen in both forms catalyses the iodine–sodium azide reaction, a function of =S

and —SH linkages, but fibrin does not (—S—S— linkage does not). (12) Fibrin is readily soluble in sodium sulphide, which disrupts —S—S— linkages. (13) Blood clotting can be inhibited by an excess of thiol compounds and by substances which react with thiol groups: (*a*) mercury compounds, (*b*) arsenic compounds of the arsenoxide type, (*c*) cyanides. (14) The immediate oxidation of thiol compounds by 2-methyl-1 : 4-naphthoquinone can be shown polarographically.

It is not suggested that the conversion of fibrinogen to fibrin occurs when one molecule of fibrinogen is united to another by a single —S—S— linkage, but that the fibrinogen molecule contains many potential —SH groups, and that these unite in a definite pattern forming long chains and ultimately give rise to the typical fibrin gels.

Details of the experiments which gave rise to these findings will be published elsewhere.

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Sydney Hospital,
Sydney.
Feb. 13.

[1] Craven, R., *J. Chem. Soc.*, 1605 (1931).
[2] Novelli, A., *Science*, 93, 358 (1941).

Methionine and the Fatty Liver of Infant Pellagrins

ON a previous occasion, we were able to demonstrate that the intensely fatty liver is an invariable concomitant of pellagra in infants. This fatty liver responds poorly to a balanced diet with, or without, supplements of vitamin concentrates, chiefly of the B complex; it recovers slowly when treated with crude liver extract but is rapidly and completely healed by ventriculin[1,2].

In order to obtain further information concerning the nature of this fatty liver, we decided to test the effects of methionine under controlled conditions. The amount of methionine available to us was just sufficient for two cases. One child was three years of age and the other fifteen months. As a control, we used another fifteen months old pellagrin. The three cases were selected, not only on the basis of the clinical criteria on admission, but also on the similarity of the liver lesion as determined microscopically.

The three cases were submitted to biopsy within an hour of admission to hospital, and when it was established that the fragment of liver was intensely fatty, with almost every cell containing a single, large globule of fat, such as is described previously in our category 1[2], or type 1, *b* variety[3], treatment was then instituted. The cases were put on the same basal diet of mealie meal (maize) porridge and half-strength milk and, in two cases, methionine was added in amounts stated below. Biopsy of the liver was performed in all cases soon after admission, a day after the last dose of methionine or, in the case of the control, at the end of one week.

Case 1 was a three-year-old infant. A total of 8 gm. of methionine was administered orally over four days. The treatment was stopped because the clinical condition deteriorated and the œdema became intensified. The liver, at this stage, was even worse than on admission to hospital. Treatment with a full diet and ventriculin resulted in the disappearance of the œdema fluid within four days, and the liver fat became absorbed, but at a much slower rate than in cases not pre-treated with methionine.

Case 2 was aged 15 months. A total of 11 gm. of methionine was administered orally over seven days. The clinical condition did not improve and the œdema became intensified. Another biopsy of the liver was performed and the fat was almost as abundant as at the outset of the treatment. At the end of the first week, when the administration of methionine was stopped, the ventriculin treatment was instituted. This child also recovered slowly.

Case 3 was the control and also 15 months old. On admission, the liver was indistinguishable, histologically, from those of Cases 1 and 2. This baby received no treatment other than half-strength milk and mealie meal porridge. Although the clinical condition did not improve, the liver, at the end of one week, did show some deterioration. After treatment for one week with ventriculin, the child made a rapid but uneventful recovery.

In all cases the livers were examined by fluorescence microscopy. Typical vitamin A fluorescence was not observed in the Kupffer cells. However, many of the big droplets of fat showed a dull greenish-white fluorescence. Popper and Chinn[4] maintain, from their experiments in rats, that vitamin A fluorescence disappears from the liver in choline deficiency; but in human infants we have found that the fluorescence of the fat droplets in the liver cells remains, even after treatment with methionine, and the Kupffer cells remain free from vitamin A fluorescent material.

From this investigation we conclude: (*a*) In conjunction with a high carbohydrate diet, methionine, in the amounts used over a short period, does not remove the fat from the livers of human pellagrins in a manner comparable with that described for ventriculin. (*b*) Fluorescence of the fat droplets in the livers of infants does not imply that they will respond to methionine. (*c*) Methionine, under present conditions stated above, neither removes the œdema fluid nor does it lead to clinical improvement. (*d*) A high carbohydrate diet in infants has not the lipotropic action in children which it has in many adult pellagrins[5]. (*e*) Either methionine, in the amounts used over 4–7 days, is incapable of acting as a lipotrope in infant pellagrins, or it requires some additional dietary substance to exert its lipotropic effect as Channon *et al.*[6] suggested from experiments in rats. (*f*) Ventriculin, in conjunction with a full diet, is still the best treatment for pellagra in infants. The limited amount of methionine available to us (20 gm.) prevented us from carrying out more exhaustive experiments.

We are indebted to Mr. Brown, of Glaxo Laboratories, Johannesburg, for the methionine.

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Feb. 28.

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Concentration Regulation and Volume Control in *Lumbricus terrestris* L.

PREVIOUS work on these topics (Adolph and Adolph[1], Adolph[2], Maluf[3], Wolf[4], Maluf[5], Wolf[6]) has assumed that the earthworm is a freshwater animal, and that volume changes are inversely proportional to changes in the concentration of the body fluids. Soil analyses (Russell[7]) show that the osmotic pressure of soil is higher than the above workers have assumed. Moreover, in the case of another annelid, *Nereis diversicolor*, Beadle[8] has shown that the body volume can remain constant while the body fluid is diluted. Both assumptions may therefore prove unsound.

Earthworms were kept in filter paper moistened with saline solutions, and the concentration of the body fluid was determined. The body fluid used for each determination consisted of a mixture of the cœlomic fluid and blood of four worms. This was analysed for chloride, and the conductivity of a warmed diluted sample was measured. Changes in weight were also followed, the worms being weighed in air after gentle rolling on filter paper. Equilibrium body fluid concentrations are given in the upper graph, and equilibrium changes in weight in the lower graph.

The upper graph shows that the animal possesses well-developed powers of concentration regulation, which are equally effective in media of widely different cation compositions. It can maintain a hypertonic body fluid in 'dilute' media, and a hypotonic body fluid in 'concentrated' media. Few animals so far investigated are able to maintain hypotonic body fluids, and in each case it has been supposed that they have evolved from fresh water (see Beadle[9]). It is possible to argue in a similar manner that *Lumbricus* has evolved from a freshwater to a semi-terrestrial habitat. The earthworm is certainly no longer a freshwater animal in so far as its osmotic relationships with the environment are concerned.

The lower graph shows that body weight (that is, body volume) depends on the nature and concentration of the medium. Comparison with the other graph shows that in many media, volumes and concentrations both increase. Volume control and concentration regulation are apparently not intimately correlated, at least under the present experimental conditions. Almost all the previous work is based upon an inverse relationship between concentrations and volumes, and therefore some revision of past conclusions may be necessary.

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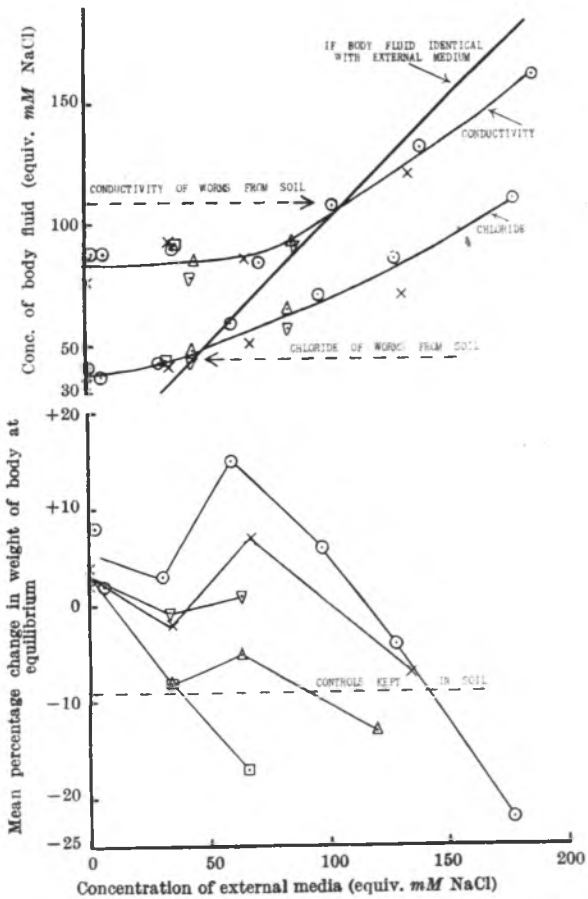

○, Sea-water dilutions; ×, sol. of sodium chloride; □, sol. of potassium chloride; △, sol. of calcium chloride; ▽, sol. of magnesium chloride.

Pigmentation of Orthoptera

THE wings and skin of the green *Mantis religiosa* L. contain not a green but a yellow and a blue pigment. The yellow pigment is of a carotenoid character, soluble in alcohol, ether, chloroform, acetone, benzene, etc. It is insoluble in water. The parts treated with the ether leave their blue pigment in the water. This pigment is precipitated from the aqueous solution by ammonium sulphate to saturation. It is very probably a chromo-protein (*ortho*pterocyane). It is immediately decomposed by a few drops of cold concentrated acetic acid.

The blue colouring matter (*ortho*pterocyanobiline) passes into chloroform, ethyl acetate or amylic alcohol. These solutions give the Gmelin reaction of biliary pigments (violet rings, then green) with strong nitric acid. The aqueous solutions show a strong biuret reaction.

The phytophagous Orthoptera, such as *Acrida turrita* L. and *Phaneroptera quadripunctata*, have the yellow and blue components, while in the hind wings of *Oedipoda caerulescens* and *Oed. schochii* there is only water-soluble pigment.

The green hæmolymph also contains the blue and yellow components. A green drop, absorbed by filter paper, turns blue in an organic solvent. A blue drop is in turn dissolved in water.

The bright red hind wings of *Oedipoda miniata* Pall., as well as an orange-yellow carotenoid, contain also a red pigment soluble in water. It is probably a chromo-protein (*ortho*pteroerythrine). It is decomposed by acetic acid, like the blue pigment. The red colouring matter (*ortho*pteroerythrobiline) gives the Gmelin reaction, while the aqueous solution shows a strong biuret reaction.

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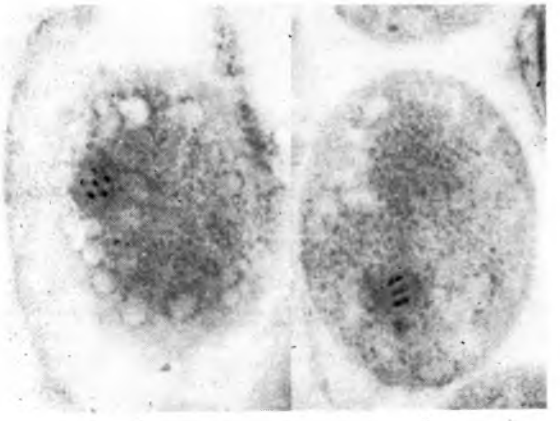
Easy Demonstration of Nuclear Division in an Animal Cell

THE chance appearance of a perfectly stained nematode egg in a smear of intestinal Protozoa prepared by a student (Marjorie Ind) led to the making of preparations *ad hoc*. The details of nuclear division in these were clear, and as cytology is strange ground to me I consulted Dr. C. D. Darlington.

The worm first treated was *Nematospiroides dubius* Bay. (Strongyloidea), kindly identified by Dr. H. A. Baylis. It is a very common parasite of the upper part of the small intestine of the woodmouse, *Apodemus sylvaticus*, pink in colour, coiled into a characteristic tight spiral column, the female worm being about 10 mm. in length. The eggs segment to eight cells *in utero*. A mouse may yield more than a hundred worms, and in the colony in my garden all seem to be infected. They are caught by a box trap with oatmeal on the floor and a raisin on the trigger.

Owing to the large size of the eggs of the worm the treatment is rather slow. Put one to four female worms on a coverslip with just enough saline to hold them; cut across repeatedly with needles to release eggs and pieces of oviduct containing eggs and sperm; smear with a stroke of the needle; float film downwards on to freshly mixed alcoholic Bouin's fluid; reverse after a minute and fix for three hours. The smear is allowed thirty minutes at each alcohol change and staining is by Delafield's hæmatoxylin, port wine colour, overnight. Differentiate with 1 per cent acid alcohol for three hours; blue the film in slightly ammoniated alcohol of the same grade; clear with clove oil for thirty minutes and allow a few minutes in xylol before mounting.

The common strongyloid worm, *Oswaldocruzia* sp., of the frog intestine answers equally well, and no doubt many other small nematode worms will do so. This opens up a field of investigation, as Dr. Darlington says that, in spite of the classical example of *Ascaris*, very little is known about the chromosomes of nematodes. The clearest picture is given of meiosis in the maturing eggs, a series of several often lying in a piece of oviduct and showing successive steps. There are six bivalents all showing terminal chiasmata, and at late metaphase these appear like a circle of large diplococci which can be counted with the 1/6 objective (see photomicrograph). Mitosis also can be followed in the segmenting egg, but is less clear in detail than meiosis as the chromosomes appear as a ring, or double ring, of minute granules on a quite clear spindle. Chromosome behaviour is much the same in both the species of worms examined. Dr. Darlington considers that a study of meiosis will prove more important than the mitosis which does not show the features (that is, diminution) of the *Ascaris* type.



1 2

MATURING EGGS OF *Nematospiroides dubius* (NEMATODA) SHOWING THE NUCLEUS IN MEIOSIS: POLAR AND SIDE VIEWS. × 500. PHOTO. BY J. MANBY.

Methods of preparing smears for chromosomes are, of course, well known, but the application to nematode worms appears to be new, or not generally known. It is for its possibilities for class work that this casual discovery makes its appeal to me. The zoologist need no longer go to plants for the demonstration of nuclear division. The worms from wild mice, voles, frogs or toads are available at any time of the year. No skilled dissection is required and the technique is simple. The student who has helped me with the preparations was successful in her first attempts with little conning. It is hoped that some worker who has access to living hookworms, *Ancylostoma* and *Necator*, will make tests with these and report on the results. The eggs are very similar to those of the worms here dealt with and should be even more readily manipulated.

LL. LLOYD.

The University,
Leeds, 2. March 17.

Species of *Lucilia* Attacking Sheep in South Africa

Two species of *Lucilia* are stated to be associated in the sheep blowfly complex in South Africa. Of these, *Lucilia cuprina* Wied. is regarded as the main primary fly which produces strike in living sheep. *L. sericata* Mg., on the other hand, is not considered as important in this respect, although known to be the chief cause of strikes in Europe.

The systematic separation of the two species rests mainly upon a difference in the colour of the femur of the fore-leg in the adult fly. In *L. cuprina* this is bright green; in *L. sericata* it is black. In *L. cuprina* the abdomen is green with a bronze sheen; in a typical *L. sericata* fly it is a distinct blue-green.

In any batch of field material containing both species, there is nearly always a gradation in the colour of both femur and abdomen so that, with certain individuals, a correct classification is difficult. The colour of a fly can also vary with the composition of the larval food supply. In addition, colour is often misleading, and in some cases is largely dependent upon the opinion of the observer. It is therefore not a scientific criterion.

The two species of flies are biologically identical. Both are attracted to, and breed upon, carrion, and both occur in wounds on the living sheep. Moreover, they interbreed readily in captivity and there is little doubt that they also do so in Nature.

In breeding experiments carried out at this Laboratory, crosses were made in both directions which gave rise to fertile progeny. In the F_1 generation, the green femur of *L. cuprina* and the blue-green abdomen of *L. sericata* proved to be dominant, all the progeny having these two characters. In the F_2 generation, segregation occurred, giving individuals of three types, namely, (*a*) with green femur and bronze-green abdomen (typical *L. cuprina*); (*b*) with green femur and blue-green abdomen (hybrids); (*c*) with black femur and blue-green abdomen (typical *L. sericata*).

In a typical batch of F_2 progeny from such a

cross we obtained: 57 individuals of (*a*); 201 individuals of (*b*); and 62 individuals of (*c*). This gives an approximate ratio of 1 : 4 : 1. This ratio was reasonably constant with all batches examined. Colour, therefore, behaves as a Mendelian character with tetraploid characteristics.

In practice, this result means that colour cannot be used legitimately as a means of separating the two species and, if this is the only character available, they should be looked upon as, at the most, two forms of the same species.

Field material always contains individuals which conform in appearance to the hybrids of the F_2 generation mentioned above. Thus, if all flies exhibiting a green femur are to be put down as *L. cuprina*, we are including under this form a proportion of the population which, strictly speaking, cannot be singled out as either *L. cuprina* or *L. sericata* but which is, in reality, the hybrid form. Because of this, it is more than probable that records dealing with *L. cuprina* bred from living sheep include these hybrids. This would explain the very high proportion of *L. cuprina* said to occur on sheep as contrasted with the low numbers of *L. sericata*. In reality, it is more likely that the typical forms occur in approximately equal numbers.

If this is accepted, the conclusion that *L. cuprina* is the main primary fly is incorrect. Although Australian workers regard the crossing of the species in the field as an unlikely contingency, they advance no convincing reason for this opinion. As the hybrid form appears in field collections, we are more justified in concluding that it does take place on an appreciable scale.

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Origin of a Toxicity to Mycorrhiza in Wareham Heath Soil

CONSIDERABLE interest has been aroused by the researches of Rayner[1] and Neilson Jones[2] on a growth failure of conifers at Wareham Heath, Dorset. These workers have demonstrated that this growth failure is associated with the development, in the soil, of a definite toxicity to the mycorrhizal fungi normally associated with these trees, and have presented convincing evidence that the toxicity is of biological origin. Neilson Jones has suggested that it may be due to production of hydrogen sulphide by aerobic sulphate-reducing bacteria. We have now been able to show that the toxicity may be due, at least in part, to the production of fungistatic organic substances by certain *Penicillium* spp. characteristic of the Wareham soil microflora.

Our observations on the mould flora of a sample of Wareham soil, as determined by plating on Jensen's agar, confirm those of Neilson Jones; such organisms as *Mucor* spp., *Trichoderma viride*, *Penicillium chrysogenum* and *Fusarium* spp., abundant in meadow or arable soils, are virtually absent. The mould flora is almost restricted to certain *Penicillium* spp., the most abundant of these being several strains of *P. janczewskii* Zal., a number of slightly differing isolates which are tentatively attributed to *P. jenseni* Zal. and a number of strains distinct from *P. janczewskii* Zal. but clearly falling into the group described by Thom as the *P. nigricans-janczewskii* series.

Cultures of these moulds have been grown on a range of liquid media and these have been periodically assayed for antibacterial activity by serial dilution tests with *Staphylococcus aureus* and *Salmonella typhi*, and for fungistatic activity by a spore germination test with the conidia of *Botrytis allii*. Using this technique, we have found that the isolates provisionally identified as *P. jenseni*, after seven days incubation at 25° C. on a Raulin-Thom medium, produce a culture filtrate which will inhibit germination of *B. allii* conidia at a dilution of 1 in 64, and growth of *Staphylococcus* or *Salmonella* at similar dilutions. The isolates referred to the *P. nigricans-janczewskii* series, on the same media and under similar conditions, will produce culture filtrates inhibiting germination of *B. allii* conidia at a dilution of 1 in 32, but requires higher concentrations to inhibit growth of *Staphylococcus* or *Salmonella*. We have not been able to demonstrate the production of inhibiting substances, under these conditions, by the *P. janczewskii* isolates, but we have found that on media containing organic nitrogen, culture filtrates are produced having a peculiar distorting effect on germ-tubes of *B. allii*, even at dilutions of 1 in 500.

The active antibiotic substance produced by our strains of *P. jenseni* has been isolated by extraction of the culture filtrate with chloroform, evaporation to dryness at reduced pressure and crystallization from ethyl alcohol. The substance thus obtained crystallizes from ethyl alcohol in small colourless prisms which appear throughout the liquid in clusters resembling pairs of wings. It decomposes without melting at about 205° C., and the decomposition products melt at about 225° C. The analysis of this substance (Table 1) agrees with that of gliotoxin[3,4,5].

TABLE 1.

%	Found I	Found II	Calc. for $C_{13}H_{14}N_2S_2O_4$
C	48·1	47·9	47·8
H	4·5	4·5	4·3
S	19·4	19·7	19·7
N	8·4	8·9	8·6

However, authentic gliotoxin produced by *Trichoderma viride*[5] crystallizes in separate prisms from ethyl alcohol, while large rosettes of prisms are formed on the walls of the container. Although there is a considerable difference in the appearance of the two specimens, a comparison of their properties has shown the two to be identical. The specific rotations agree within the limits of experimental error. For a solution of 0·4 gm. gliotoxin from *P. jenseni* in 100 ml. chloroform $[\alpha]_D^{17\cdot5}$ was − 248°, and for a solution of 0·65 mgm. gliotoxin from *T. viride* in 100 ml. chloroform $[\alpha]_D^{19}$ was − 243°.

The absorption spectra in the ultra-violet have been studied by Mr. F. M. Page and Dr. W. C. Price. Solutions of the two specimens give the same absorption curve.

Biological properties of gliotoxin from *P. jenseni* and from *T. viride* are identical, so it is concluded that the observed differences in size and arrangement of the crystals were in all probability due to traces of impurity in one or other of the samples.

We have found gliotoxin to be highly toxic to mycorrhizal fungi. Various concentrations of gliotoxin were included in malt-extract agar (*p*H 5·2) by addition of Seitz-filtered aqueous solutions of gliotoxin to tubed agar medium at 40° C., followed

by rapid cooling to avoid decomposition of the gliotoxin. The degree of growth of a range of mycorrhizal and pseudomycorrhizal fungi on these media, after fourteen days incubation at 25° C., is recorded in Table 2.

TABLE 2.

Gliotoxin μgm./ml.	*Boletus bovinus*	*Boletus elegans*	*Myc. radicis nigro-strigosum*	*Myc. radicis atrovirens*	*Rhizoctonia* sp.	*Phoma radicis callunæ*
0	++	++	++	++	++	++
5	−	+	+	+	+	++
10	−	+	−	−	−	++
20	−	−	−	−	−	+
40	−	−	−	−	−	−

++ normal growth; + reduced growth; − no growth.

Newman and Norman[6] have presented strong evidence that the low level of microbiological activity in sub-surface soils is due to the accumulation of antibiotic metabolic products of certain soil organisms. It appears plausible to suppose the toxicity of Wareham soil to mycorrhizal fungi, and its generally low microbiological activity, to be due to accumulation of gliotoxin and other antibiotic substances produced by the *Penicillium* spp. dominating its mould flora. It is realized that further investigation will be necessary before final proof of this hypothesis can be offered.

We are much indebted to Dr. M. C. Rayner for cultures of mycorrhizal and other fungi.

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Bracknell, Berks. March 1.

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Influence of *p*H and Salts on the Solubility of Calcium Oxalate

IT has been observed that ingestion of soluble oxalates aggravates the condition of oxaluria. Barrett[1] has shown that oxalate absorption is reduced or even inhibited when milk or a soluble calcium salt is taken simultaneously. He explains this as an immobilization of the oxalate as calcium oxalate, which is almost insoluble at the *p*H obtaining in the intestine. Whether intestinal absorption of calcium oxalate is influenced by other ions has been little investigated. Fiske and Logan[2] have noted the effect of magnesium, phosphate and sulphate on the solubility of calcium oxalate but have not presented quantitative data. We have investigated quantitatively the effects of acetate, borate and phosphate ions at various *p*H values on the solubility of calcium oxalate.

*p*H	ml. $KMnO_4$
2·72	5·40
4·03	2·80
4·44	2·60
5·27	2·90
7·26	2·90

TABLE 2. *M*/5 ACETIC ACID; *M*/5 SODIUM HYDROXIDE.

*p*H	ml. $KMnO_4$
8·40	2·35
8·85	2·70
9·75	3·70
10·56	4·20

TABLE 3. *M*/5 BORIC ACID; *M*/5 SODIUM HYDROXIDE

The general principle adopted was the addition of various amounts of *M*/5 sodium hydroxide to a fixed amount of *M*/5 acid and dilution with water to a fixed volume. For example, to 50 ml. *M*/5 phosphoric acid 5, 10, 15, etc., ml. *M*/5 sodium hydroxide were added and the total volume made up to 200 ml. in all cases. Excess powdered calcium oxalate was added and the mixture kept at 38° C. After determining the *p*H with a glass electrode potentiometer, the mixtures were filtered and the filtrates titrated with potassium permanganate. The titration values given in the accompanying tables are in ml. *N*/100 potassium permanganate per 100 ml. filtrate.

From our results it appears that the solubility of calcium oxalate is little affected by acetate ions between *p*H values 2·72–7·26, and borate ions between *p*H values 8·40–10·56. In the presence of phosphate, however, the solubility decreases between *p*H 1·56 and *p*H 6·16, then increases gradually up to *p*H 8·2 and thereafter very steeply. Moreover, the minimum solubility of calcium oxalate has a higher value in the presence of phosphate than of acetates.

In the *p*H range 6·5–8·0 reported to be found normally in the intestine, the solubility of calcium oxalate and therefore absorption of oxalate ions arising from calcium oxalate is small even in the presence of phosphates of the food. Should conditions arise leading to a greater alkalinity than *p*H 8·0, say, 8·0–8·4, in the intestine, we infer from our results that absorption of oxalates arising from calcium oxalate should be considerable in the presence of phosphates. That this increase in solubility is due to replacement of oxalate by phosphate is borne out by phosphate estimations on filtrates corresponding to *p*H 7·58 and *p*H 10·40 (Table 1). Although the initial concentration of phosphate in the two buffers was identical, the final values were in the ratio, phosphate (*p*H 7·58) : phosphate (*p*H 10·40) = 80 : 1.

TABLE 1. *M*/5 PHOSPHORIC ACID; *M*/5 SODIUM HYDROXIDE.

*p*H	1·56	1·65	1·76	2.00	2·26	2·45	2·74	3·20	5·37
ml. $KMnO_4$	30·00	27·05	24·55	17·80	15·60	13·40	10·90	8·00	3·70
*p*H	6·16	6·56	6·77	6·94	7·13	7·24	7·58	7·78	8·14
ml. $KMnO_4$	3·50	4·55	4·80	5·00	5·25	6·10	6·40	7·20	20·00
*p*H	8·42	8·80	9·06	9·42	9·70	9·90	10·20	10·40	
ml. $KMnO_4$	188	284	388	508	624	736	848	1084	

A similar displacement was observed on the surface of a specimen of urinary oxalate stone when it was placed for a day in a Sorensen buffer of *p*H 8·0.

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[1] Barrett, I. F., *Lancet*, **213**, 574 (1942).
[2] Fiske and Logan, *J. Biol. Chem.*, **93**, 211 (1931).

Particle Shape

MR. E. J. W. WHITTAKER has directed attention[1] to the frequent use of the term 'needle-shaped' in chemical literature as a loose description of certain crystal shapes, and proposes a method of calculating an 'acicularity coefficient' to make this description more precise. Such a coefficient, however, would be characteristic not of the substance, but only of a particular batch of it formed under conditions which give rise to the particular 'habit'.

The bare description, 'needle-shaped', occurs frequently when a complete crystallographic description seems desirable. Its use is sometimes a confession of failure, the crystals being so thin that the observer cannot discover the exact nature of the terminations. Sometimes one feels that the term merely expresses lack of interest in the crystallographic details.

The measurements which Mr. Whittaker suggests (three on each crystal) would involve a considerable amount of labour. If one's purpose is to describe a substance, it would seem better to expend the effort on an attempt to determine a few crystallographic constants which would be truly characteristic. If, on the other hand, one is interested in chemical reactivity or physical properties, a study of 'habit' may be valuable. In this case, however, the equidimensional particle (for example, cube or sphere) should be regarded as one end-point in the scale, as in Wadell's sphericity number. Wadell[2] expresses the sphericity by the fraction d_n/D_s, where d_n is the diameter of the sphere of the same volume as the particle and D_s is the diameter of the circumscribing sphere. A slight modification of this test may quite easily be applied to rectangular parallelepipeds, and if the sides are $a \geqslant b \geqslant c$ the degree to which the particle approaches the equidimensional habit (the cube) is clearly $\sqrt[3]{abc}/a$, the perfect cube being represented by unity. The cube possesses no relative elongation along its axes, and one mode of establishing a scale in which the cube has relative elongation of 0 is to define the elongation as $1 - \sqrt[3]{abc}/a$. Some may find it easier to comprehend these assessments if the values are all multiplied by 100, so that one can speak of a cube as being 100 per cent equidimensional, and an infinitely long needle as being 100 per cent 'acicular'.

A more detailed classification of shapes by Zingg[3] takes ratio into consideration in a somewhat similar manner to that used by Mr. Whittaker; but Zingg's method leads to the recognition of tendencies towards four habits: spherical (for he approaches it from the sedimentary petrographer's point of view), disk-shaped, rod-like and bladed.

It should be borne in mind that with microscopic particles, the measurement of two dimensions may be all that is practicable, and shape assessments based on this limited data may be better than no data at all[4,5].

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[1] *Nature*, **155**, 331 (1945).
[2] Wadell, H., *Pan-Amer. Geol.*, **61**, 187 (1934).
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THE coefficients proposed by Mr. E. J. W. Whittaker[1] for expressing shapes of rectangular parallelepipeda are not, in my opinion, quite satisfactory. The acicularity coefficient ($ac : b^2$) does not really express true acicularity, because the term 'acicular' means 'needle-shaped' and is commonly applied to elongated crystals with a cross-section approaching a regular polygon. The term 'acicular' cannot, strictly speaking, be applied to elongated tabular crystals, which are usually referred to as 'laths', if short, and 'blades', if long. Again, the isoproportionality coefficient ($a : b$ or $b : c$) does not express any significant shape, because it is based on two dimensions only.

Various coefficients can be devised for expressing the habit of crystals; but I think that the following coefficients are better suited to express the characteristic shape of a rectangular parallelepipedon ($a \geqslant b \geqslant c$):

1. Elongation $E = \dfrac{a^2 - b^2}{bc}$.

2. Tabularity $T = \dfrac{ab^2 - ac^2}{bc^2}$.

For a cube, both these coefficients are equal to zero.

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[1] *Nature*, **155**, 331 (1945).

MR. S. I. TOMKEIEFF'S criticisms of the coefficients I have proposed for expressing particle shape are based on two points: the term 'acicularity' applied to the coefficient $ac : b^2$, and the use of $a : b$ or $b : c$ as the second shape parameter. With regard to the definition of acicularity, I would point out that my use of this term is an extension of its common meaning, so that it may be applied in a generalized sense to figures with three unequal principal dimensions. This extension is quite analogous to the extension of the terms positive and negative as applied to the indicatrix of biaxial crystals in crystal optics, these terms being derived from their use in describing the indicatrix of uniaxial crystals. Also, although my isoproportionality coefficient is not an explicit function of all three dimensions, it is not independent of any of their values owing to its definition as $a : b$, or $b : c$, whichever is the smaller, and it does, in combination with the acicularity coefficient, uniquely express any shape. Although there is a loss in mathematical rigour here, there is a great gain in simplicity.

Satisfactory coefficients for describing particle shape must satisfy the two mathematical criteria: (1) The coefficients must be homogeneous functions of a, b and c. (2) They must be independent.

They should also satisfy, so far as possible, the following four conditions: (3) The coefficients applicable to a complex shape should analyse that shape into two variables which are readily separated subjectively in the impression given by the complex shape. (4) Their numerical values should vary along a series of shapes in accordance with subjective estimates of the changes occurring from one shape to another. (5) The coefficients should be as easily calculable as possible from the values of a, b and c. (This is of considerable practical importance if a large number of particles is being measured.)

(6) The coefficients should possess whatever other properties may be required for the work in connexion with which they are to be used.

Elongation and tabularity probably satisfy condition (3) better than do the acicularity and isoproportionality coefficients. But subjective impressions are much less sensitive to slight changes of shape than are the numerical values of E and T; and the calculation of these coefficients involves a considerably greater number of operations than is required for the acicularity and isoproportionality coefficients. With regard to condition (6), the two systems are probably suited to different purposes. Thus on my system a mixture of tabular square prisms and elongated ones would always give mean coefficients corresponding to a square prism (or to a cube if the values were appropriately distributed), whereas on Mr. Tomkeieff's system it would not.

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Chemistry at the Older Universities

IN an article in *Nature* of February 10 on "Chemistry at the Older Universities of Britain during the Eighteenth Century", Dr. Archibald Clow repeats a number of assertions of a highly flattering character which have been made from time to time regarding John Mayow, by Beddoes, Yeats, Gotch, Gunther and others; statements which it is surely time to eliminate from the history of science. Dr. Clow says that Mayow's "De Sal-nitro et Spiritu nitro-aereo heralded the later discovery of oxygen", and he quotes, apparently with approval, Gunther's view that Mayow was the "greatest chemist whom Oxford ever produced". Also he says that "Mayow was not an associate of Boyle; indeed they seem to have been mutually unaware of each other's work, and Mayow's contributions remained hidden for many years".

In an article published some time ago entitled "John Mayow in Contemporary Setting"[1], I pointed out that these views—as well as many others held regarding Mayow—are very erroneous; and that Mayow's work, far from being independent of Boyle's, was merely a pale reflexion from it. Mayow, in fact, mentions Boyle fairly often, and states that some of his experiments were similar to those of Boyle. Part of his endeavour was to show that what we call nitric oxide obeyed Boyle's Law, and although here he does not mention Boyle he very probably thought the connexion to be so obvious as not to require it. That Mayow's work was not hidden at all is shown by the fact that it received extensive review in the *Phil. Trans.* at the time of its publication.

On the other hand, that Boyle was aware of Mayow seems to be clearly indicated by the fact that Oldenburg, in a letter dated July 10, 1674, writing to Boyle, says: "I hear some very learned and knowing men speak very slightly of the *quinque Tractatus* of J. M., and a particular friend of yours and mine told me yesterday, that as far as he had read him, he would shew to any impartial and considering man more errors than one in every page"[2]. All who have really studied Mayow's work are pretty certain to agree with these "learned and knowing men". It is time that our perspective regarding Mayow was finally and definitely readjusted.

T. S. PATTERSON.

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[1] *Isis*, 15, 47, 504 (1931).
[2] Boyle's "Works", 5, 395*b* (1744).

IT has been very kindly pointed out to me by Dr. K. R. Webb, of Southampton, that I have done less than justice to Cambridge chemistry by omitting to mention that it was I. Milner (1750–1820) who, although Jacksonian professor of natural philosophy and not a chemist *per se*, observed in 1788 that ammonia passed over heated manganese dioxide is converted into red fumes which dissolve in water to form nitric acid. This oxidation of ammonia now effected catalytically by atmospheric oxygen is the basis of the modern commercial method of preparing nitric acid. Both Milner and his successor, F. J. H. Wollaston (1762–1823), taught chemistry and published plans of their courses.

Other minor points are 'Robinson', p. 161, col. 2, line 38, should read 'Robison'; 'Vagani' should read 'Vigani' throughout; the intrusive comma between Cullen and went, p. 160, col. 2, line 41, should be deleted; the first of R. Watson's Essays appeared three years earlier than stated; finally, although R. T. Gunther in "Early Science in Cambridge" (p. 225) gives the date 1741, apparently Mickleburgh (or Mickleborough) held office until 1756.

On the other hand, as far as Oxford is concerned, following the long line of historians from Beddoes to Gunther I credited John Mayow with being one of the great luminaries of early Oxford chemistry. That this is not so has been discussed by Prof. T. S. Patterson, and all chemists interested in the early history of their subject should refer to his masterly analysis referred to above.

ARCHIBALD CLOW.

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Exypnopia

FROM time to time I have experienced, immediately upon awakening from sleep (ἔξυπνος), the ability to see with illumination below the threshold for scotopic vision. This power of seeing in the dark, which is transient, is quite different from scotopic (twilight) vision: the colour red can be distinguished; and the field of vision is small. I think that the portion of the retina employed is the *macula lutea*, a part which is generally regarded as being night-blind. That the illumination was really below the threshold for scotopic vision is confirmed by my wife who, on at least two of the several occasions, observed that the room (which was 'blacked-out') was pitch-dark.

The phenomenon appears to me to be an interesting survival of a faculty which must formerly have been of considerable value to man, a faculty analogous to that of pricking up the ears, which some of us—doubtless the less highly civilized—still retain.

A. F. DUFTON.

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March 31.

RESEARCH ITEMS

Some Interesting New Fishes

GEORGE SPRAGUE MYERS describes two remarkable minute blind fishes and some related forms in his recent work ("Two Extraordinary New Blind Nematognath Fishes from the Rio Negro, representing a New Sub-family of Pygidiidae, with a Re-arrangement of the Genera of the Family, and Illustration of some Previously described Genera and Species from Venezuela and Brazil". Calif. Acad. Sci. Fourth Series. **23**, No. 40; Nov. 1944). These two blind fishes, *Pygidianops eigenmanni* (new genus and species) and *Typhobelus ternetzi* (new genus and species), have no cheek spines. *Pygidianops* has no eyes, and in *Typhobelus* they are rudimentary. They resemble one another closely but differ sufficiently to warrant the separate genera. They form a series with *Glanapteryx anguilla* Myers, described previously from the same locality, rock pools below Sao Gabriel Rapids, Rio Negro Brazil, which possesses eyes and in many ways resembles the other two. It is probable that the two blind fishes live buried in the sand. The author is of the opinion that the absence of cheek spines is a primitive feature which relates them to *Nematogenys*, the most primitive pygidiid, and that they are probably derived from the Nematogenyinæ.

New Genera and Species of New Zealand *Collembola*

A PAPER by J. T. Salmon of the Dominion Museum, Wellington (*Rec. Dom. Mus.*, **1**, 123; 1942–44), describes nine new genera and forty-one new species of *Collembola*. Nine varieties are classed, provisionally, as new sub-species; but the author is of the opinion that these are more probably only colour variations of the species. The paper is the result of an investigation (mainly in the Wellington area) of what is termed "the micro-Collembolan fauna of leaf-mould and soil". Full and systematic descriptions of the genera and species, together with twelve plates (one coloured) containing clearly executed illustrations, make this a valuable reference work.

South African Onychophora

R. A. HOLLIDAY records some interesting observations on the behaviour of peripatids in captivity ("Further Notes on Natal Onychophora", *Ann. Natal Mus.*, **10**, Part 3; Dec. 28, 1944). These chiefly refer to *Peripatus mosleyi*. Apparently the young are born only towards the end of March and throughout April. The number of young produced by one female is 6–8 in a year, one, or more often two, at a time. The newly born young eats its first moult and then proceeds to fend for itself, the feeding habits being similar to the adult. The insect food is covered with a copious flow of saliva, and it seems that it is probably at least partially liquefied before being ingested. These notes are accompanied by a very beautiful series of photographs.

Schyzotrypanum Cruzi

H. Meyer and M. X. Oliveira have published a paper with the title, "Sôbre O Desenvolvimento Intracelular Do 'Schyzotrypanum Cruzi' Em Cultura De Tecido Como Meio De Verificaçao Da Autonomia Celular" (*Rev. Brasil. Biol.*, **4**, No. 1), in which it is shown that there is a strict relationship between the cycle of *Schyzotrypanum Cruzi* and the host cell. *S. Cruzi* continues to develop in the cells until it has exhausted all its nutrient media, and the physiological condition of the cell determines the number of trypanosomes that are formed. From this it may be conjectured that cells in tissue cultures are independent units, because, on the assumption that an intercellular connexion exists, it would be possible for the parasite to migrate to an adjacent cell from which it could derive nourishment. A number of experiments proved, however, that this did not occur. Adjacent cells have the parasite in different stages of development, and so far the investigations have proved that the life-cycle of *S. Cruzi* is always restricted to one cell. The subject is to be dealt with more fully later.

Preferential Segregation in Maize

A. E. LONGLEY (*Genetics*, **30**, 100; 1945) shows that in the presence of the knobbed chromosome 10 of maize the genes on other chromosomes which bear knobs sometimes show preferential segregation. Rhoades had already found that genes on knobbed-chromosome 10 segregated in a preferential manner. Longley shows that there is a preferential accumulation of non-homologous knobbed chromosomes in the functional megaspores. There results a preferential disjunction and accumulation of knobbed chromosomes to the functional megaspore. Two genetical results are to be expected and are shown to be occurring: (*a*) abnormal segregation of genes located near the knobs, (*b*) false linkage between genes on non-homologous chromosomes. There is little or no evidence of a corresponding behaviour in microsporogenesis.

Low-Temperature Requirements of Fruit Trees

DECIDUOUS fruit trees often fail to show normal spring bud-opening unless during the dormant season they have been exposed to low temperatures for periods which vary with the species and even with the variety. With grapes, C. A. Magoon and I. W. Dix (*Proc. Amer. Soc. Hort. Sci.*, **42**, 407; 1942) find that when the plants are placed in a greenhouse at 60–70° F. after exposure to 45° F., the number of days required for bud-break to occur is inversely related to the number of hours of exposure to the low temperatures. Here as with blueberries (G. M. Darrow, *ibid.*, **41**, 189; 1942) varietal differences exist and with blueberries the absence of sufficient winter chilling results in unsatisfactory spring growth and, frequently, the subsequent death of the plants. Delayed spring bud-opening, too, is exhibited by insufficiently chilled pecan trees; but C. W. V. Horn (*ibid.*, **41**, 65; 1942) reports that winter spraying with 2:4-dinitro-6-cyclohexylphenol prevents this delay in spring growth. On one variety (Halbert) that requires only very slight winter chilling, the effect of the winter spraying was only slight.

Energy Relation in Enzyme Reactions

ALTHOUGH on a thermodynamic basis a very large number of reactions may be theoretically possible in a given biological system, the presence of enzymes will result in the selective catalysis of only a limited number of these reactions. In the cell, the prominent processes of hydrolysis and condensation and of oxidation-reduction are accompanied by a variety of other reactions such as amination, deamination, alkylation and so on. Many such reactions are proceeding in the cell continuously and simultaneously. Proteins are constantly being broken down into their constituents and these degradations are balanced by syntheses. The position of this dynamic equilibrium

is determined not only by the thermodynamic potentials but also by the kinetics of the reactions catalysed by the individual enzymes. In "Energy Relationships in Enzyme Reactions" (*Ann. New York Acad. Sci.*, **45**, 357; 1944), by J. S. Fruton, E. G. Ball, M. Bergmann, H. M. Kalckar, O. Meyerhof and C. V. Smythe, some of these problems, such as the energy-yielding mechanisms favouring peptide bond formation, are discussed.

Aluminium Phosphide

FIVE different compounds of aluminium and phosphorus have been reported at different times, prepared in various ways. W. E. White and A. H. Bushey (*J. Amer. Chem. Soc.*, **66**, 1666; 1944) prepared a phosphide by a method depending on passing hydrogen containing phosphorus vapour over an intimate mixture of finely divided aluminium and red phosphorus, and then starting the reaction by heating the mixture. A short, vigorous reaction occurred, and the product was cooled in hydrogen. The product was analysed in different ways and its composition found to be variable. The authors discovered, however, that the X-ray spectra were identical for the principal constituent, and by a visual comparison of the intensities of the aluminium lines on the powder diffraction patterns and a process of correlation with mixtures of aluminium powder and quartz, and by a consideration of the hydrogen liberated by acid, the conclusion was reached that only one compound, AlP, exists. The highest purity reached was 94 per cent AlP. The compound is remarkably stable to heat, but is, of course, decomposed by moisture with evolution of phosphine.

Average Magnetomotive Force Expended on Tapered Teeth

A PAPER by O. I. Butler (*J. Inst. Elec. Eng.*, **92**, Pt. 2, No. 25, Feb. 1945) outlines the theory, method of construction and use of a family of curves allowing a rapid and accurate estimation of the average m.m.f. expended on tapered magnetic teeth of an electrical machine. The parameters used result in less complicated relationships between the variables than with any alternative accurate method; this somewhat simplifies the calculations necessary to obtain the curves for magnetic materials having different B/H characteristics. An analysis is made of the inaccuracy of the simple 'one-third' rule under varying conditions of magnetic loading and tooth profile, and it is shown that the use of this rule can lead to very considerable errors.

Relation of Geomagnetism to Solar Activity

A. J. OL (*Bull. Acad. Sci. URSS.*, Sér. Géog. Géophys., No. 6, 359; 1943) presents a new theory of geomagnetic phenomena in their relation to solar activity. This theory, originally suggested by M. N. Gnevyshev in 1938, attempts to correlate geomagnetic disturbances not with the individual solar phenomena but with the whole process of solar activity manifest in sunspots, solar flares and flocculi as developed in the active regions of the sun. Such a process is called the 'solar impulse'. The statistical study carried out by the author shows how much this theory can be developed and elaborated. It is shown, for example, that geomagnetic phenomena are associated with the phase of the solar impulse which follows its maximum phase. It is suggested that this theory provides a more precise correlation between solar activity and geomagnetism.

Atmospheres of Planetary Satellites

THE 82-in. reflector of the McDonald Observatory has recently been used in conjunction with low- and medium-dispersion spectrographs to study the atmospheres of Pluto and of the largest ten satellites in the solar system. In his preliminary report on the results (*Astrophys. J.*, **100**, 378; 1944), G. P. Kuiper reproduces a series of interesting spectrograms of the satellites and their primaries in the photographic, visual and infra-red regions of the spectrum. Only Titan, sixth and largest satellite of Saturn, is found to have an atmosphere of sufficient prominence to be detected, though Triton, Neptune's satellite, and Pluto are to be studied further. The composition of Titan's atmosphere is similar to that of Saturn, though the optical thickness is somewhat less. The methane absorption bands at 6190 A. and 7260 A. show up well; and the ammonia band at 6400 A. is suspected on microphotometer tracings, though confirmatory plates will be needed to establish its presence. The presence of molecules rich in hydrogen on a body so small as Titan is rather surprising. Stability during astronomical periods is not possible for hydrogen itself under present conditions on Titan, though methane and ammonia are retained. But a substantial increase in temperature, say, by 100° C., would result in rapid dissipation even of the present constituents. Consequently, the present atmosphere must have been acquired since Titan had the high surface temperature which current theory demands for all bodies of the solar system. Similar, though less compelling, considerations follow for Mars, Venus and the earth, in all of which the atmosphere must have escaped from the crust after the latter had cooled.

Variability of γ Cassiopeiæ

D. L. EDWARDS, Norman Lockyer Observatory, Sidmouth, in a paper "Changes in γ Cassiopeiæ During the Past Hundred Years" (*Mon. Not. Roy. Astro. Soc.*, **104**, 283; 1945) discusses all available observations of this star since 1830 with the object of detecting any variations of magnitude or spectrum before the previous outburst. The first suggestion of variability in γ Cassiopeiæ was made by W. R. Birt (*Mon. Not. Roy. Astro. Soc.*, **2**, 79), and although he referred again to his suspicions twenty-six years later, he does not appear to have followed the matter up. As a result of his collection of data, Edwards concludes that even before the recent outburst this star was subject to frequent variations in spectrum and magnitude, although these changes were small in comparison with those observed after 1933. In spite of the fact that the changes were frequently very small, they have been supported by independent evidence, often from different observers, and in several cases they are sufficiently large to leave little doubt as to their reality without any other evidence. The suspected changes occur at dates which fall in a regular periodic series, and the best fit was found, by trial and error, to be given by a double maximum, with a separation of 4·30 years, recurring at intervals of 10·67 years. Hence the maximum occurred regularly at intervals of 4·30 and 6·37 years alternately, and these figures were used, with the well-determined date of 1937·3 as starting point, to determine the computed dates of maxima. The observations fit very closely into the scheme with the exception of the 1934·6 outburst, and it is suggested that this was due to some exceptional cause.

NATURAL HISTORY OF SCRUB TYPHUS*

THE work of the last ten years on diseases of the typhus group has permitted us to understand certain sides of them much more clearly. It is now known that there is one disease of this group widely spread in eastern Asia, transmitted from rodents to man by what we should call harvest mites. It should be known as 'scrub typhus' or alternatively as 'mite-borne typhus'. No good general account of it, particularly from the entomological side, is available in print. The disease is of considerable importance in the British Empire.

The natural history of the disease is complex, and it may be best to approach it by setting down what is known about the so-called 'harvesters' of Britain and northern Europe. They are the larvæ of *Trombicula autumnalis*; the so-called 'chiggers' of North America are closely related. These larvæ, which are a fraction of a millimetre long, attach themselves to the skin of rodents, man, birds, etc., and hold on for several days. They drop into the soil, moult to become a nymph, moult again to become an adult and the female then lays eggs. Our knowledge of the life-history in the soil is fragmentary, but it seems to be established that the nymph and adult are vegetarian or that they feed on decomposing organic material. It seems that there is only one species in Britain, and it is probable that there is only one generation in the year. It is known that the rabbit and the bank vole are important hosts of the larva. On the bank vole, larvæ are common in late summer and autumn and after that diminish through the winter, to fall to a minimum in June. The species occurring in Britain seems to be localized to light soils, particularly those which are chalky, and the distribution is often extremely patchy. It seems probable that, by applying methods worked out for problems of soil entomology, much might be learned about the biology of this animal.

In attaching itself to the mammal, the larval *Trombicula* ejects a digestive juice which causes an area of hyaline degeneration: this often takes the form of a sharply defined column, vertical to the skin. Nothing is felt at the time when the larval mite is puncturing the skin; but some hours later irritation develops in some, but not all, human beings. The irritation may be quite serious, particularly to troops living in the field.

In south-east Asia there are many genera and species of Trombiculid mites, and the larvæ of a considerable number of them attack man. Rodents are certainly important hosts, and the natural history of scrub typhus is very complex because of the variety of rodents in this part of the world.

The larvæ are important because they transmit the infectious agent producing the disease we call scrub typhus. The earlier work was mostly Japanese and showed that the larva of *Trombicula akamushi* feeds normally on voles (*Microtus*) on alluvial soils. It transmits infection from vole to vole or vole to man. As the mite only feeds on a mammal once in its life-history, the infection must be hereditary, and the virus has actually been recovered from wild adult mites. A similar or identical infection, always transmitted by larvæ of *Trombicula*, is known or believed to occur in the great triangle bounded by Japan, New Guinea and northern Queensland, Ceylon and the Maldives. Within this great area the disease may occur under exceedingly different environmental conditions, for example, in equatorial forest, or in grassland, or on barren islets and atolls.

In man the disease is generally serious. There is a small ulcer at the site of attachment of the larval mite, high fever and a considerable mortality. The disease is widely distributed over the area of south-east Asia, and as men are living and fighting in jungle, it has proved much more common than generally expected. It tends to be highly localized and to produce occasional outbreaks with a very variable but serious death-rate.

* Substance of a Friday discourse at the Royal Institution delivered by Prof. P. A. Buxton, F.R.S., on April 27.

CONFERENCE ON X-RAY ANALYSIS*

THE second Annual Conference of the X-Ray Analysis Group of the Institute of Physics, and the fourth Conference on X-Rays in Industry which the Institute has arranged, was held in London at the Royal Institution during April 12–13. The Conference was an open one, and the attendance was about two hundred and fifty. The chairman, Sir Lawrence Bragg, opened by thanking the Royal Institution for the use of its premises, and welcomed scientific visitors from the Continent, who for the first time were able to be present at the Conference. Speaking of the X-Ray Analysis Group, Sir Lawrence reported briefly on its work during the past year. It now has 187 members, and in addition to its annual conference it held a meeting in Leeds last November on the performance of X-ray tubes. The committee has also produced recommendations for the design and dimensions of a standard powder camera[1], and has in hand the revision and reproduction of Beevers-Lipson strips for Fourier analysis. It was hoped that the Group might sponsor the publication of a journal for papers on the atomic structure of matter and allied subjects. The chairman, secretary-treasurer, and ten members of committee of the Group were declared elected, in the absence of further nominations. A warm vote of thanks was made to Dr. Lipson for his work for the Group since its formation; his place as honorary secretary-treasurer is to be taken by Mr. F. A. Bannister (Minerals Department, Natural History Museum, Cromwell Road, London, S.W.7).

Absolute Values of X-Ray Wave-Lengths

At the Conference in 1943, the question of correcting X-ray wave-lengths, which were known to be in error by about 0·2 per cent, was left until the conversion factor might be more accurately known and international agreement might be reached as to its value. As these conditions are now at least partially fulfilled, the meeting considered further steps to be taken. Dr. Lipson said that there are three possibilities: to recommend immediately a value of the conversion factor, to leave the determination of the conversion factor to Prof. M. Siegbahn and the Americans who have worked on it, or to continue to use the old wave-lengths and await further developments. Of these he prefers the first.

* Report prepared by Audrey M. B. Parker, A. R. Stokes and A. J. C. Wilson.

Dr. W. A. Wooster said that it would be undiplomatic to do anything further until other men of science on the Continent can be consulted; but Dr. W. H. Taylor considers that Prof. Siegbahn is the only authority who need be approached. Dr. Lipson said that the agreement between Prof. Siegbahn's value of 1·00201 and the Americans' value of 1·00203 for the conversion factor is extremely good, and pointed out that an accuracy better than 1 part in 10^5 could scarcely be expected in view of the breadths of X-ray emission spectra. It was agreed after some discussion that the chairman should ask Prof. Siegbahn and Dr. R. T. Birge and Prof. B. E. Warren to reach agreement on the best value of the conversion factor, after which the American and British X-Ray Analysis Groups should prepare new sets of tables of wave-lengths and crystal lattice parameters embodying the corrected values. For the time being it was agreed to use 'kX.' instead of the (incorrect) 'A.' as the abbreviation for 1,000 X-units.

Proposed Publication of a Journal

Sir Lawrence Bragg reported to the Conference on the discussions of a sub-committee on publication. There is at present no journal dealing satisfactorily with the interests of the Group, and papers on crystallographic subjects appear in nearly sixty different periodicals. The committee is satisfied that there are enough British papers yearly to make possible the publication of a quarterly journal. The scope of the journal would be determined by the material investigated, not the methods used; that is, it would cover structure of matter, not diffraction. The American Society for X-Ray and Electron Diffraction is discussing a similar project, and it might be possible to co-operate with them. The possibility of co-operating with Continental workers is also under consideration.

The Conference expressed its general approval of a new journal, and authorized the committee of the Group to continue with the project.

X-Ray Diffraction Technique

Two sessions for the presentation of scientific papers were held on each day. During the first morning session, a number of new and improved methods of use of X-ray diffraction were described. These were concerned more with techniques than with fundamentals, and embodied a large number of useful ideas for experimental work. Dr. A. Guinier described the use of convergent and practically monochromatic beams of X-rays obtained by reflexion from bent quartz crystals ground to a suitable curvature, and showed how very clear diffraction photographs can be obtained with short exposures. Mrs. Nora Wooster spoke about the use of the Weissenberg goniometer for determination of the orientation of diamonds and the examination of the variation of perfection of crystal surfaces. There followed papers by Dr. I. MacArthur on the measurement of long spacings in protein fibres, including special precautions needed when spacings are of the order of 500 A.; by Mr. J. B. Nelson on extrapolation methods for the elimination of errors in lattice parameter measurements; by Miss A. M. B. Parker on small-radius cameras for rapid selection of single crystals and determination of their orientation; and by Dr. W. Wrazej on the examination of tempered martensite.

Dr. A. J. C. Wilson reported on the progress of the index of powder photographs which was started under the Institute's auspices soon after the 1942 Conference in order to supplement the index produced by the American Society for Testing Materials. He said that as a result of a search through papers published during 1925–39, and of the response by the British Museum and many industrial laboratories to a general appeal, the X-ray data for 1,200 more substances had been collected and sent to America for publication by the American Society for Testing Materials. The supplement to the Index would soon be available, and annual supplements are to be issued.

Laboratory Equipment

The afternoon session on April 12 was devoted to a discussion of laboratory equipment. The outstanding feature was a demand for the preparation of standard specifications for many types of instrument such as high-temperature, long-spacing and other X-ray cameras, microphotometers, X-ray tubes, etc. Standard specifications for a powder camera have already been prepared by the X-ray Analysis Group Committee[1]. It is recognized that such standard equipment, if made, will not be final, and workers will still have to be able to improvise.

Dr. R. F. Hanstock described an industrial laboratory equipped primarily for the determination of residual stresses in fabricated aluminium alloys[2]. Special devices for mounting specimens up to 3 ft. in diameter are provided. The specimen-to-film distance is obtained by smearing vacuum-annealed silver powder on the specimen surface, and it is estimated that the stress is obtained to an accuracy of better than 1 ton/sq. in. Geiger counters have been found satisfactory for recording positions of the X-ray diffraction maxima.

Mr. H. S. Peiser began his talk by enumerating the types of problem which are dealt with in industrial crystallographic laboratories; namely, (1) identification, (2) semi-quantitative analysis, (3) molecular weight and shape, (4) crystal structure, (5) texture. Some possible modifications to Astbury's design of a rotating anode tube[3] were mentioned and some details of a home-made gas tube given. It can be shown that a hot-cathode demountable tube gives a slightly more intense beam than the gas tube, though it is less efficient, and gives more white radiation. He stressed that reasonable care should be taken to safeguard the health of X-ray workers[4].

Dr. W. A. Wooster discussed some methods other than those of X-ray diffraction which are of use in the study of crystals. Information leading to a determination of symmetry class can be obtained from (1) interfacial angles, (2) etch figures, (3) refractive indices, (4) optical anisotropy, (5) piezo- and pyroelectric phenomena. The flotation method for density measurement was mentioned, as was also the determination of molecular orientation from measurement of variation of diamagnetic susceptibility with direction. He described also two methods of measuring peak voltage, one using the minimum wave-length and the other a potential divider and cathode ray oscillograph.

Interpretation by Optical Principles

Both sessions on April 13 were devoted to a discussion of the interpretation of X-ray diffraction by means of optical principles. The four main contributions were from Sir Lawrence Bragg, Dr. H. Lipson,

Mr. G. B. Hey and Prof. J. M. Robertson. Sir Lawrence Bragg summarized his paper as "a little of the history and some elementary book-work". He outlined the development of Fourier methods from the first tentative suggestion made by his father[5] in 1915 to an actual synthesis by Havighurst[6] in 1925. The book-work was an elementary treatment of Fourier synthesis[7] and of the Patterson function, to provide a basis for the practical applications following in other papers. He concluded by describing how Fourier summations can be done optically, thus obviating tedious calculations[8].

Dr. Lipson then described some successful applications of Fourier methods. The fundamental difficulty is to obtain the signs (or the relative phases) of the structure amplitudes. This difficulty can be overcome if the structure contains a heavy atom (copper sulphate pentahydrate[9], phthalocyanine[10]), or forms one of an isomorphous series (the alums[11]), or if the distance between the constituent molecules can be altered suitably (horse methæmoglobin[12]).

In the afternoon, Mr. Hey presented a paper by Dr. L. J. Comrie and himself on methods of calculation. The most important requirements are efficiency and ease of checking. The methods developed by crystallographers are in general efficient, but little attention has been paid to checking. Repeating the calculation is a slow and uncertain check. Two safer methods are differencing and cross-summation, and Mr. Hey gave details of their application. He concluded by suggesting modifications making the methods more suitable for use by professional computers not expert in crystallography, and describing a least-squares method of refining approximate structures[13].

Prof. Robertson then spoke on the significance of the results obtained by Fourier syntheses. It is theoretically possible for two structures to give identical diffraction patterns[14], and therefore structures should be tested by all other available methods before being finally accepted as true. A check on the correctness of structures is the comparison of interatomic distances found by X-ray analysis with those found by other methods. Such comparisons of carbon-carbon distances indicate that an accuracy of about 0·02 A. is attainable in fixing atomic positions. He concluded by describing the structure of coronene, and mentioning some theoretical implications of the variations found in the carbon-carbon bond-length.

A lively discussion followed each of these papers. It is hoped to publish a fuller account of the papers and the discussion in the *Journal of Scientific Instruments*.

Future of X-Ray Analysis

An extremely interesting and inspiring talk on the future of X-ray analysis in the form of an evening lecture was given on April 12 by Prof. J. D. Bernal. He spoke first of the advances which may be expected to take place in fundamental studies when the wartime interruption comes to an end. All basic structure types are now well established, and lines of research will branch out in one direction towards more complicated structures, largely of biological interest, and in another towards the elucidation of imperfect crystal structures.

Tools essential to these studies, such as extremely efficient X-ray tubes, and calculating devices of great intricacy, will almost certainly be developed as a result of advances in other fields in physics.

A far greater part will be played by the ever-increasing use of X-rays as an auxiliary tool in scientific research in other fields. Such use of X-rays has gone ahead during the War, as can be seen from the great success of the Institute of Physics meetings, and the Cambridge Summer School. In order that this research tool should be of the greatest possible use, it must be combined with other techniques such as spectroscopy and microscopy including the electron microscope. A considerable number of research and training schools will be required if there is to be available a sufficient number of trained X-ray crystallographers. In order that this branch of science as a whole shall continue to advance, the connexion between the theoretical and applied fields must always remain as close as, or closer than, it is to-day.

Prof. Bernal dealt also with the problem of centralization of publication, and with international co-operation.

Exhibition

In addition to the discussion, an exhibition of X-ray photographs, apparatus and new books of interest to crystallographers was arranged. Several makes of powder cameras and single-crystal rotation and oscillation cameras were on show. There was an ionization spectrometer and a two-crystal moving-film goniometer for the determination of absolute intensities. A back-reflexion camera was exhibited in which the film can be rotated on a ball-race instead of using the collimator itself as a bearing. A new design of goniometer head gives a very wide range of angular adjustment, and can be easily transferred from one suitably fitted camera to another.

A machine for calculating structure factors for one atom was demonstrated, and it was suggested that with a series of these machines it would be possible to calculate structure factors for up to fifteen atoms per unit cell. A very elegant bent-quartz monochromator was shown, with which a relatively very intense convergent crystal-reflected beam is obtained. There was also a demonstration of quartz crystals, and the manner in which they are cut for use in piezo-electric oscillators. Of particular interest to those who wish to make structure models was a special jig for drilling wooden balls, and a new form of clip for holding them securely together. The new books included "The Structure of Metals" by C. S. Barrett (McGraw-Hill), "X-Ray Crystallography" by M. J. Buerger (Wiley), and an "Introduction to X-Ray Metallography" by A. Taylor (Chapman and Hall, in the press). There were also photo-lithoprint reproductions of some books published in Germany, including "Röntgenstrahl-Interferenzen" by M. von Laue and "Internationale Tabellen zur Bestimmung von Kristallstrukturen".

[1] *J. Sci. Instruments*, **22**, 57 (1945).
[2] Frommer, L., and Lloyd, E. H., *J. Inst. Met.*, **70**, 91 (1944).
[3] *J. Sci. Instruments*, **22**, 68 (1945).
[4] Recommendations of the X-Ray and Radium Protection Committee, 32 Welbeck Street, London, W.1.
[5] Bragg, W. H., *Phil. Trans. Roy. Soc.*, **215**, 253 (1915).
[6] Havighurst, R. J., *Proc. Nat. Acad. Sci.*, **11**, 502 (1925).
[7] Bragg, W. L., "The Crystalline State", 221–229 (London: Bell and Co., 1933).
[8] Bragg, W. L., *Nature*, **143**, 678 (1939); **149**, 470 (1942). Bragg, W. L., and Lipson, H., *J. Sci. Instruments*, **20**, 110 (1943).
[9] Beevers, C. A., and Lipson, H., *Proc. Roy. Soc.*, A, **146**, 570 (1934).
[10] Robertson, J. M., *J. Chem. Soc.*, 1195 (1936) (II).
[11] Cork, J. M., *Phil. Mag.*, **4**, 688 (1927). Lipson, H., and Beevers, C. A., *Proc. Roy. Soc.*, A, **148**, 664 (1935).
[12] Boyes-Watson, M. J., and Perutz, M. F., *Nature*, **151**, 714 (1943).
[13] Hughes, E. W., *J. Amer. Chem. Soc.*, **63**, 1737 (1941).
[14] Patterson, A. L., *Phys. Rev.*, **65**, 195 (1944).

SPIN IN THE UNIVERSE

SIR EDMUND WHITTAKER discussed "The Spin of the Universe" in his presidential address to the Royal Society of Edinburgh at the annual statutory meeting held on October 23, 1944 (Year Book of the Royal Society of Edinburgh, 1945).

Starting with Earl Rosse's discoveries of spiral nebulæ, the first of which was *M* 51 (although examined previously by several astronomers the much greater resolving power used by Lord Rosse showed its spiral character for the first time), Whittaker proceeds to examine the cosmological significance of rotation and spin characteristics of the spiral nebulæ. He refers to the theory propounded by H. Alfvén (*Ark. Mat., Astr., och. Fys.*, **28** A, No. 6; 1942), which accounts for the angular momentum possessed by the planets of the solar system (a short outline of this theory appeared in *Nature*, **150**, 405, Oct. 3, 1942, and **152**, 721, Dec. 18, 1943). Alfvén's theory would apply to the stars as well as to the sun, and would lead us to assume that a star is generally accompanied by a family of planets—a view corroborated by recent discoveries of planets associated with other stars. His theory shows how spin can be acquired by material bodies under the action of electric and magnetic fields, or, in other words, spin can be transferred from ether to matter, and hence it is natural to inquire whether anything is known about spin or angular momentum in the ether.

Since the discovery of the theory of relativity, the ether has been discarded except as the name of an invisible transmitter of actions at a distance, and the ether theories have been replaced by the new science of atomic physics. How has the change, in which the fundamental entities are elementary wave-particles or corporundals of certain kinds, affected our conception of invisible spin? Within the last two decades it has been found that each of these elementary particles possesses a certain definite quantity of spin, and this is of great importance in determining the behaviour of the particle. A short description of *quantum numbers* is followed by an account of the discovery in 1925 that a third quantum number is required to describe an electronic level, a discovery which immediately led to the question, "To what physical character of the atom does this new third quantum number correspond?" Reasons were soon forthcoming to suggest that this third number corresponded to the total spin of the whole atom, just as the second quantum number represented the angular momentum or spin of the orbital motion of the electron, and it was shown that it was not the spin of the nucleus but of the electron which took place.

A study of the Zeeman effect led to the conclusion that the angular momentum or spin of the electron is $\frac{1}{2}h$, where h is Planck's constant of action divided by 2π, and that the electron has a certain fixed magnetic moment associated with the spin. It is impossible to verify the spin and magnetic moment by direct observation, owing to the uncertainty principle, and the phenomenon of electron-spin belongs to quantum theory, for which reason it possesses peculiarities not met with in classical dynamics. It is a quantum-mechanical entity, and when we speak of its component in the direction of the z-axis, say, the only meaning attached to the statement is that there is a certain probability that the axis of spin will be parallel to the z-axis and the spin-component of amount $\frac{1}{2}h$, and also the probability that the axis of spin will be antiparallel to the z-axis, the spin component being now $-\frac{1}{2}h$. It has been found that each of the other elementary particles also possesses a definite amount of spin; the proton, the neutron and the positron can each have the same spin as the electron, $\frac{1}{2}h$, while the photon or light corpuscle has the spin h, and the spin of the meson may have either of the values 0 or h.

Whittaker refers to the important part that the spin of the elementary particle plays in chemical combination and to its influence on what is called the statistical behaviour of the elementary particles, and deals briefly with the Maxwellian statistics, the Fermi statistics, and the Bose statistics, generally recognized under the composite titles, Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein, but it is impossible in a limited space to deal with every feature of the address. One important matter may be mentioned. The correlation between the particle and the wave properties of the elementary particles has been long known, so far as concerns energy, momentum and velocity, and the question arises, "What feature of the waves is to be interpreted as spin?" Sir Charles Darwin discovered the true solution in 1927, and concluded that the wave-aspect of spin was simply the capacity to exist in different states possessing the same energy and momentum, analogous to differently polarized waves of light. In 1928 Dirac found the wave equation of the electron in a form which was invariant under all the transformations associated with the principle of relativity, and spin appears to be a consequence of the symmetry of the cosmos with respect to space and time. The concept of spin thus emerged in a new light; it had originated in atomic physics, and it was now lifted into a new context, that of relativity theory.

Relativists had directed their attention for many years to the remarkable difference existing, as regards relativity, between motions of translation and of rotation. According to the principle of relativity, it is impossible by observational means to detect uniform motion of translation which occurs wholly within the system; but the case is quite different as regards rotation. We can speak of velocities of rotation in an absolute manner, without specifying the framework with respect to which the angular displacement takes place. Certain problems in the relativity theory of spin arise, to which reference is made, and some of these are still controversial. As Whittaker points out, the study of rotation is essentially a cosmic problem, and in attempting to solve it we are brought back to the spiral nebulæ. It seems probable that their inner regions rotate as if rigidly connected, the linear velocity increasing with the distance, while in the outer parts the linear velocity decreases with increasing distance. Prof. E. A. Milne has proposed an explanation of the rotation of the spiral nebulæ and of the possession of spin by most large objects and groups of objects in the universe. He has deduced from his kinematical relativity that the angular momentum of any cosmical system increases proportionally to the time, that is, to what he calls *kinematic time*, which is time as measured by atomic vibrations and radioactive clocks. Hence a spin which was initially small will grow continually greater, and there is therefore nothing surprising in the existence of large accumulations of angular momentum. No theory to explain spin in the universe has yet been generally accepted, but it is reasonable to hope for a solution of this fundamental problem of cosmology in the near future.

MARINE ECOLOGY AND THE FISHERIES

WITH the present two numbers of the *Hull Bulletins of Marine Ecology*, volume 1 is complete*. Of volume 2 four numbers are already published and three are in the press. Prof. A. C. Hardy, editor of these bulletins, in his explanation at the beginning of volume 1 gives an excellent simplified résumé of the whole. Ecology as he defines it "is establishing the relationship between a creature and its surroundings in terms of quantity". He sketches the gradual growth of marine ecology with admirable clarity, its scope, early history, and the beginning of the work at Hull leading to all these researches. This work, planned by himself and successfully carried out, includes his invention of the plankton indicator and, following this, the plankton recorder, both of which have proved to be of real help to the fishery industry. Here a story is told in the simplest terms which is of special interest and importance. It has always been Prof. Hardy's aim to bring science and industry together. How successful he has been is shown in the tributes paid to him by the skippers of the vessels which have his apparatus in use.

His explanation proceeds to summarize each bulletin in volume 1. Again as simply as possible the contents of each part are explained, with clear diagrammatic illustrations of apparatus and of planktonic organisms. This is an excellent method of introducing the work to non-specialists.

No. 6, concerned with the main plankton survey, deals with the monthly changes in the zooplankton other than Copepoda and young fish as shown by the plankton recorder. Here the seasonal changes are much in evidence, and the distribution of *Sagitta*, *Limacina*, *Clione*, Lamellibranch larvæ, *Cladocera*, Caprellid Amphipoda, Decapod larvæ, Echinoderm larvæ and *Oikopleura* is shown in series of monthly charts, while the seasonal fluctuations are compared in time-chart histograms.

These researches have been suspended for the present; but it is hoped that they may be developed in several directions for a long period in the future.

* *Hull Bulletins of Marine Ecology*, edited by Prof. A. C. Hardy and Dr. C. E. Lucas. Vol. 1, pp. i–xliii, October 1944, 3*s*. Title Page, Contents Table, List of Personnel, Preface and Explanation. Vol. 1, No. 6, pp. 255–275, Plates cxxvi–cxlix. July 1944, 4*s*. Continuous Plankton Records. The Zooplankton (other than Copepoda and Young Fish) in the Southern North Sea, 1932–37, by Dr. G. T. D. Henderson and N. B. Marshall.

THEOLOGY IN AN AGE OF SCIENCE

IN his inaugural lecture at the University of Oxford on November 3, 1944 (Oxford: At the Clarendon Press, 2*s*. net), Prof. Leonard Hodgson, regius professor of divinity, asked how the voice of theology is to be heard in a scientifically minded age. Must it not inevitably belong to a world of thought alien to the scientific outlook?

Science has been defined by Dr. C. H. Waddington as "the organized attempt to discover how things work as causal systems". This view assumes that all events are explicable in terms of causal systems (or that there are no events lying outside the range of scientific study). In this case, does the fact that psychologists and sociologists are recognized as men of science mean that all human behaviour can be accounted for on causal grounds? Or that they can study only such aspects of it as are thus causally explicable?

To take the former view is to beg a very large question; to take the latter is to assert that there can be no scientific study of such purposive behaviour as is explicable in terms not of causes but of reasons—a limitation which psychologists and sociologists would reject.

The fact is, remarks Prof. Hodgson, "we live in a world in which there are two orders of events—those which follow from causes, and those which are done on purpose, for reasons". Thus, if science limits itself strictly to the causal order it can only deal with one part of our experience.

If theology is a science, it would presumably deal with a subject-matter not dissimilar to those of psychology and sociology, that is, events which are done on purpose, for reasons.

Rejecting the traditional idea of revelation as "erroneous and untenable", Prof. Hodgson declares that "the divine revelation is not given in the form of propositions conveying a ready-made knowledge, but in events which are divine redemptive acts". These acts, and the evidence for them, it is the business of theology to study, and here lies its claim to be a science.

"Theology is itself one of the sciences—the empirical study of the evidence for certain mighty acts of God in the history of the world."

To be scientific, such studies would have to be wholly unprejudiced. Of course the evidence for some of these events, and these not the least important, is not easy to establish: and it is perhaps not justifiable to speak of these events, as Prof. Hodgson does, as "a certain sequence of events which, as events, are as observable as any others".

Theology then would appear to be a science in the same sense as history is one. But to divest theology of its philosophical aspects would be to divest it of most of its interest and depth.

RESOLUTION OF EXTRAGALACTIC NEBULÆ

UNLIKE the other nebulæ in the local group, the two companions of the Andromeda nebula—*M* 32 and *NGC* 205—and the central region of the Andromeda nebula itself, have hitherto defied resolution into stars by the most powerful instruments at the disposal of astronomers. It was therefore supposed that the luminosity of their brightest stars was abnormally low. This conclusion is amply confirmed by the resolution of these objects on plates taken recently on the 100-in. telescope (W. Baade, *Astrophys. J.*, 100. 137; 1944).

Some time ago, unexpected signs of incipient resolution on ordinary plates taken under good conditions gave grounds for hoping that further refinements of technique would lead to complete resolution. This has now been achieved by the use of red-sensitive plates behind a filter passing only the region 6300–6700 A., so as to avoid the strong night-sky emission. Only nights of exceptional definition were used, and only these if the temperature variations were such as to minimize changes of form of the 100-in. mirror. The plates were obtained with exposures of the order of four hours, and show that

the hitherto amorphous structure of these galaxies has disintegrated into a great number of faint red stars close to the threshold limit of the plates.

This behaviour is quite unlike that of the hitherto resolvable systems, in which the brightest stars are white and are relatively rare. Baade believes that the galaxies contain two types of stellar population differing in their Hertzsprung-Russell diagrams. Type I contains *O* and *B* supergiants and open clusters, and is exemplified by the slow-moving stars in the solar neighbourhood; type II, exhibited pure only in early-type nebulæ, contains short-period Cepheids and globular clusters. Both types co-exist in our own galaxy.

This new technique for resolving extragalactic nebulæ by employing red-sensitive plates in the best observing conditions with the 100-in. telescope has also shown that even early-type nebulæ can be resolved if their distance does not exceed 300 kilo-parsecs. Since this is the distance usually taken to mark the boundary of the 'local group' of galaxies, the criterion of resolvability becomes the test of membership of the local group. This test, applied by Baade (*Astrophys. J.*, **100**, 147; 1944) to *NGC* 147 and to *NGC* 185, shows that these inconspicuous companions of the Andromeda nebula are local galaxies best classified as elliptical nebulæ of low luminosity and small density gradient. These additions increase the number of recognized members of the local group from eleven to thirteen, and dwarf galaxies now outnumber giants by two to one.

The proportion of elliptical systems is steadily rising as a result of recent discoveries: they now number nearly a half of the known local nebulæ. The new data do not support the view that globular clusters and elliptical nebulæ lie at opposite ends of a common sequence of stellar agglomerations. The biggest globular clusters are still some ten times smaller in linear dimensions than the smallest elliptical nebulæ, and the mean densities of the two systems differ by a factor of the order of fifty.

FORTHCOMING EVENTS

Monday, May 28

BRITISH PSYCHOLOGICAL SOCIETY (INDUSTRIAL SECTION) (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 12.45 p.m.—Prof. C. A. Mace: "Industrial Training or Industrial Education?"

Tuesday, May 29

ROYAL COLLEGE OF SURGEONS (Lincoln's Inn Fields, London, W.C.2), at 4 p.m.—Prof. Arnold Sorsby: "Penicillin and Gramicidin S. in Ophthalmology".

EUGENICS SOCIETY (at Royal Society, Burlington House, London, W.1), at 5 p.m.—Mr. Cyril Bibby: "Sex Education—Aims, Possibilities and Plans".

TELEVISION SOCIETY (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Dr. W. Sommer: "The Human Eye and the Photo-Cell".

Wednesday, May 30

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. Colin G. Butler: "The Behaviour of Bees when Foraging".

SOCIETY OF CHEMICAL INDUSTRY (PLASTICS GROUP) (at the Royal Institution, Albemarle Street, London, W.1), at 3 p.m.—Mr. H. V. Potter: "Leo Hendrik Baekeland: The Story of His Life" (first Baekeland Memorial Lecture).

PHYSICAL SOCIETY (COLOUR GROUP) (at the Royal Photographic Society, 16 Prince's Gate, London, S.W.7), at 3.30 p.m.—Mr. L. C. Jesty: "Colour Television".

Thursday, May 31

INSTITUTE OF FUEL (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 10.30 a.m. and 2.30 p.m.—Conference on "Industrial Thermal Insulation" (to be opened by Dr. E. W. Smith, C.B.E.).

ROYAL AERONAUTICAL SOCIETY (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 6.30 p.m.—Mr. T. P. Wright: "Aviation's Place in Civilization" (Thirty-third Wilbur Wright Memorial Lecture).

Friday, June 1

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Prof. James Gray, F.R.S.: "Migration of Animals".

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Exhibition of Films of Engineering Interest.

GEOLOGISTS' ASSOCIATION (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Prof. A. Austin Miller: "Some Physical Features of the Dolgelly District".

APPOINTMENTS VACANT

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

LECTURER IN ORGANIC CHEMISTRY at the City of Liverpool Technical College—The Director of Education, 14 Sir Thomas Street, Liverpool 1 (June 1).

LECTURER IN PHYSICS at Loughborough College, Leicestershire—The Registrar (June 7).

TUTOR, and ASSISTANT TUTOR, IN THE DEPARTMENT OF SOCIAL SCIENCE, London School of Economics and Political Science—Acting Secretary, at the Hostel, Peterhouse, Cambridge (June 8).

LECTURER IN RUBBER TECHNOLOGY at the Northern Polytechnic, Holloway Road, London, N.17—The Clerk (June 13).

DIRECTOR OF RESEARCH at the Institution of Automobile Engineers—Research Department of the Institution, Great West Road, Brentford, Middlesex, marked "Director of Research" (June 16).

ASSISTANT LECTURER IN ANATOMY, London (Royal Free Hospital) School of Medicine for Women, Hunter Street, Brunswick Square, London, W.C.1—The Warden and Secretary (June 23).

PROFESSOR OF PHYSIOLOGY at King's College of Household and Social Science—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (June 26).

METALLURGIST in Midlands for research work on cemented carbides—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, London, W.C.2 (quoting F.4005.XA) (June 30).

READER IN ENTOMOLOGY in the University of Durham, tenable at King's College, Newcastle-upon-Tyne—The Registrar of King's College (June 30).

PROFESSOR OF INDUSTRIAL HEALTH in the University of Durham, tenable at the Medical School, King's College, Newcastle-upon-Tyne—The Registrar of King's College (July 31).

FELLOWSHIP IN ECONOMICS at Balliol College, Oxford—The Master's Secretary (Aug. 31).

VICE-PRINCIPAL (woman) of Wye College (University of London) with experience in university teaching in science, horticulture, agriculture or economics—The Acting Principal, Wye College, near Ashford, Kent.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial Bureau of Animal Health. Review Series, No. 2: Modes of Spread of Streptococcus Agalactiae Infection in Dairy Herds. A Report on Co-ordinated Observations Organised by the Agricultural Research Council of the United Kingdom. Pp. iii+28. (New Haw, Weybridge: Imperial Bureau of Animal Health, 1944.) 3*s*. [284

Institution of Electrical Engineers. Report of the Council for the Year 1944–1945. Pp. 12. (London: Institution of Electrical Engineers, 1945.) [55

Carnegie United Kingdom Trust. Thirty-first Annual Report for the Year 1944. Pp. 8. (Dunfermline: Carnegie United Kingdom Trust, 1945.) [55

John Innes Horticultural Institution. Thirty-fifth Annual Report for the Year 1944. Pp. 24. Bulletin No. 1: Answers to Growers. Pp. 60+8 plates. 2*s*. 6*d*. (London: John Innes Horticultural Institution, 1945.) [55

Other Countries

Transactions of the San Diego Society of Natural History. Vol. 10, No. 10: A New Race of Kangaroo Rat from the Argus Mountains, California. By Laurence M. Huey. Pp. 131–132. Vol. 10, No. 11: The Geckos of the Genus Coleonyx with Descriptions of New Subspecies. By Laurence M. Klauber. Pp. 133–216. (San Diego, Calif.: San Diego Society of Natural History, 1945.) [214

Zoological Society of San Diego. Publication No. 21: Herpetological Correlations; 1. Correlations in Homogeneous Populations. By Laurence M. Klauber. Pp. 101. (San Diego, Calif.: Zoological Society of San Diego, 1945.) [284

Transactions of the Mining, Geological and Metallurgical Institute of India. Vol. 39, No. 4: A Contribution to the Study of Ordinary Carbon and Medium Manganese Steel Rails. By J. S. Vatchegandhy and Dr. G. P. Contractor. Pp. vi+200+14 plates. Vol. 40, No. 1: The Course of Recent and Future Developments in the Steel Trade in India. By R. A. Macgregor. Pp. 24. (Calcutta: Mining, Geological and Metallurgical Institute of India, 1944.) [284

Indian Research Fund Association. Special Report No. 12: Studies on Basal Metabolism in India. By Dr. V. N. Patwardhan. Pp. 22. (Cawnpore: Job Press, 1944.) 6 annas. [284

The vacancies advertised in these columns are available only to applicants to whom the Employment of Women (Control of Engagement) Orders, 1942-3, do not apply.

MURDOCH TRUST

For the BENEFIT of INDIGENT BACHELORS and WIDOWERS of good character, over 55 years of age, who have done "something" in the way of promoting or helping some branch of Science. Donations or Pensions may be granted to persons who comply with these conditions. For particulars apply to MESSRS. SHEPHERD & WEDDERBURN, W.S., 16 Charlotte Square, Edinburgh, 2.

COMMONWEALTH OF AUSTRALIA

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

FELLOWSHIP IN GENETICS AND ANIMAL BREEDING

Applications are invited from university graduates who have been actively engaged in the study of genetics and animal breeding for appointment to a Fellowship in Genetics and Animal Breeding. Applications, in duplicate, should reach the Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2, not later than June 25, 1945.

The appointment will be for a period of three years and the salary will be £A1,000 for the first year, £A1,100 for the second year, and £A1,200 for the third year.

The successful applicant will be expected to take up his work in Sydney, N.S.W., in association with the Council's laboratories there. The work will be carried out in the Council's Division of Animal Health and Production, and the facilities of the Division, including laboratory space, laboratory animals as well as Field Station flocks, will be available to the Fellow. Facilities will also be provided for the maintenance of any special small animals the Fellow may require in the prosecution of his studies.

It is expected that the Fellow will devote the major part of his work to the study of the sheep, but this should not preclude him from pursuing some more academic line of research. He may be expected also to initiate others into work in the field of genetics and animal breeding.

The appointee will be expected to take up his fellowship within reasonable time, say six months, of appointment. It is suggested that he should travel to Australia via the United States of America where he might spend a period of about three months in visiting appropriate institutions and in establishing or renewing contacts with workers in genetics and animal breeding in that country. Final plans with regard to this proposed visit will be made after consultation between the Fellow and the Council.

During the tenure of the Fellowship, the Fellow will be asked to advise the Council on the establishment of more permanent facilities for the prosecution of work in Australia on genetics and animal breeding.

The same conditions regarding leave, travelling expenses, and the like as are applicable to officers of the Council will apply to the Fellow.

(Signed) G. A. COOK,
Secretary.

Council for Scientific and Industrial Research,
314 Albert Street,
East Melbourne, C.2, Victoria.

UNIVERSITY OF CAMBRIDGE

DEMONSTRATORSHIP IN METALLURGY

The Appointments Committee of the Faculty of Physics and Chemistry give notice that they intend to appoint a University Demonstrator in Metallurgy, to hold office from October 1, 1945. The appointment will be subject to the Statutes and Ordinances of the University. The initial basic stipend of a University Demonstrator is £200 a year; but the Faculty Board, subject to the approval of the General Board, may resolve that an additional payment not exceeding £150 a year be made to a Demonstrator who is not a Fellow of a College, and a further additional payment of approximately £150 a year may be made for teaching in excess of the basic amount.

Candidates are requested to state their age and give the names of not more than three referees, together with any evidence of qualifications they may desire to submit. Applications should reach Dr. F. B. Kipping, Secretary of the Appointments Committee of the Faculty of Physics and Chemistry, the University Chemical Laboratory, Pembroke Street, Cambridge, on or before Monday, July 2, 1945.

WYE COLLEGE

(UNIVERSITY OF LONDON)

The Governors invite applications from men or women for the following appointments:

(1) Department of Agriculture—Head of Department, salary £1,000–£1,200. (2) Department of Horticulture—Head of Department, salary £1,000–£1,200. (3) Department of Chemistry—Head of Department, salary £800–£900. (4) Lecturer in Fruit Growing, salary £425–£625. (5) Lecturer in Chemistry (also qualified to give instruction in Elementary Physics), salary £425–£625. (6) Assistant Lecturer in Chemistry, salary £375. (7) Lecturer in Surveying and Building Construction, salary £425–£625.

Closing date for receipt of applications, June 9, 1945.

Further particulars regarding any of the above appointments may be obtained from the Acting Principal, Wye College, Wye, nr. Ashford, Kent.

WYE COLLEGE

(UNIVERSITY OF LONDON)

The Governors invite applications from women for the post of VICE PRINCIPAL (resident). Applicants should have had University teaching experience in Science, Horticulture, Agriculture or Economics. Salary £750–£950 with superannuation under the F.S.S.U. Further particulars may be obtained on application to the Acting Principal, Wye College, Wye, nr. Ashford, Kent. Closing date for receipt of applications, June 9, 1945.

WYE COLLEGE

(UNIVERSITY OF LONDON)

The Governors invite applications from men for the post of SECRETARY & REGISTRAR. Applicants must be University graduates with experience in office administration. Salary (non-resident) £600, rising by annual increments of £20 to £700 with superannuation under the F.S.S.U. Further particulars may be obtained from the Acting Principal, Wye College, Wye, near Ashford, Kent. Closing date for receipt of applications, June 9, 1945.

CITY OF BIRMINGHAM EDUCATION COMMITTEE

ASTON TECHNICAL COLLEGE

WHITEHEAD ROAD, BIRMINGHAM, 6

Principal: D. Dudgeon Stockley, B.Sc., M.I.Mech.E.

Applications are invited for either of the following temporary full-time appointments, men or women: (1) LECTURER to take ENGLISH and FRENCH and also Geography or History. (2) SCIENCE LECTURER to take Biology, Chemistry, Physics.

Applicants should hold appropriate degree or equivalent. Salary: new Burnham Technical Scale. Duties to commence September 1, 1945. Further particulars will be sent on receipt of stamped addressed envelope by the Principal, to whom applications must be returned on the form provided, not later than June 7.

P. D. INNES,
Chief Education Officer.

UNIVERSITY OF DURHAM

CHAIR OF INDUSTRIAL HEALTH

Applications are invited for the Chair of Industrial Health, tenable at the Medical School, King's College, Newcastle-upon-Tyne.

The candidate appointed, if now on National Service, will not be expected to take up the appointment until his release.

The salary will be not less than £1,500. Previous industrial experience is not essential.

Further particulars may be obtained from the undersigned by whom applications, together with the names of three persons to whom reference may be made, should be received not later than July 31, 1945, although consideration will be given to later applications from those serving overseas.

G. R. HANSON,
Registrar of King's College.

UNIVERSITY OF DURHAM

Applications are invited for the Readership in Entomology, tenable at King's College, Newcastle-upon-Tyne. The candidate appointed, if now on National Service, will not be expected to take up appointment until his release. The salary offered is £750 per annum.

Further particulars may be obtained from the undersigned, by whom applications should be received not later than June 30, 1945, although consideration will be given to later applications from those serving overseas.

G. R. HANSON,
Registrar of King's College.

THE QUEEN'S UNIVERSITY OF BELFAST

MUSGRAVE STUDENTSHIPS

Applications are invited for three Musgrave Studentships in Pathology, Physics and Biology. The appointments will date from October 1, 1945, and will be tenable for one year each, but are renewable for a further period.

Applications, which must be from Graduates from a University, must be lodged with the Secretary of the University, before June 1, 1945, on forms which may be obtained from the undersigned.

RICHARD H. HUNTER,
Secretary.

IMPERIAL BUREAU OF ANIMAL NUTRITION

ROWETT RESEARCH INSTITUTE, BUCKSBURN, ABERDEEN

Applications are invited for the post of Assistant. Applicants should be University Graduates and those with degrees in science, especially biological science, and a knowledge of foreign languages, will be preferred. The duties will be abstracting, précis writing, indexing. Salary scale: £300–£15–£390 with War bonus. Superannuation F.S.S.U. after probationary period, unless already a member. Initial placing according to qualifications and experience. Applications to be sent by June 9 to the Deputy Director of the Bureau at the above address.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF MATHEMATICS AND MECHANICS

With effect from October 1, 1945, several junior appointments in this Department will be made in the grades of Assistant Lecturer (Scale £350 : £375 : £400) and Demonstrator (£250 : £275 : £300), with F.S.S.U. membership; tenure limited to three or four years.

Applications to The Secretary, Imperial College, London, S.W.7.

KING'S COLLEGE NEWCASTLE-UPON-TYNE

IN THE UNIVERSITY OF DURHAM

Applications are invited for the post of Lecturer in Applied Mathematics. Duties to commence October 1, 1945. Initial salary will be between £450 and £550 according to qualifications and experience. Further particulars may be obtained from the undersigned to whom four copies of application, together with the names of not more than three referees, should be sent not later than Saturday, June 9, 1945.

G. R. HANSON,
Registrar of King's College.

LOUGHBOROUGH COLLEGE

Principal: Dr. Herbert Schofield, M.B.E.

DEPARTMENT OF PURE AND APPLIED SCIENCE

Applications are invited for the position of Lecturer in Physics up to Degree standard. Honours Graduate with research and industrial experience preferred. Salary will be in accordance with the Burnham (1945) Scale for Technical Colleges, with a special responsibility allowance for a suitably qualified and experienced candidate. Further details and form of application, which should be returned by June 7, may be obtained from the Registrar, Loughborough College, Loughborough, Leics.

AUCKLAND UNIVERSITY COLLEGE

(UNIVERSITY OF NEW ZEALAND)

Applications are invited for the CHAIR OF BOTANY. Salary £1,075 per annum. Allowance for travelling expenses. Appointment (for five years in first instance) to commence March 1946.

Further particulars from the Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1.

UNIVERSITY OF SYDNEY

CHAIR OF AGRICULTURE

The Universities Bureau of the British Empire, c/o University College, Gower Street, W.C.1, has been asked to advertise the vacant Chair of Agriculture in the University of Sydney. Salary £1,250 plus superannuation. Applications (6 copies stating age, experience, publications, medical certificate and recent photograph) to reach the Registrar, University of Sydney, by August 18, 1945.