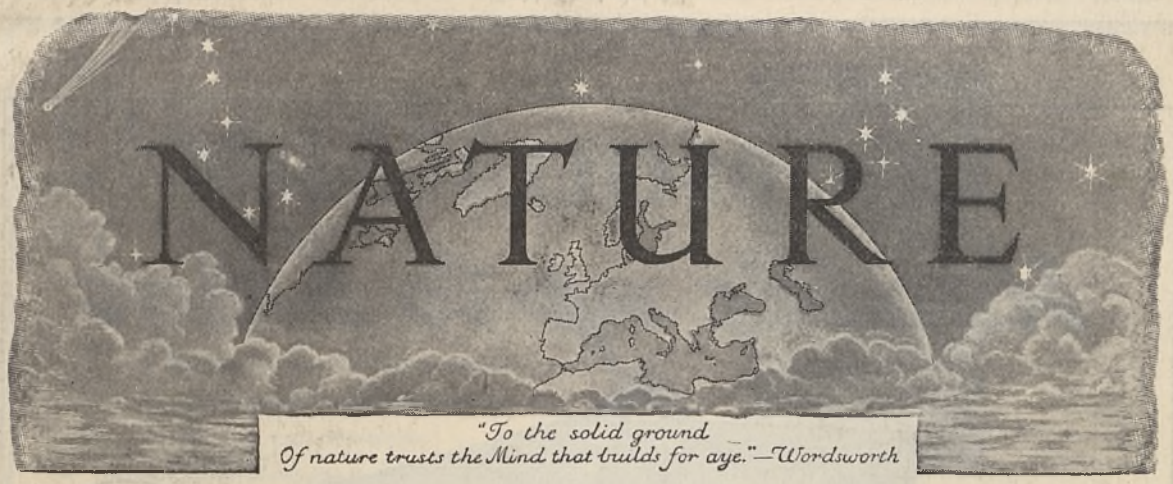
SUPPLEMENT: RECENT SCIENTIFIC and TECHNICAL BOOKS



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LIBRARIES AND RESEARCH NEEDS

THE University and Research Section of the Library Association has now formulated proposals regarding the post-war development of the university and research libraries of Great Britain. These proposals overlap in some respects the recommendations of the Council of the Association made in consequence of Mr. L. R. McColvin's report on "The Public Library System of Great Britain", but also deal with a group of libraries, some of which come within the scope of the former proposals and almost all of which are of special interest to the man of science. Reviewing the place of the university and research libraries in a national system, and considering in succession the national and the local organisation of book resources for research, the new report* will be carefully studied by all who recognize the importance of scientific and technical books as tools for industrial research, apart altogether from the wider field which they present for research in the arts, the humanities and the social sciences. Its recommendations, which have already been adopted by the Council of the Association, are in substantial agreement with the recommendations of the earlier report where they overlap, and they represent developments which the Council considers are needed to enable the university and research libraries of Great Britain to carry out their work efficiently and to make their full contribution to the national life.

The libraries with which this report is concerned differ widely in age, in size and in scope, and have in common only their function of supplying materials for the advancement of knowledge. Some of them, like the university and university college libraries, are the property of the bodies they exist to serve, and the interests of those bodies have naturally a first claim on their services. Almost without exception, the university libraries, however, have recognized that a part of the service which a university owes to the community is to make available, within the measure of its means, and to those qualified to make use of them, such of its library resources as are not available elsewhere. Other libraries which are also the property of corporate bodies, such as the learned, scientific and professional societies, industrial research associations, Government departments, firms and newspapers, owe their services to the bodies which establish and maintain them, and need feel less obligation than the university libraries to the outside public. For much specialized literature they are the obvious and often the only source of supply. But while a firm's library clearly could not make its resources generally available, all these libraries have rendered much more assistance to outsiders than any statistics can show, and many libraries in both these groups have, as 'outliers' of the National Central Library, placed their resources fully at the disposal of those who need them.

* Library Association. University and Research Libraries of Great Britain : their Post-War Development. Pp. 16. (Library Association, Chaucer House, Malet Street, London, W.C.1, 1946.)

While these libraries have already shown that they are willing to undertake obligations as part of the organised book resources of Great Britain, it must be remembered that they are rightly proud of their independence, which for practical reasons also they would be most unwilling to surrender. Moreover, many even of the university libraries are neither staffed nor equipped to handle easily the mechanical side of any considerable expansion in the inter-library lending through the National Central Library. The abnormal conditions of the last few years, with the interruption to runs of European scientific and technical periodicals and the scarcity of copies reaching Great Britain, have put a premium on lending books and periodicals, which has severely strained such resources as these and like libraries possess for dealing with merely the packing and postage involved.

If these libraries are to undertake obligations as part of the organised book-resources of Great Britain, due regard must be had to such circumstances. Like considerations to a certain extent may apply to a further group of Government libraries, such as the British Museum or the Science Library, the primary obligations of which are not to a particular department but to the public in general. Finally, there is the group of great municipal reference libraries, including commercial and technical libraries, which in contents, staffing, organisation and function have for long been a very important part of the country's resources for research. Apart from definite schemes for co-operation which they have initiated, as at Sheffield, such libraries have always welcomed readers outside the boundaries of their authorities, and more recently they have made their resources available for inter-library lending as freely and profitably as the university and special libraries.

Outside all these groups stands the National Central Library, the organisational work of which has made possible the utilization of their resources, and the collections of which, though limited by financial stringency and damaged during the War, are not unimportant. The development of the National Central Library in the last thirty years out of the Central Library for Students does not appear to be well known to scientific workers, although its Information Department, which is concerned with applications for books not available in its Library Department, and traces them and arranges for their loan, can be a research tool of the first importance. Apart from the fact that the National Central Library's collections are intended to supplement existing provision, on the ground of the services of the Information Department alone there is ample reason for implementing the recommendation of the McColvin Report that the National Central Library should be recognized as an integral part of the national system, and guaranteed a reasonable permanent means of existence and the wherewithal to plan for the future and for whatever developments the well-being of the country demands.

The address on the National Central Library which Mr. R. H. Hill gave to the London and Home Counties Branch of the Library Association at Brighton on October 6, 1945 (*Library Association Record*, December 1945), should be of interest to scientific workers who wish to form an opinion as to the place of the National Central Library in the nation's system of libraries for research, and it will be noted that in the present report the Library Association urges more adequate financial support for it. In making this recommendation, the report has in mind not merely the work of the National Central Library in administering the whole system of inter-library lending, which it is assumed will be continued and extended as the indispensable basis of the proposed developments, but also that the importance of its own resources for research will increase.

The principal recommendation of the Library Association's report, however, is a survey of library resources in Britain for research. This, it is urged, is the first step to secure the fuller co-ordination required in the interests of economy and of efficiency, but which is at present hampered by uncertainty as to how far the different fields of knowledge are covered by different libraries. To supply this information, to show library administrators where the country's collection of books is redundant and where it is deficient, and to show the reader where he will find the collections most useful for his purpose, are the prime objectives of the survey. Much of the material for such a survey is probably already in possession of the National Central Library and of the Association of Special Libraries and Information Bureaux, and the report suggests that a co-operative scheme should aim at providing for every subject or group of subjects at least two collections as complete as possible, one from which books are never lent, and one of books available for loan.

Similar surveys locally in each region of Great Britain are also recommended and might lead to even closer co-operation. The report instances, for example, the organisation of a reference and a loan set of the Public Record Office publications, the Sheffield scheme for pooling technical periodicals and the local collection of local literature. A survey is also desirable of the many old endowed libraries, such as those of cathedrals, parishes, churches, colleges and schools. Some of these are admirably catalogued and well known, while others are little known and inaccessible. For such a survey a special committee would be required to offer advice where needed on questions of cataloguing and preservation. Production of a short directory of such libraries, as a first objective, might be followed by a series of uniform catalogues or a union catalogue. A union catalogue has already been undertaken for books earlier than 1700 in cathedral libraries. This aspect of the survey obviously closely touches the work of the British Records Association and the Historical Manuscripts Commission in establishing the National Register of Archives.

The report recommends that all libraries agreeing to take part in the national and local systems of library co-operation should be eligible for a share in any public funds which may become available for the provision of books. While such grants would involve guarantees that they were rightly expended,

and in particular that they were not used in relief of the normal library expenditure of the institution, they would not interfere with the independent administration of the libraries, and, as already indicated, the report stresses the necessity of retaining the present system of voluntary co-operation of independent institutions. The preliminary survey of national resources would involve a certain expenditure, but it is not anticipated that the developments proposed would involve much additional finance. The building of the collections indicated as necessary would be achieved in part by the better direction of existing expenditure which the survey itself would make possible, though it is suggested that the survey would probably point to the desirability of further expenditure on periodicals at the Science Library.

These are the main features in the report of interest to scientific workers. There is some discussion of the professional aspects of work in research libraries, such as the qualifications of staff, salaries and training; but the report is one which deserves attention by all who realize the extent to which books form the primary or ancillary material for the prosecution of research, and the consequent necessity for adequate supplies of books in the many fields of industry, commerce, education and administration.

It would not be claimed that the proposed survey of national book resources is the only direction in which co-operation between libraries, and indeed between libraries and the users of libraries, is desirable or possible. The increased contacts which may result from the survey may well be expected, for example, to stimulate two developments which are long overdue in Great Britain, and which would be of immense service to the reader and buyer of books, whether private or for a library, and in stimulating the browsing and wide reading which is such a fruitful habit for the student and research worker to acquire. The first of these is the production in Britain of something corresponding to the *Quarterly Book List* which has been issued in the United States since 1945 by the Superintendent of Documents, United States Government Printing Office. This list is produced under the guidance of an advisory committee with Mr. L. H. Evans, librarian of Congress, as chairman, and including representatives of such bodies as the National Research Council, the Army Medical Library, the American Council of Learned Societies, the Social Science Research Council, the American Library Association and the American Council on Education. The *List* originated in a recommendation of the Inter-American Conference for the Maintenance of Peace, held in Buenos Aires in 1936, and in promptitude of publication and the authority of its annotations is far ahead of the *Aslib Quarterly Book List*, which is all that is available in Great Britain to replace the British Science Guild's "Catalogue of British Scientific and Technical Books", last published in 1930. The United States *Quarterly Book List* gives the names and occupation of its contributors, but the annotations are unsigned because the Library of Congress assumes full responsibility for all material appearing in the *List*. While it is highly selective and neither comprehensive nor exhaustive, it should be invaluable to those wishing to keep abreast of current contributions of the United States in the fields of the fine arts, literature, philosophy and religion, biography, the social sciences, the biological sciences, the physical sciences, and technology. Merely from the point of view of national prestige, a production of like quality in Britain is desirable.

The second development is a matter which more closely concerns the universities themselves and on which Bruce Truscot just touched in his "Redbrick University"; and although he discusses the question of reading, books and libraries more fully in the freshman's guide, "First Year at the University", just published, he does not quite get to the heart of the matter—the priceless value of really good bookshops as a stimulus to the book buying and browsing for which he pleads. The contrast in this respect between Oxford and Cambridge and some of the towns in which 'Redbrick University' is located is almost unbelievable; and if by some means of co-operation between librarians and publishers, the standard of bookshops accessible to provincial universities could be raised to something approaching that which prevails in Oxford and Cambridge or in London and Edinburgh, for example, a real service would be done to learning. Meanwhile, it may well be hoped that publication of this report by the Library Association will not only stimulate initiation of a survey of the national library resources for research, but will also promote co-operation between libraries and librarians of all types, locally as well as nationally. Creative thinking and clear definition of objectives are essential for the successful launching of practical schemes which will ensure a more adequate supply of the books which are the essential tools of research and their most efficient handling from the broadest point of view.

A CRYSTALLOGRAPHIC APPROACH TO STEREOCHEMISTRY

Grundlagen der Stereochemie

Von Prof. Paul Niggli. (Lehrbücher und Monographien aus dem Gebiete der exakten Wissenschaften, Chemische Reihe, Band 1.) Pp. 283. (Basel: Verlag Birkhäuser, 1945.) 32.50 francs.

WITH the detailed problems of classical stereochemistry developed first in organic chemistry under van't Hoff and Le Bel, and twenty years later in inorganic chemistry under Werner, this book is not directly concerned. It is not a text-book of stereochemistry, but rather a presentation of the fundamental principles on which a comprehensive stereochemistry can be developed. The author's distinguished contributions to the geometrical theory of crystal structure and to mineralogy are well known. In recent years the highly successful developments of crystal chemistry, particularly in the direction of the silicates and other mineral structures, have added to and deepened this background. Consequently it is not surprising if the treatment is found to follow lines perhaps unfamiliar, but nevertheless very stimulating, to the chemist.

Niggli feels that the earlier attempts to solve the general problem of the spatial distribution of atoms in compounds were rendered more difficult, and failed to achieve general applicability, because of the failure to distinguish clearly between the study of the *position* which atoms take up and the *forces* which cause them to assume and retain these positions. Accordingly, some thirty years ago, he undertook the development of a stereochemistry which should embrace organic as well as inorganic radicals, and crystals as well as molecules. He considers that the stereochemical behaviour of atoms can only be satisfactorily treated after a rigidly idealized investigation of the symmetry relations has been undertaken; and only when the various possibilities have been systematically classified is it worth while investigating the causes which lead to the observed arrangements. The fact that quite similar structures have been found to result from totally different bond types shows the essential accuracy of this approach to the problem. On the other hand, valency ideas developed from the frequent occurrence of simple stoichiometric ratios, while they undoubtedly achieved success over wide areas of chemistry, actually retarded the development of those other areas—alloys, natural silicates, etc.—which could not be adequately classified by valency ideas alone.

Accordingly, more than half the present book is taken up with the development of a general theory of the symmetry of molecular and point configurations. In this the general terminology and methods of crystallography are used. Now, mathematical crystallography is a beautifully simple and complete science, because it deals with the limited number of symmetry types which are applicable to infinite but periodic structures based on a regular lattice. The importance of such a study in crystal chemistry, where the whole crystal is effectively the molecule, cannot be over-estimated. But it is more difficult to grasp its application to that self-contained group of atoms which the chemist usually associates with the word 'molecule'. Nearly all such chemical molecules, including even the complex viruses, may conform to the laws of crystallography if they have the opportunity of arranging themselves regularly in space; but this does not necessarily help us any better to understand the infinite complexity of the atomic arrangement in the molecule itself.

Only later on in the book does the author consider the combining capacities of atoms, devoting attention continually to the necessity for clear definition of the terms which are used. In his view there is no fundamental distinction between homogeneous combination as in graphite and diamond, and heterogeneous combination as in boron nitride and zinc blende. In discussing many other structures, often on the lines of Pauling, he introduces a form of representation of electron distribution which is both easy to read and is free from the appearance of a static electron which the familiar noughts-and-crosses method might suggest. This may be illustrated by his formulation of carbon dioxide as

$$\frac{4}{1}\,O\,\frac{4}{2}\,C\,\frac{4}{2}\,O\,\frac{4}{1},$$

the numerator indicating the number of electrons concerned, and the denominator the number of atoms between which they are shared. This enables one to tell at a glance (1) how many external electrons there are in the compound; for example, $4 + 4 + 4 + 4 = 16$; (2) whether or not any given atom has a completed octet; for example, $\frac{4}{2}\,C\,\frac{4}{2}$ means that carbon has eight electrons all shared; (3) whether an atom carries a net electrical charge; for example, the fact that the sum of the fractions $\frac{4}{2} + \frac{4}{2} = 4$ means that in this case carbon has four outer electrons as in the neutral atom. The resonance structure of carbon dioxide which Pauling writes as $^{+}O = C - O^{-}$ appears in Niggli's formulation as

$$\frac{2}{1}\,O\,\frac{6}{2}\,C\,\frac{2}{2}\,O\,\frac{6}{1}.$$

From this we see that the total number of electrons ($2 + 6 + 2 + 6$) is still 16; that each atom has still a completed octet, but that while the carbon atom is electrically neutral $\left(\frac{6}{2} + \frac{2}{2} = 4\right)$ the left-hand oxygen atom carries a positive charge $\left(\frac{2}{1} + \frac{6}{2} = 5\right)$ and the right-hand one a negative charge $\left(\frac{2}{2} + \frac{6}{1} = 7\right)$.

In the development of his ideas Niggli has had the advantage of lavish facilities for the construction of models. His book is profusely illustrated with photographs of these, but the reader will probably feel that they mainly serve to emphasize the indispensability of three-dimensional aids to the study of stereochemistry.

David T. Gibson
J. M. Robertson

A PSYCHOLOGIST LOOKS AT RELIGION

Personality and Religion

By Dr. William Brown. Pp. 195. (London: University of London Press, Ltd., 1946.) 9*s*. 6*d*. net.

THIS book attempts to consider the general problem of religion in the light of modern psychology. Much modern psychology, owing to a certain limitation of outlook, is in no position to give an adequate account of religion. Psychology is a natural science, and the natural sciences rightly abjure philosophy as lying outside their sphere of inquiry. But it is impossible to give a fair estimate of the validity of religion apart from philosophical inquiries. It can no doubt be examined as a section of human mental experience and activity, but as to the question of the existence of any spiritual reality with which man comes into contact in religious experience, that is a matter with which psychology is not competent to deal.

It is true that psychologists have not hesitated to pronounce upon this point. Freud's views on religion may be found in his "The Future of an Illusion". Here religious belief is dismissed as an illusion, the disguised fulfilment of a wish for security and mental comfort. In the Freudian picture the individual's environment, or the 'reality' to which he finds himself so ill adapted, is strictly limited to the outside physical and social world. The spiritual world is taken no account of and assumed not to exist.

Dr. Brown, however, is a psychologist who is also a philosopher, so that the religious problem is not, for him, so easily dismissed. Moreover, even as a

psychologist, he is doubtful of the soundness of the Freudian analysis. Its weakness is that it explains normal mental experience in terms of the abnormal, without supplying any clear criterion as to what is normal and what is not. No one would attempt to explain physiological function in terms of pathology. Furthermore, whereas pathological mental processes of projection and regression, and the influence of an Œdipus complex, are commonly diminished or eliminated by a course of psycho-analysis, this is not so in the case of religion. Dr. Brown's experience has been the exact opposite. After an analysis extending over ninety-two hours, supplemented by many hours of self-analysis later, his religious convictions were found to be stronger than before, while his religious feelings had been purified and freed from much that was merely infantile.

The Freudian theory of 'complexes' would seem to have something in common with A. F. Shand's theory of 'sentiments', which he defined as "organized systems of emotional dispositions, centred about the idea of some object". Dr. Brown would term these 'sentiments', which are normal healthy features of the mind, 'interests', and the word does give a clearer idea of what the thing is. In contrast to these sentiments or interests the complex is an abnormal, unhealthy mental system, produced in general by some painful experience in the past. It is essentially of the nature of a fixation, anchoring the mind down, whereas a sentiment is a normal, healthy growth. Through the sentiments, which grow by including within themselves a larger and larger number of objects, the mind gains greater and greater freedom and a wider scope of activity. A complex, on the other hand, ties the individual down to the incident which caused it, and the mind cannot develop. Nor is a sentiment subject to disintegration by psycho-analysis, as a complex is. Such at least is Dr. Brown's experience.

Dr. Brown suggests that the religious attitude should be considered as distinct from the logical, the æsthetic and the ethical attitudes. Religion is based on a fourth general attitude—that of the individual towards the universe "so far as he envisages it as something upon which he completely depends and to which he attaches ultimate value". So far as we value the universe, and worship it or hold it worthy, so far are we adopting a religious attitude. The man who pursues truth for its own sake and studies science in an impersonal way, with rigorous self-discipline, is really showing his belief in a religion and is taking up a religious attitude. Science may be made a religion, and in so far as it is so made, it becomes more than mere science. Philosophy too may be made a religion, but in so far as it is so made it is more than mere philosophy. Instead of regarding scientific advance as freeing us from the 'superstition' of religion, we may find that in the advance of science religion is needed more and more to restore the balance, and to keep us from reaching views which are a caricature of existence.

With regard to personality, Dr. Brown holds that it should be distinguished from individuality, which indicates a mere difference from other people. But as the individual reaches maturity he is carried towards the pursuit of values classified under the three headings, goodness, beauty and truth, which values are general, teaching us that we belong to one another, are all members of the one universe.

"We find ourselves in the universe. This is what I call personality. We see the paradoxical nature of the term. Personality is general, but it is also creative. The universality of personality is creative because it partakes of the creativeness of the totality of things."

Thus personality is to be regarded as a process rather than a product, since it is never completely produced. As it grows it produces something new, and brings with it increased insight into the nature of things and the values of the universe. Thus personality and religion are indissolubly connected.

Dr. Brown, as psychologist and philosopher, has written a book full of valuable and suggestive ideas.

J. C. Hardwick

PRINCIPLES OF HUMAN PHYSIOLOGY

Principles of Human Physiology

Originally written by Prof. E. H. Starling. Ninth edition, by Prof. C. Lovatt Evans; the Chapters on the Special Senses, by Prof. H. Hartridge. Pp. x + 1155. (London: J. and A. Churchill, Ltd., 1945.) 36*s*.

THE first edition of Starling's "Principles of Human Physiology" appeared in 1912. It set a high standard then, and that position has been fully maintained by subsequent editions. The present one is the ninth. From time to time after its first appearance many parts have been re-written, so that now little of the original remains, though in general its plan is the same. It gives within the compass of one volume an account of the present state of physiological knowledge which will be adequate for the student of science or medicine and serve as a useful book of reference to biologists in general.

Physiology is a science that, like others, is continually expanding and it is not easy to keep a book of this kind within a reasonable size. Much credit is therefore due to Prof. Lovatt Evans, its present author, for the judgment he has exercised in his pruning and grafting. A new and welcome feature of this most recent edition is the introduction of "Historical Notes". Since the importance of any new discovery can only be properly appreciated by reference to what has gone before, it is very desirable that students should, whenever possible, have the past and present put into proper perspective. The inclusion of these summaries of the history of the subject should help to bring this about. It certainly ought to excite their interest as well as make them realize that the roots of physiology go very deeply into the past.

A chapter on the "Temperature and Heat Balance" of the body replaces the former one on "Body Temperature and its Regulation". It gives among other matters a more extensive discussion of the various physiological and physical factors which control the heat balance of the body, the effect of climate and clothing on this, and the phenomena observed when heat regulation breaks down.

In every major section of the book alterations and additions have been made to bring it up to date, in so far as that is possible in a book of this kind. When it is borne in mind that this edition was produced under the adverse conditions of war-time and, as the author states, often under actual enemy attack, all those concerned are to be congratulated on the result.

H. S. Raper

CIVILIZATION AND THE PURSUIT OF KNOWLEDGE*

By Sir RICHARD GREGORY, Bt., F.R.S.

SINCE the annual meeting of the British Association at Dundee in the year 1939 was brought to an abrupt end by the imminence of war, it has been neither desirable nor possible to bring members together for another meeting of the usual kind in Great Britain or overseas. Even now, a year after the armistice, conditions are such that accommodation for all the sections of the British Association and their members at Newcastle or Birmingham, where, but for the War, we should have met in 1940 and 1941, is impracticable, on account of the devastation which these cities have suffered from enemy action. Next year, however, the series of annual meetings which was begun in 1831, when the Association was founded, will be resumed at Dundee, and the broken parts of the chain will again be linked together.

This year's assembly is, therefore, of a token character and is limited to a single day instead of the week usually occupied in the presentation of scientific papers and the delivery of addresses before the various sections. By the statutes of the Association it is laid down that an annual meeting shall be held, and that the president shall deliver an address at such a meeting during his year of office. For a number of reasons these two obligations could not be met during the period of the War, though I have been re-elected to the presidency every year since 1939, when this high honour was bestowed upon me.

The intervening years have, however, been very usefully employed in the preparation and presentation of reports by research committees appointed by the Council of the Association and by a number of public conferences on scientific subjects of wide interest. The conferences were organised, with the approval of the Council, by the Division for the Social and International Relations of Science, which was founded at the Cambridge meeting in 1938 with powers to arrange such meetings at times or places other than those of the normal annual meetings. Beginning with a conference on "Science and World Order", held in September 1941, and attended by representatives of more than twenty of the United Nations, a number of other conferences were arranged, the last being on "Scientific Research and Industrial Planning", held in December 1945.

All these conferences were concerned with aspects of modern science in relation to the outlook and service of contributors to the advancement of natural knowledge and their contacts with problems of progressive human development. This is the cause to which my chief thoughts and work have been devoted for the past fifty years, and for the promotion of which the British Association has always stood. As it is the custom of presidents of the Association to deal in their annual addresses with subjects which have long occupied their close attention, I cannot do better than follow the usual practice, in this swan-song of retirement, by taking as my theme "Civilization and the Pursuit of Knowledge".

* Presidential Address to the British Association for the Advancement of Science, delivered on July 20.

The Dawn of Civilized Man

The nature, origin and evolution of life, and the endeavours of man to understand it and the place in the universe of the world in which he lives and has his being, have been discussed on many occasions at meetings of the British Association. In his presidential address at the Dundee meeting in 1939, Sir Albert Seward used existing knowledge to reconstruct a view of plant life on an ancient land of which Scotland is now a remnant, and sixty million years before it was inhabited by man. Even this long period dwindles into insignificance in comparison with that of more than two thousand million years which have elapsed since the earth took geological form in the astronomical universe.

Organic life has existed upon the earth for about 1,200 million years, but *Homo sapiens* as a product of its evolution can be traced back to a stage of less than one hundred thousand years. An impressive illustration of this short period of human tenancy was given in an address by Prof. James Ritchie as president of the Section of Zoology at the Dundee meeting. Taking the twelve hours on the dial of a clock to represent the span of 1,200 million years, living organisms would cover the period from midnight to seven o'clock. From this hour until 11.15, fishes and amphibia, reptiles, birds and mammals would successively develop and predominate, with primitive man making his appearance at less than a minute before noon and our own species less than a second and a half ago. On this time-scale, the period from our Neolithic ancestors of about ten thousand years ago to the present epoch is represented by one-tenth of a second.

It is usual to date civilization from those times of the New Stone Age, when men began to cultivate food-crops, care for and breed domesticated animals, make polished flint implements, produce the potter's wheel and the plough in their simplest forms, use boats for movement on water, undertake spinning and mining, and provide by artificial means for the primary needs of communal life—food, shelter and clothing. There are still a few groups of human beings who have not advanced beyond these primitive conditions of life ; but as they have not progressively improved these conditions, they cannot be said to be civilized in the sense in which the word is now understood.

What is Civilization ?

What civilization actually means depends upon the values attached to thoughts and works by which man has separated himself from his purely animal ancestry. In Johnson's time, the word was used only in a civil or legal sense and not as a measure of material, moral or intellectual attainment. Each of these elements of development can be a dominant characteristic of a human society at a particular place or period ; and when they are combined to reach a high standard for the general good, the best type of social organisation may be said to have been reached.

If civilization is regarded as a formative process, then a new era began when Neolithic man became a tool-using animal, with the desire to acquire new knowledge and apply it to improve the mode of life of himself and his fellows. Its roots are in the human mind and its character is determined by the aptitude to accept ideas and give effect to them. The course of development of material resources, of morals and religion, of language and other means of emotional expression, differs in time and place, but the creative or receptive agent is always the human mind. Refinement of manners and customs is commonly associated with conventional class distinctions, but these characteristics cannot rightly be said to provide essential standards of advance in civilization. A better measure is afforded by the proportion of the community who participate in the general welfare and appreciate the opportunities provided for their physical comfort and intellectual culture.

Civilization is thus a continuous process, which for the present purpose may be said to have begun with the art of agriculture in the Near East about ten thousand years ago, and at an early date to have reached Britain with the potter's art. The first steps in the working of metals, such as gold and copper, seem, however, to have been made in the Nubian region of north-east Africa. At one time, therefore, the negroid branch of the human race could be said to have been in the van of civilization both in its art and material culture. When given opportunities for development, coloured people have proved themselves just as capable of creative thought and efficient action as the white or other groups.

It is indeed unwarrantable to assume that any group of individuals or racial types are superior to others solely because they possess greater wealth or power. There are many types of civilization, but none provides standards of highest attainment in every field of human thought and endeavour. In the past, each has had its rise and fall, sometimes because of climatic or other natural changes, but more often through the use of superior military forces and the subsequent occupation and administration of the vanquished territory. They all belong to the panorama of structures of human societies and take their separate places in the continuous record of the world's history, beginning with the advent of the New Stone Age about ten thousand years ago.

Inquiry and Interpretation

In the study of man and his activities, three types of cultural development may be recognized; and they are all measured by different standards. In the fine arts the imaginative qualities of the mind appeal primarily to the emotions through stimulation of the æsthetic judgment, with feeling rather than reason as the standard of value; material culture is the province of mechanical arts; and science—the domain of reason—is systematic and formulated knowledge in all fields of human understanding—natural, moral, social and political. Natural science, or natural philosophy, is only one division of science as thus defined; yet, by general usage, the single word now signifies organised natural knowledge. The history of civilization from this point of view is a history of intellectual development in which science has been the chief factor in changing habits of thought from superficial observation and speculative and anthropomorphic theories of causation to clear concepts, rational conclusions, and progressive principles in the advancement of man and society.

In the most primitive times man had to acquire knowledge of the world of Nature around him in order to survive. The effort to secure the food and shelter necessary for his existence demanded a never-ceasing exploitation of the resources of his environment for the progressive improvement of his material equipment—an equipment which he learned to turn against his fellow man, no less than against the animal world upon which he preyed for food and clothing, or against which he must defend himself. But in this struggle, even more than on his personal prowess, his skill, and the bringing of food-plants and animals into his service, man relied upon his imagined understanding of, and his supposed power to control, the hidden causes of the nature and behaviour of the beings and objects of his world; in other words, he believed that natural conditions and events could be modified by the medicine of magic. Though the magical beliefs of primitive man may seem to us vain and crude, they should not be despised; for in these blind gropings to probe causation in Nature may be seen the remote and humble beginnings of the urge to the understanding of the universe, which is science.

When, however, magic is understood to be the practice of the pretended art of influencing the course of natural events by compelling the agency of spiritual beings, or by bringing occult principles into operation, it is more closely related to religion than to science. Art became associated with magic and religion many thousands of years before the era of the New Stone Age, which has been taken as the beginning of civilization of human societies. Thirty thousand years or so earlier, realistic paintings and drawings were made on the walls of dark caves, and objects were carved on bone and ivory, or fashioned in clay. They still remain to afford the earliest tangible evidence of that spirit in man's nature which was to act as his guide, both for good and ill, in his upward progress towards the most advanced stages of development to which civilization has yet attained.

There are several views as to the nature of the urge which led to these manifestations of early cultural development. One is that early man, like his counterpart, the backward peoples of modern times, believed that, by the exercise of his ability to represent his desires in graphic form—in other words, to effect his purpose of controlling those forms of animal life upon which he depended for his food-supply—he was setting in motion forces more potent than his own to that end, and making of his painting and carving an act of magical invocation, or it may be of religious observance.

Even if nothing more than a magical significance be attached to these realistic representations—cave-bear, mammoth or bull, the browsing deer and the vital energy of a galloping herd of horses, and the like—certain other examples of this artistic activity afford evidence of ideas which can be placed within the category of religion, if only of a rudimentary type. Some of the figures are forms of men with heads masked as animals, such as appear in representations of gods in ancient Egypt and Babylonia. They are regarded, therefore, as evidence of early conceptions of a spirit—even of a divinity—in animal form, and are associated with worship and supplication, whether for material desires or as ceremonial connected with a cult of the dead.

Worship and Works

By Neolithic times our direct progenitors gave expression to certain clear conceptions of their belief in a form of existence after physical death and made provision for it in graves during the ritual of interment. Bodies were laid in particular positions with reference to the rising or the setting sun; and for the continued sustenance of the spirit, food was provided, with weapons for its protection, ornaments as amulets to ward off evil influences, and when human sacrifice was a part of the ritual, slaves to administer to its needs. Whatever the origin of these and other spiritual beliefs, the practice of them marks a distinct stage in the development of man's mind and works and has always played a potent part in shaping the structure of civilized life.

From one point of view, worship in the sense of adoration or reverence of the spirits of ancestors represents recognition of particular qualities of human nature and the desire to maintain them. When these qualities are conceived to be possessed supremely by supernatural beings, religion assumes a wider and more purposeful meaning. It becomes an attitude of mind towards the mysterious, with instinct as its basis and intuitive feeling as the standard of value. Religious experience can claim to be positive knowledge just as much as facts which appeal to the physical senses can be said to represent ultimate reality. As factors which have influenced human development throughout all stages of civilization, religion and science are inseparable, but it cannot be said that the two systems of thought have the same rates of rational advance, whether in principles or practice. Each is concerned with the pursuit of truth whether for its own sake or for increasing the contacts of human life with things and forces, visible and invisible, in the heavens and on the earth.

The light of truth is a spectrum of many colours to which human consciousness is receptive in varying degrees. In the physical sense, light does not become manifest until it is reflected by matter, and in the sense of a divine influence its truth has to be perceived spiritually. It is through the study of the heavens and the earth from these two points of view of worship and inquiry that religion and astronomy meet in celestial fields. All living things upon the earth depend upon the light of the sun for their origin and growth. Many millions of years before man appeared, there were song-birds which did homage to its power in pæans of thanksgiving at the passing of darkness and the coming of dawn. This form of salutation may be regarded as the beginning of instinctive reactions to the influence of light, which in man became worship and religious observance. With the recognition of the sun as a great power-station having a deity in charge came the association of light with life and goodness, and darkness with death and evil. Whether these higher abstract qualities attributed to celestial beings are reflexions of what are observed and admired in human communities or reactions to divine influence is a question which cannot be answered by positive knowledge, and must be left to individual consciousness for judgment.

Celestial Movements and Meanings

When the apparent movements of the sun and moon were used to measure intervals of time and seasons, the knowledge gained was intended for practical service and not as a contribution to rational or abstract truth. Astronomy was then the handmaid of astrology, which associated human lives and affairs with particular parts of the celestial sphere and the deities who occupied them. Astronomy is still the science of the heavenly bodies, but these are studied as physical objects and not as living beings. An immense amount of precise knowledge of celestial phenomena and events was obtained in ancient Egypt and Assyria, and its factual value is not affected by interpretations given to it. The accumulation and correlation of all such natural knowledge acquired by observation or practical experience is the function of science, while the way in which it is applied and interpreted affords a measure of the strength of a community in the history of civilization.

The association of astronomical objects and events with religious and other festivals, and with theological teaching, is a characteristic of most early civilizations, and is expressed in much of their art and literature. It is closely connected with the culture of Egypt and Mesopotamia, and also occupies a prominent place in the sacred literature of India. Among the material taken over by the Greeks from the Babylonians were the zodiac, knowledge of the planets and their courses among the constellations, and a method of predicting eclipses by means of the cycle known as the Saros—a period of eighteen years, eleven and one-third days. In this period, solar and lunar eclipses recur in a regular sequence at the same intervals of time and can, therefore, be predicted. Knowledge of the period descended to the Chaldeans, who occupied a part of Babylonia, and was transmitted by them to the Greek and Roman worlds.

When particular facts about phenomena or events reveal relationships from which no exceptions are known, they are expressed as scientific truths, and in this sense represent natural principles or laws. By discovering from the accumulation of observations during many centuries that 223 lunar months correspond with 18 years, 11⅓ days, or just over 6,585 days, the Chaldeans were able to announce the 'law of eclipses' as a natural and verifiable truth. This, like the regularity of the returns of the sun and moon and unchanging groups of stars, was a striking example of law and order in Nature, whatever views were held as to its cause or purpose in the scheme of human life.

Another cycle, not to be confused with the Saros, which relates only to the prediction of eclipses, was discovered in the fifth century B.C. by a Greek mathematician, Meton. He found that there was the same number of days, within a couple of hours, in 19 solar years as in 235 lunar months. This relationship was regarded as of such importance that it was inscribed in letters of gold from 1 to 19 on Greek monuments and was called the 'Golden Number'. For more than a thousand years the Metonic Cycle has been used to determine the date of Easter, upon which all the movable feasts of Christian Churches depend. As this date is determined also by that of the spring equinox, both the sun and the moon as seen from the earth are involved in it, but by the use of the simple cycle of Meton its prediction becomes relatively easy. The point of particular interest is that astronomical observations and measurements originated the dates of the chief religious festivals from the earliest civilized times to the present day.

Reactions to influences of objects and phenomena of the heavens upon conditions of life on the earth thus connect both the physical and emotional parts of human nature. Interpretation of their causes depends upon the attitude assumed towards mysteries and the light of knowledge. Their creation and maintenance may be regarded as divine designs available for the service of mankind or as elements and forces in a universe in which the earth is but a particle. The view that celestial objects are the sources or symbols of the vital force or forces appears at the very dawn of civilization as the foundation of the great religions of the world. It was expressed in the faiths of Ancient Egypt and Assyria by impressive ceremonies in magnificent temples.

Knowledge of the constellations seems to have come to the Greeks through the Phœnicians, and was brought into practical service by its use in navigation. Homer refers to certain stars as having been sent by Zeus as portents for mariners. There are many other references to constellations in the Homeric epic poems, which describe conditions of life and thought in the period of the ninth and eighth centuries B.C. Hesiod, who succeeded Homer, gave more details of the guidance for farming operations afforded by the appearance of particular stars at different times of the year. He regarded the Iron Age, which was then beginning, as degenerate in comparison with the earlier Bronze and Stone Ages when man lived in perfect innocence in a veritable Garden of Eden. The works of both Homer and Hesiod portray stages of civilization when the affairs of deities were believed to be much the same socially as those of human beings, with little difference in their qualities or actions. Heaven and earth were thus brought together in spiritual as well as practical service, and heroes became divinities in celestial abodes.

In the Indus valley civilization the Aryans, when they invaded the country not later than the middle of the second millennium B.C., brought with them concepts which personify the forces of Nature as divine and spiritual beings. Their attitude and outlook are embodied in the hymns of the "Rigveda", which date from about 1200 B.C. and were developed in the treatises known collectively as the "Upanishads", or conferences, in about the same period as that of early Greek philosophy. The belief in the personified natural forces of the Vedas was finally carried so far as the creation of an organised polytheism or pantheon and an elaborated caste system of society in which the Brahman was supreme instead of the warrior of the Vedic classics.

Natural Knowledge and Philosophy

In this early philosophy, man is the centre of the cosmic scheme, and he shares the vital force with the gods, without being dependent upon them. He differs from all other things, animate or inanimate, in the capacity for thinking, leading eventually to the Brahmans becoming the 'head' of the social organism because they possessed it to a higher degree than other classes, including the warriors, whose powers depended upon the use of 'lower' parts of the human body. Brahmanism became a new Hinduism with the teaching that every Hindu could share this knowledge and by mystical thought attain to the same perfection. Many variations of these beliefs have been formulated and incorporated in Hinduism, but the main ideas remain the same. With the introduction of Buddhism in the sixth century B.C., came the teaching that the performance of sacrifices and daily rites to deities were no measure of attainment of the right way of human life and conduct. Since that time Hinduism and Buddhism, together and separately, have determined the course of civilization in the Middle and Far East.

It is a remarkable historical fact that the sixth century B.C. was a period of great emotional and intellectual ferment, in which there was displayed a general and widespread interest in religious and philosophic speculation, particularly in the East. Buddhism, Taoism, and Confucianism all had their origin in that century; and their followers to-day number more than half the population of the world. There is no personal god in these religions or ethical systems; but conceptions of relationships between the heavens and the earth, or the universe and man, are common components of them. Each is concerned with a way of life and the exercise of human virtues, and each is tolerant of the others. It is thus possible for the three cults, with Christianity in addition, to be accepted together as guides to individual conduct, without discrimination between them.

Though there are decided differences between the principles of Taoism and those of Confucianism, each system makes ethical conduct its chief object, and neither is associated with fanaticism against other religions. The cult of ancestor worship in China has no mythological motive, but expresses the philosophical conception that continuation of life lies not in the immortality of the soul, but in the perpetual remembrance of the righteous by mankind. The original teaching of Taoism has, however, been modified by contact with Buddhism, and Lao-tze, its founder, has become one of a trinity of deities in a mystical pantheon. While it is possible to say simply of Buddhism that it was concerned with the way of salvation of the individual, Confucianism, which is synonymous with Chinese civilization, aimed at the regeneration of a whole society through a reformation in the conduct and character of all its members.

Just as in the sixth century B.C., Buddhism, Taoism and Confucianism separated man from celestial deities, so in the same period the Greek philosophers Thales and Pythagoras began the study of Nature as made manifest to the senses with the view of discovering relationships between effects and causes. They and their Ionian school were the first 'lovers of wisdom' to separate natural philosophy from all-personifying religious faith and to constitute a method of interpreting Nature distinct from the primitive conceptions of unenlightened minds. The idea of Person in a divine sense was tacitly set aside or limited, and an impersonal Nature conceived as a separate subject of study. The scope of natural philosophy, with its objective character and invariable laws, discoverable by a proper and methodical application of the human intellect, was thus defined. Though these principles were not maintained for long, they opened up those veins of speculative philosophy which occupied afterwards so large a portion of Greek intellectual energy, with most enduring results on Western civilization.

Plato, the greatest of these thinkers, opposed the scientific school which had arisen to study natural objects and phenomena apart from supernatural agencies, and to interpret the processes involved by submitting them to independent rational inquiry. It was against these materialists, of whom Democritus of the fifth and fourth centuries B.C. was the leader and last of the physical school, that the main argu-

ments were advanced by the Socratic system of reasoning in the tenth book of Plato's "Laws". Disregard of the gods, or unbelief in their concern for human affairs and conditions affecting them, was held to be a danger to a State and a crime to be denounced by every law-abiding citizen and punished severely.

The words used by Plato near the beginning of the discourse express very clearly the difference between the scientific and theological attitudes towards the pursuit of natural knowledge ; and they are to-day as truly typical of the two points of view as they were in the first recorded statement of conflict between religion and science.

"It is the novel view of our modern scientists," said Plato, "that we must hold responsible as the cause of mischief. For the result of the arguments of such people is this ; that when you and I try to prove the existence of the gods by pointing to these very objects—Sun, Moon, Stars and Earth—as instances of deity and divinity, people who have been converted by these scientists will assert that these things are simply earth and stone, incapable of paying any heed to human affairs, and that these beliefs of ours are speciously tricked out with arguments to make them plausible."

This denunciation of the mode and meaning of the studies of the early Greek physicists has particular interest at the present time : for it was directed against Democritus, the renowned founder of the atomic theory. It is a tribute to the free intellectual atmosphere of Greece at the time that such an impious theory should have been conceived at all. In its crude form, the Athenian, Epicurus, used the theory as the basis of ethical teaching in which divine providence had no part ; and it was expounded by Lucretius to the Roman world in his comprehensive philosophical poem "On the Nature of Things".

The Disruptive Atom

Lucretius' fervid exposition of the theory that the universe may be analysed into two elements—atoms and space—in different relationships even as an explanation of life, the mind and the soul, makes his poem a great contribution to the philosophy of science as well as to classical literature. According to this view, all forms of matter are due to combinations of unalterable atoms in ceaseless motion ; and the universe is a vast concourse of them under the control of fixed laws and independent in these respects of a providence or intelligent cause continually guiding their movements.

The theory remained a philosophic speculation for about eighteen centuries before attention to it was revived ; and it was established as the foundation of modern chemistry by John Dalton early in the nineteenth century. Towards the end of that century, the discovery was made that the chemical element, uranium, continuously emitted radiations which produced effects of both heat and light without measurable loss of mass. This led to the discovery of radium and other radioactive substances ; and scientific attention was concentrated on all their aspects—theoretical and applied.

At the beginning of the present century these studies led to the conclusion that the energy released by radioactive action was due to the spontaneous disintegration of their constituents. In the terminology of chemistry, atoms are still the smallest units which enter into combination ; and they make up the constitution of all substances, just as millions of different words are formed from letters of the alphabet. Chemical atoms are, however, now known to consist of systems of smaller particles in very rapid motion around a nucleus ; and their physical disruptions become manifest in the effects of radioactivity. The source of this energy was proved later to be in the nucleus of the atom and not in the lighter particles called electrons, revolving around it. Further experiments showed that the core itself could be divided and that the process was sometimes accompanied by an enormous output of energy.

These principles of nuclear fission had been established before the discovery was made, early in the year 1939, that when the nucleus of an atom of uranium had been split in two, additional atomic bullets were produced which carried on the disintegration process by themselves. A chain reaction could thus be created which broke up the uranium with great rapidity and at the same time released energy with immense violence.

All this experimental work was done purely in the pursuit of natural knowledge, and was communicated freely to scientific societies and publications. The military significance of the fission chain reaction then came to be realized both in Europe and the United States, where, with the collaboration of American, Canadian and British scientists, a vast engineering plant was erected, and the frightful atom bomb was manufactured as an instrument of war. There were no secrets in the principles upon which its construction was based, but, as with other industrial applications of scientific discoveries, the conversion of laboratory experiments into engineering works on a vast scale meant that special methods had to be discovered and used in the process, and these alone constitute the secrets of atom bomb manufacture.

British and American scientists and technologists took three years to convert laboratory experiments into an engineering plant, that is, to bridge the gap between science and invention, and by so doing to make available an almost inexhaustible source of mechanical power. When atoms took form out of the void, this energy was locked up in their nuclear hearts ; and whatever may be the spiritual meaning or purpose of its creation, the discovery of it in the pursuit of knowledge is just as natural as that of any other force. When Prometheus of classical antiquity stole fire from heaven for use on the earth, he was condemned by Zeus to daily torture for this sacrilege. The celestial fire stored up by plant cells many millions of years ago and concentrated in sediments of the earth's crust is stolen daily in the form of coal and oil and used for the service of man.

The view that to acquire such knowledge of natural properties and forces is to partake of its divinely forbidden fruits is still held and has been forcibly expressed against scientists since atom bombs were exploded with such terrible effects over Hiroshima and Nagasaki. There can never be moral sanction for such mass destruction of human life, though history affords other examples of it in crusades and similar religious conflicts. It is an offence against the light, for whatever cause it is undertaken. The pursuit of natural or of supernatural truth is the noblest of man's endeavours. The use of the knowledge gained has enabled man to penetrate into the centres of stars, but it can carry him also down into the pit to perish if his animal instincts continue to prevail over his moral understanding.

(*To be continued*)

VACCINIA HÆMAGGLUTININ

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WORK on the hæmagglutinin of vaccinia virus was initiated by an observation by Burnet in October 1941 that a chorioallantoic membrane emulsion agglutinated fowl cells to a low titre. This phenomenon was then studied by Nagler[1,2], who was responsible for the general development of the technique of dealing with the reaction. He found that not all fowls provide cells susceptible to agglutination. Roughly 50 per cent of fowls give fully agglutinable cells, another 30 per cent show varying degrees of agglutinability, whereas 10–20 per cent give cells which are quite inagglutinable. All embryonic cells are wholly inagglutinable, the character appearing in the appropriate proportion of chicks two to four weeks after hatching. Nagler showed, too, that calf lymph, despite an equally high virus content, was ineffective as an agglutinating agent.

Vaccinia hæmagglutination is inhibited by appropriate immune sera either of animal or human origin, and most of Nagler's work was concerned with the antibody response following human vaccination. In general, a significant response followed primary vaccinations or secondary vaccinations in which a fully developed vesiculopustular reaction developed at the site of inoculation.

Accelerated or immune type reactions gave much smaller rises in antihæmagglutinin titre. The antibody titre fell rapidly after reaching its peak about a month after vaccination, but in a considerable proportion of vaccinated persons a trace of residual antibody was detectable years after the last vaccination.

The next development in the work came with the recognition that ectromelia virus of mice, also in the form of chorioallantoic membrane emulsion, agglutinated the same limited range of fowl cells as were agglutinated by vaccinia virus preparations. Burnet and Boake[3] found that the two hæmagglutinins were very similar in most respects and were serologically related though not identical. The most interesting difference was that ectromelia virus preparations agglutinated mouse cells readily, while vaccinia preparations equally active against susceptible fowl or pigeon cells failed to do so. No explanation for this difference is yet available, but it is hard to believe that the susceptibility of the mouse erythrocytes is not in some way related to the virulence of ectromelia virus and not vaccinia for the species. Incidentally to this work, it was shown that vaccinia can be used to immunize mice effectively against ectromelia. Further studies of the experimental epidemiology of ectromelia, using the methods made available by these hæmagglutinin reactions, are being undertaken by Fenner.

Under the stimulus of the discovery of this relationship between vaccinia and ectromelia viruses, a further study of the nature of the hæmagglutinins was undertaken by Burnet and Stone[4]. They found it easy to demonstrate that the virus particles were not the hæmagglutinin, thus bringing to light a sharp difference from the influenza-mumps group of viruses. Absorption of vaccinia hæmagglutinin with suitable red cells leaves the virus titre unaffected : high-speed centrifugation (15,000 r.p.m. for 1 hour) deposits more than 95 per cent of virus with insignificant reduction in the hæmagglutinin titre of the supernatant fluid. In many types of experiment preparations may be obtained showing ratios of hæmagglutinin to active virus particles which are widely discrepant from those obtaining in a typical chorioallantoic preparation. The absence of hæmagglutinin in standard calf lymph of high virus content has already been mentioned. All these results are in accordance with the interpretation of the hæmagglutinin as a virus product with specific antigenic properties but considerably smaller than the virus particles.

Attempts to determine the chemical nature of the hæmagglutinin included extraction of dried material with alcohol and other solvents. It was planned to use both 'susceptible' and 'insusceptible' fowl cells in testing all fractions on the assumption that only the virus hæmagglutinin would show such a differential effect. A suspension of the alcoholic extract in saline, however, gave such a high titre agglutination with 'susceptible' cells (and none with 'insusceptible' ones) that doubts immediately arose. Suitable tests showed that any alcoholic extract of dried tissue gave a similar differential agglutination of fowl cells—stock Wassermann or Kahn antigens show the phenomenon excellently. As offering an indirect approach to the nature of the virus hæmagglutinin, Stone and Holden undertook to determine the nature of the tissue lipids responsible for this type of hæmagglutination. After an extensive investigation, Stone[5] concluded that purified lecithin (egg yolk or ox heart) dispersed with cholesterol in saline was the most active available agent, but that almost as active preparations could be obtained with cardiolipin[6], sphingomyelin and various cephalin fractions. Freshly prepared cephalin made by Folch's method[7] was almost inactive but became highly active after a few weeks exposure to the air. Cholesterol alone and various fatty acids with or without cholesterol were inactive.

These results indicated strongly that the vaccinia and ectromelia hæmagglutinins were composed of a virus antigen plus a phospholipid component, the latter being responsible for union with the surface of the cell.

So far, direct attempts to isolate the virus hæmagglutinin have been limited to showing that it may be freed from a good deal of inert material by precipitation with ammonium sulphate.

The existence of phospholipid as the effector component of the virus hæmagglutinin has, however, been demonstrated by showing that the agglutinating activity is destroyed by lecithinase of two types. Solutions of *Cl. welchii* toxin Type A prepared from dried material precipitated by ammonium sulphate, kindly given to us by Dr. A. W. Turner, rapidly destroyed the agglutinin in the presence of calcium ions but were inactive if phosphate or citrate was present in the system. Boiled material was inactive. Cobra venom 1 : 10,000 of dried material in phosphate buffer (pH 7·0) was also highly active in destroying the activity of vaccinia and ectromelia hæmagglutinins, all activity being lost in two hours at 37°.

In addition to the two different types of lecithinase known to be responsible for the major biological activities of these natural poisons, both contain other enzymes, including hyaluronidase. The hæmagglutinins are, however, stable in the extracts of chick embryo tissues or mouse liver in which they are normally prepared, and were unaffected by exposure to rat testis extract rich in hyaluronidase. Hæmagglutination by influenza viruses is quite unaffected by either *Cl. welchii* toxin or cobra venom. The

results therefore indicate that the destruction of hæmagglutinin activity is a direct function of the specific lecithinases.

Conclusion. Vaccinia and ectromelia viruses produce in infected tissues soluble hæmagglutinins active against a limited range of red cell types. The hæmagglutinins are complexes of a phospholipid (probably lecithin) with an antigenically specific virus constituent.

This is a record of work in which W. C. Boake, F. M. Burnet, E. Clark, H. F. Holden, F. P. O. Nagler and J. D. Stone of this Institute have at various times been concerned.

[1] Nagler, F. P. O., *Med. J. Austral.*, **1**, 281 (1942).
[2] Nagler, F. P. O., *Austral. J. Exp. Biol.*, **22**, 29 (1944).
[3] Burnet, F. M., and Boake, W. C., *J. Immunol.*, in the press.
[4] Burnet, F. M., and Stone, J. D., *Austral. J. Exp. Biol.*, in the press.
[5] Stone, J. D., *Austral. J. Exp. Biol.*, in the press.
[6] Pangborn, M. C., *J. Biol. Chem.*, **153**, 343 (1944).
[7] Folch, J., *J. Biol. Chem.*, **146**, 35 (1942).

HEAT DAMAGE IN CEREAL SEEDS

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RECENT work by Peters[1] and his co-workers upon burn damage in animal tissue reveals features of primary damage not unlike some present in grain which has been damaged by excessive heat during drying. This damage in grain is manifested by delay and by reduced resistance to adverse conditions when it is afterwards germinated. Animal tissue burns are complicated by diffusion from the cells of substances which may be of a toxic character, but with grain such effects appear to be absent.

As with other forms of biological damage, mild heat damage in oats, barley and wheat is reversible, but severe damage causes death of the cells. One of us[2] has shown that if grain be heated, there is a temperature of treatment at and above which the grain is incapable of germination, and also another temperature, some 9° C. lower, which causes mild damage, showing itself as a delay in the germination of the grain after planting or damping. This narrow zone of temperature separates normal grain from grain incapable of germination, and between 14 and 36 per cent moisture content (wet weight basis) the lower temperature of damage can be expressed by the equation :

$$\theta = 122 - 5 \log_{10} t - 44 \log_{10} m,$$

where θ is temperature in degrees C., t time of heating in minutes, and m percentage moisture content. At 36 per cent moisture content the equation holds at least over the range 1–120 minutes. Within this narrow zone, damage is revealed by delay in the onset of germination, and by death of some grain, the degree of damage increasing rapidly with severity of treatment. Thus the delay in appearance of germination behind a control unheated sample showing 99 per cent germination capacity* within seventy-two hours may vary from a few hours to twenty days. In the early stages of damage, using new grain of high germination energy and capacity, there is little or no effect upon the capacity of grain grown in the laboratory upon damp sand, although delay is marked. After the initial germination, growth proceeds normally, and thus damage is for all practical purposes completely reversible. After treatment at higher temperatures within the zone, many grains fail to germinate, and this damage must be considered as irreversible. A sample of wheat, and another of barley (both at 14 per cent moisture content), showed no germination capacity whatever after treatment at 74° C. (for forty minutes), but when sown after treatment at 70°, 68°, 66°..... 50° C., under normal garden conditions, they produced sound grain of high vitality at harvest, although several of the grains treated at 68° and 70° C. (especially at 70° C.) failed to germinate, and the onset of the germination of the living grain was markedly delayed.

Laboratory germination tests of such heat-damaged grain had indicated that in the early stages between damping and the first visible appearance of growth, the grain, in contrast to unheated grain, was very sensitive to external conditions, especially to excess of water. Similarly a winter-sown heated wheat, showing 60 per cent germination capacity in the laboratory, was almost completely killed by winter frosts and rains within a few days of planting, while the unheated control wheat germinated normally. The evidence available indicated that heated grain needed optimum conditions of water and aeration in the primary stages, but that after growth had commenced it behaved in a normal manner.

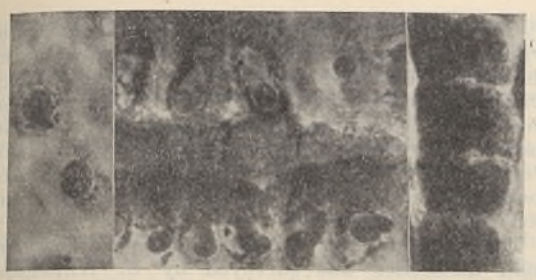
It seemed possible that cytological examination of heat-damaged grain might reveal the nature of the reversible disorganisation effected by heat, and one of us (P. T. T.) has examined embryos of such grain, both of barley and of wheat, completely covering the damage zone at 15 per cent moisture content and thirty-six minutes heat treatment (50–76° C.).

Attention was first concentrated upon the chromosomes because Peto[3] had reported that heat treatment of dormant and germinating barley caused many chromosome breaks and translocations in the cells of the root tips of young plants. No chromosome abnormalities sufficient to account for the general delay in germination were detected in the present material. Nor was there evidence that the delay was due to later differentiation following elimination of abnormal cells. The fact that only rarely did the seedlings show growth distortion and that the mature plants were morphologically and physiologically normal would also point to a non-genetic effect of heat rather than to a permanent effect on the chromosomes. Plants from heat-treated grain were, it is true, somewhat shorter in the straw, but meiosis and pollen fertility were normal.

Other cytological observations were carried out at 4-hour intervals during the incubation of grain in contact with water at 27° C. in order to test this view. The following results were obtained.

(1) *Normal grain* showed a gradual increase in the size of the nucleolus (Fig. *a*) accompanied by a rapid decrease in the basophily of the cytoplasm (Pappenheim's stain) before the first nuclear divisions occurred. Afterwards the staining intensity remained steady at the lower level. This course of development is probably at least in part due to the transformation of the ribonucleic acid in the cytoplasm to the desoxyribose form necessary for chromosome reproduction[4].

* Germination capacity : the percentage of grain which eventually germinates. Germination energy : the percentage of grain which germinates within a specified time at a fixed temperature, for example, three days at 16° C. Good barley or wheat should show at least a 90 per cent level.



a b c

CELLS FROM EMBRYOS OF BARLEY SHOWING DIFFERENCES IN NUCLEOLI AND STAINING INTENSITY IN NORMAL GRAIN (*a*), HEAT-DAMAGED GRAIN (*b*) AND HEAT-KILLED GRAIN (*c*), AFTER 24 HR. INCUBATION AT 27° C.

(2) *Heat-damaged living grain* showed at first no change in the nucleolus. The duration of this quiescent period depended on the severity of the heat treatment. Then activity as in normal grain occurred, but as the nucleolus increased in size it yielded blister-like protrusions (Fig. *b*). This activity was accompanied by a slower decrease in the basophily of the cytoplasm. When serious blister formation occurs, the damage is apparently irreversible.

(3) In heat-killed grain there was no change in nucleolar size; the basophily of the cytoplasm showed no decrease and may even have increased slightly (Fig. *c*).

The observations on the nucleolus suggest that, even when still alive, the damaged cell has lost some of its power of selective permeability. It is unable when active to control the entry of water into the nucleolus. Support for this suggestion is obtained from the fact that when water uptake is restricted, the abnormal nucleolar behaviour in damaged grain is much less marked, and the grains eventually germinate. Nevertheless, before germination damaged grain still shows the lag in development of the nucleolus. The rate of decrease in basophily of the cytoplasm to the level at germination, and later, is similarly slower. The sensitivity of damaged grain to excess water and to the formation of nucleolar protrusions thus seems to be secondary and due to alterations in permeability.

The primary factor in heat damage seems to be an inactivation of the cell, accompanied by an alteration in permeability which may be of much less importance. As the chemical activity of the cell is believed to be essentially enzymic in character, such inactivation suggests at least one vital heat-labile system in the earliest stages of the chain of activity preceding cell division, and such a bottleneck may be responsible for the delay in germination. This delay may well be due to inactivation of enzymes responsible for reduction of ribose nucleic to desoxyribose nucleic acid. The changes in staining intensity would agree with such an interpretation.

Measurements of carbon dioxide output of respiring grain[5] indicated that the respiration of mildly damaged grain was almost normal, and even of severely damaged grain was much greater than corresponded to its final germination capacity. Thus such figures were quite useless as tests for mild heat damage, and even grain incapable of germination showed a carbon dioxide production one fifth or so of that of normal grain (at 30 per cent moisture content). The respiration death point (that is, where respiration was but 1–2 per cent of normal) was some 4° C. above the germination death point. It thus seems that mild heat damage is not accompanied by, and could not be attributed to, inactivation of enzymes primarily concerned with the respiration process. Similarly with animal tissue Peters reports that after heat treatment at the marginal damage temperatures, tissue respiration showed no fall.

Quoting Peters' report: "50–55° C. for 30–60 seconds is a critical temperature for damage, producing permeability changes with liberation of substances from the skin cells, which can be detected histologically. The degree of damage has been correlated with increasing temperature. Higher temperatures induce a different condition, including fixation and coagulation of the protein; the actual temperature for damage is 48–50° C. This temperature can destroy some enzymes in a short period; but it is not yet decided whether enzyme damage or change in lipoprotein in the cell interface is the initial biochemical alteration."

Dry wheat at 14 per cent moisture content is not strictly comparable with living tissue, because of the influence of water content upon temperatures of damage, but grain at 37 per cent moisture content, as just prior to germination, if immersed in hot water for one minute, shows a damage zone of 53–62° C. (water temperatures). The results of Hutchinson and Booth[6] indicate that at the death temperatures of the wheat grain there is severe protein coagulation and enzyme inactivation, and that in damp grain treated at the low temperature of damage which causes but little delay in germination, alterations can be detected in the grain which are almost certainly due either to a form of protein coagulation or to enzyme inactivation. Careful observation reveals some slight germination delay at temperatures a few degrees below 53° C., and indicates too that vitality as judged by ability to withstand excess water and other sub-optimal germination conditions is probably adversely affected. It may thus be that in the case of grain, as with animal tissue, the first biochemical alteration is a permeability change, whereas the retardation of germination is probably caused by enzyme inactivation at slightly higher temperatures.

[1] Peters, R. A., "The Biochemical Lesion in Thermal Burns", *Brit. Med. Bull.*, **3**, 81 (1945).
[2] Hutchinson, J. B., *J. Soc. Chem. Ind.*, **63**, 104 (1944).
[3] Peto, F. H., *Can. J. Res.*, 9, 261 (1933); **13C**, 301 (1935); **15C**, 217 (1937).
[4] Darlington, C. D., *Discovery*, **6**, No. 3, 79 (1945).
[5] Greer, E. N., and Hutchinson, J. B. (unpublished).
[6] Hutchinson, J. B., and Booth, R. G., *J. Soc. Chem. Ind.* (1946), in the press.

DIELECTRICS IN THEORY AND APPLICATION

TWO discussions on the subject of dielectrics were held recently, the first by the London branches of the Royal Institute of Chemistry and the Institute of Physics jointly at the Royal Institution on March 20, the second by the Faraday Society during April 24–26 at the Wills Physical Institute at Bristol. The former meeting surveyed broadly the fields of physical theory, chemical preparation and industrial application of the subject, while the latter discussed surveys and original papers on the present state and immediate trends of physical-chemical and physical research.

Dealing first with the more 'industrial' side, N. J. L. Megson, adviser on plastics to the Ministry of Supply, showed that the most important new dielectrics are

usually of the high-polymer type. Most of the latter are either 'thermoplastic' (plastic when hot) materials with long chains having considerable freedom of movement, or 'thermosetting' (hardened by heat) materials which when heated yield a cross-linked structure with little freedom. Either type may be produced by condensation or polymerization. The general type of electrical properties can be predicted from the chemical structure; for example, the improvement from the 'Novolak' phenol-formaldehyde to the cresol- or xylenol-formaldehyde and thence to the benzyl resins may be ascribed to the relative increase of hydrocarbon and decrease of polar hydroxyl groups. The polar amino structure of urea and similar resins gives electrical properties no better than those of phenolic resins; but the high nitrogen content may be the reason why they are less subject to 'tracking'. Polymerized hydrocarbons such as polythene and polystyrene are excellent dielectrics, but are softer and less resistant to heat due to the absence of cross-linkages. Some increased resistance to heat has been achieved by substituting chlorine for hydrogen in polystyrene. Another recent method of inducing heat resistance is by the polymerization of doubly unsaturated compounds, such as the diallyl derivatives, from which resins are obtained resembling the methyl-methacrylate resins but having thermosetting characteristics. Lastly, there is the substitution of carbon by silicon obtained in the 'silicones', which are based on the —O—Si—O—Si— chain and can be cross-linked. Although these last are highly resistant to heat, and the other methods have also shown promise, the plastic, which is an excellent dielectric, resistant to heat and easily utilizable, is not yet in production.

A. J. Maddock dealt with dielectric heating where the materials involved, such as glues, wood and fabric, are not always regarded as dielectrics. Heating by dielectric losses in a high-frequency field has the advantages that the heat is generated uniformly throughout the volume where it is wanted, and the low thermal inertia permits rapid heating and close control. Frequency is not critical, since the total energy loss as the frequency passes through that of a dipolar absorption shows no maximum and the losses in practice change only slowly. While the idea was suggested by von Siemens and Tesla, it was not until 1935 that Leduc applied the method to vulcanizing rubber, while the major development has been confined to the past few years. In the range 2–5 Mc./s., powers up to hundreds of kilowatts are used; from 10 to 25 Mc./s. medium powers apply with instances up to 100 kW.; from 50 to 80 Mc./s. the power does not usually exceed 1 kW.; while in the range 100–200 Mc./s. only low-power special applications are involved.

A very successful application is the preheating of plastic materials prior to moulding and the polymerization of thermosetting resins used to bond paper, fabric and wood into boards or articles such as gear wheels. In bending plywood in two directions the material can be built up over the former by lightly 'tacking' it with a species of 'gun': the assembly is then compressed and heated in its final shape, since the 'tacks' can then break. The gun is formed of a coaxial transmission line, the open end of which is pressed on to the work, by which the high-frequency field is applied locally in the vicinity of the end. The combination of this analogue of spot-welding with shaped electrodes for seams enables plastic, bonded and glued articles to be made by rapid and continuous processes usually associated with more amenable materials such as fabrics without the damage involved in operations such as stitching. Dielectric heating may be used for drying provided the rate of extraction of moisture is not a limiting factor; an example is in drying artificial silk. Possibilities being explored lie in reheating cooked foods, softening frozen foods and the sterilization of poor thermal conductors.

The present state of the physical theory of solid dielectrics was surveyed by S. Whitehead, director of the British Electrical and Allied Industries Research Association, at the London meeting, and by H. Fröhlich (to whom recent theoretical developments are largely due) at the Bristol meeting in rather similar terms. The absorption bands or natural frequencies of small molecules lie in the visible or near infra-red; but with large molecules, such as are encountered in dielectrics, the absorption bands can be of much lower frequency. These collision-broadened bands can influence the electromagnetic spectrum, for example, at 10^{10} cycles per sec., because Van Vleck and Weisskopf and also Fröhlich have shown the classical Lorentz theory to give too small an effect at frequencies remote from the natural frequency. The normal electromagnetic range is influenced by dipoles which, in many solids as opposed to liquids, may only have one direction with respect to the molecular axis, but of either sense in that direction. When the dipolar interaction is small, as in dilute solutions or at high temperatures, the transition of the dipoles from one direction to the opposite provides a relaxation time and a resultant variation of dielectric constant and loss angle very similar in shape to that derived from the Debye theory, except for the values and significance of the parameters. When most of the molecules are dipolar so that their interaction is important, and when the temperatures are low, the turning of some dipoles may facilitate the turning of others in the vicinity, leading to an effect analogous to the 'domain' hypothesis in ferro-magnetism.

The transition from the low-temperature to the high-temperature case occurs at a critical temperature which may be the melting point, and is of the type known as a λ-transition, where the dielectric constant can reach very high values and where there is a discontinuity in the specific heat, in conformity with the work of Müller and Ubbelohde. In the high-temperature or dilute-dipole region, it seems that the right shape of dielectric constant and loss-angle curves is probably only found with ice, so that with this exception supplementary hypotheses such as those of Yager and of Garton of a distribution of relaxation times are required to explain experimental results on solids. Lamb confirmed at Bristol the behaviour of ice except that a large power-factor at 10^{10} cycles per sec. requires an additional source of absorption; while a paper by Smyth, in essence, approached some of the foregoing hypotheses from the aspect of molecular freedom.

Some detailed discussion centred around the theory of the internal field in dielectrics. Debye, Onsager and Fröhlich all regard the dielectric as a continuum with respect to a dipole; by the first, the medium is supposed to react slowly to change of dipole orientation; Onsager thinks the medium reacts quickly compared with the dipole; while Fröhlich takes into account the relative magnitudes of the relaxation times of dipole and medium, indicating that Onsager should be right at high

temperatures. Actually, however, the vicinity of a dipole has a 'discrete' structure, and Sack has calculated the exact effect of short-range interaction for a single-dimensional case of a chain molecule, showing that the frequency dependence according to Debye or Fröhlich is unaltered. Baur and Massignon put forward a calculation of the interaction potential in a crystalline field, or rather a general method of calculation. Frank concluded in general that Debye's 'hindering energy' has real significance and that Onsager must always be to some extent in error, while he also gave an analysis of certain detailed types of interaction. Kirkwood and also Böttcher considered the internal field in an amorphous fluid; the former gave an exact theory for the sphere of influence around a dipole considered as fixed.

Dipole relaxation is generally associated with a species of viscosity in liquids, but in solids is held to be a thermally activated transition across a potential barrier; although Pelzer directed attention to Kramer's view that a kind of diffusion analogous to Brownian motion forms a more general concept to which the activation process is an approximation. But the differences discussed between experiment and existing theory may well have been greater than possible errors on this account. Fröhlich has explained that the relaxation time in a chain molecule should increase at first proportionately with chain-length but thereafter more slowly with an asymptotic curve. The papers by Willis Jackson and Powles on benzene and paraffin solutions, Collie, Ritson and Hasted on water, Abadie on acetone and water, Whiffen and Thompson on pure hydrocarbons, related materials and solutions, supported the general outline of fairly well-defined relaxation times, but no simple concept of viscosity can be applied. Nevertheless, particular interest is attached to the first paper, because it is believed that the experiments on benzene solutions are the first to show a good agreement with Debye's theory with a single relaxation time, due possibly to the small molecules involved.

Girard and Abadie indicated the wide deviations from theory which are observed in some cases, and mentioned the complexity introduced if the liquid molecules were conceived as ellipsoidal instead of spherical; Schallamach has studied the properties of mixtures of dipolar liquids and the multiple absorption bands which can occur. As to solids, Oakes and Richards in the case of chlorinated polythenes, Plessner and Richards in the case of solutions of esters in polyisobutylene and polythene, Carter and others in the case of natural and synthetic rubbers, have applied with some success the hypothesis of Fuoss and Kirkwood, which is essentially similar to Garton's earlier theory already mentioned of a distribution of relaxation times. However, Garton and also Gevers and du Pré addressed themselves to the problem of good dielectrics with small power factors which vary only slightly with frequency over wide ranges. Both papers adopted the Pelzer–Wigner transition-rate method with a distribution of heights of the potential barriers. Garton considers the transition from permanent 'potential wells' or equilibria to temporary 'wells', the depth or binding energy of which have a Maxwellian distribution, whence the relative constancy of the power factor follows. Gevers and du Pré, however, only go so far as to indicate the general kind of distribution of potential barriers which can explain observation, ignoring Garton's point that the polarizability depends on the relative life of a dipole in a given state.

This modification of the rate process stimulated discussion, as also did the attempts to identify the potential barriers by Eyring's method with activation energies and entropy changes associated with physical-chemical bonds, particularly when, as in Whiffen and Thompson's work, the entropy change of activation appeared negative. It was shown that this anomaly is entirely dependent on the multiplying factor in Eyring's equation which, so to speak, sets the time-scale, so that it is difficult, if not impossible, to make an absolute interpretation on these lines in absence of an exact solution of the particular solid structure, although relative changes should be valid. A relative change is involved, for example, in the comparison of homologues with different chain-lengths, where Fröhlich's views seemed qualitatively to be confirmed. Lastly, Whitehead directed attention to the use of linear theory in analysing dielectric properties, such as eliminating undesirable or inaccurate parameters, and the difficulty attending experimental verification unless the crucial range can be properly chosen.

Perovskite crystal types which include the high dielectric constant titanates formed the subject of two papers. The structure is that of connected octahedra as regards the oxygen atoms, or cubic as regards the titanium (or similar element) atoms, with a central large metallic cation. According to Miss Megaw, if the latter is too small for stability, the cubic symmetry may be distorted to monoclinic form; but in some compounds, including those with high dielectric constants, the metallic cation is too large and there is tetragonal distortion with a λ transition to the cubic form above a critical temperature, with possibly another reverse λ transition at a lower temperature analogous to the double transition in piezoelectric crystals. Rushman and Strivens, adopting this picture, considered the possibility of the small titanium ion's 'rattling' in the structure distorted in the tetragonal manner, so that an effective dipole is produced. They claimed that the general behaviour of these crystals could thus be explained, and the high dielectric constant would be an example of the λ transition and an analogue to the ferro-magnetism discussed by Fröhlich. However, the highest dielectric constant does not actually occur at the temperature for the crystalline transition, and in the discussion doubt was cast on the hypothesis that the polarization was due to the type of ion displacement described.

A notable feature of the papers at Bristol was the enormous advance made during the War in high-frequency dielectric measurements in the centimetric wave-lengths, up to $2{\cdot}5 \times 10^{10}$ c./s. The infra-red region is not very remote from this, and some discussion took place on the use by Whiffen and Thompson of what is essentially an infra-red technique adapted to these frequencies. Willis Jackson summarized the main features of resonance and standing-wave methods applied particularly to coaxial lines and wave guides; he gave the basic relations between complex dielectric constant, refractive index, power factor, permittivity, propagation constant, attenuation coefficient and phase constant, indicating the way in which these various but equivalent parameters appear in different methods of measurement and description.

At the London meeting, Megson, and at Bristol, Sutton, indicated the many ways in which dielectric studies have elaborated or given concrete expression to chemical concepts. The importance in engineering

is daily self-evident. The theoretical physicist using the dielectric approach has probably made a more remarkable contribution to the theory of the solid state and, to a less extent, the liquid state; but his fertility has rather overwhelmed the experimentalist. The rich and varied experimental techniques disclosed at these meetings give, however, high promise for the eventual elucidation of these difficult but fundamental problems.

OBITUARY

Sir George Julius

When the Australian Council for Scientific and Industrial Research was established in 1926, Sir (then Mr.) George Julius was invited to take the part-time chairmanship of the Council and of its Executive Committee. He held office until the end of 1945, and so was intimately associated with all the developments of this virile organisation during its first twenty years. He died on June 28 at the age of seventy-three.

Born in Norwich, Julius was educated at the Church of England Grammar School in Melbourne and later at the University of New Zealand, where he attended classes with his contemporary and friend, Ernest Rutherford. Graduating in engineering, he was appointed in 1896 to a post in the Locomotive Department of the Western Australian Railways, and while there he carried out an extensive investigation of the mechanical properties of Australian hardwoods. After eleven years he left Government service and set up as a consulting engineer in Sydney. His firm (later Julius, Poole and Gibson) was in the course of years associated with very many of the main engineering enterprises of Australia.

Sir George's personal contacts were wide, but his chief interest lay always in mechanical invention, much of his work being done in a very fine private workshop at his beautiful home at Darling Point on the edge of Sydney Harbour. He is perhaps best known to most people for his work on the Julius totalizator, now in use on many racecourses throughout the world. His father, the late Churchill Julius, formerly Archbishop and Primate of New Zealand, and himself no mean amateur engineer, was always deeply interested in his son's inventions, including all improvements to the totalizator; but he was careful to preface an approach to the subject by a declaration that such machines might well be sunk in the Harbour!

In 1898 Julius married Eva, the third daughter of another very famous Australian engineer, Mr. C. Y. O'Connor, who built the Mundaring Weir at Perth and, despite deplorable political interference, carried through to complete success a scheme for the transmission of water from Mundaring to the goldfields of Kalgoorlie and Coolgardie.

As president of such bodies as the Australian Institution of Engineers, the Engineering Association of New South Wales, and the Electrical Association of New South Wales, Sir George played a notable part in the professional public life of his adopted country. He was knighted in 1929 and later received the honorary degree of D.Sc. from the University of New Zealand. His last visit to England was in 1927, when he attended the Empire Agricultural Conference which led to the establishment of the Imperial Agricultural Bureaux.

David Rivett

NEWS and VIEWS

New President of the British Association:

Sir Henry Dale, O.M., G.B.E., F.R.S.

Sir Henry Dale has been elected president for the year 1947 of the British Association for the Advancement of Science. Sir Henry was formerly director of the National Institute for Medical Research, and for ten years before that he directed the Wellcome Physiological Research Laboratories (1904–14). He has achieved world recognition for his work on the physiological effects of histamine, a derivative of ergot, which was followed by brilliant researches resulting in the isolation of histamine and acetylcholine from animal tissues. Later work was devoted to examining the part played by these substances in physiological and pathological processes. Many other research workers have carried out their investigations under Sir Henry's guidance.

But apart from his own scientific research work, Sir Henry Dale has taken a very active part in the organisation of scientific work in Great Britain. For ten years (1925–35) he was one of the secretaries of the Royal Society of London and in 1940 was elected president of the Society—an office which he filled with conspicuous success until his statutory resignation in 1940. Until September of this year he is director of the laboratories and Fullerian professor of the Royal Institution—a post he has held since 1942. He is also a member of the Medical Research Council. He is a foreign member of numerous learned societies throughout the world. It is clear that in view of Sir Henry's outstanding career both as a scientific research worker and as administrator and organiser, the Council of the British Association has made an eminently wise choice for its next president.

Botany at the Fouad I University, Cairo

Prof. F. J. Lewis

Prof. F. J. Lewis has recently retired from the chair of botany in the Fouad I University, Cairo, which he has held since 1935. A graduate of the University of Liverpool, he devoted himself to ecological investigations and published a number of important papers on the post-glacial beds of the peat mosses of the north of England and also of Scotland. He gave up his lectureship in Liverpool to become professor in the newly founded university of Alberta, where he continued his ecological work, relating it to the rigorous climatic conditions of Canada. It must have been a great change for him to settle in Egypt; but new opportunities for ecological investigations presented themselves and led him to the establishment of a desert laboratory some little distance from Cairo. Very different problems also presented themselves by the accumula-

tion of weeds blocking the canals and drains of the Nile Delta. With the help of two of his assistants, he undertook to investigate for the Ministry of Public Works this serious interference with the system of irrigation.

As a teacher and organiser of research Lewis was most successful, as can be gathered from the rapid growth of his Department and from the fact that many of his students stayed on to prepare for the M.Sc. and Ph.D. degrees by research. During the earlier years of his stay in Egypt, the Faculty of Science was housed in an old palace at Abbassia between Cairo and Heliopolis, but for his growing department a new and more spacious laboratory was planned at Giza, the main site of the University (*Nature*, July 13, p. 43). With infinite tact and patience Lewis overcame all the difficulties this proposal involved and he now leaves the Botanical Department adequately housed for the accommodation of about 1,200 students and the large staff of lecturers and demonstrators. Fortunately, during the last few years Lewis has had the help of another professor, Prof. Y. S. Sabet, who has been a most loyal colleague. With both his students and his staff Lewis has been deservedly popular. Thus Prof. Lewis can now look back on his ten years of hard work in Cairo with complete, as well as pleasurable, satisfaction, and perhaps that has enabled him, in spite of a trying climate and war-time conditions, to retain abundant physical and mental energy.

Botany at University College of Science, Calcutta
Prof. S. P. Agharkar

Prof. Shankar Purusottam Agharkar, of the University College of Science, Calcutta, has retired after thirty-two years of service. Prof. Agharkar was appointed Ghose professor of botany in 1914 and deputed to Germany for further studies. In Berlin he studied under A. Engler, L. Diels, G. Haberlandt and others and obtained the doctorate of the University in 1919. In the meantime, with the inauguration of the Post-Graduate Department of the University of Calcutta, the palatial residential building of the late Sir Tarak Nath Palit at Ballygunge was converted into the Biological Laboratory and Prof. Paul Brühl was placed in charge of the Botany Department. He equipped it on a large scale in different branches of botany and initiated research work by students at the University. Prof. Agharkar returned to the University in 1920. In 1929 he took complete charge of the Department after the retirement of Prof. Brühl. From then onwards, Agharkar succeeded in increasing the number of members of the teaching staff for the different branches of botany, so that to-day facilities for research in mycology, cytogenetics, physiology and palæobotany, etc., are available in the laboratory, and much good work has been published.

Throughout his career, Prof. Agharkar has played a prominent part in the different scientific societies of India: he presided over the Botany Section of the Indian Science Congress in 1924; he was president of the Indian Botanical Society in 1934; hon. secretary of the Indian Society of Soil Science (1935–40); president of the Botanical Society of Bengal (1939–42); president of the Indian Ecological Society (1944–46); biological secretary of the Royal Asiatic Society of Bengal (1943–44). He has been a member of the Committees of the Imperial Council of Agricultural Research since 1930, of the Indian Central Jute Committee since its establishment, of the governing body of the Indian Research Fund Association 1939–42. He played a prominent part in organising the scientific activities of the two well-known All India scientific organisations, namely, the Indian Science Congress Association as its general secretary from 1924 until 1934 and the National Institute of Sciences of India as its honorary secretary during 1935–45.

Prof. P. C. Sarbadhikari

Prof. P. C. Sarbadhikari, who succeeds Prof. Agharkar in the Ghose professorship of botany at the University College of Science, Calcutta, is a former pupil of the late Sir John Bretland Farmer, at the Imperial College of Science and Technology, London, where he obtained the degree of D.Sc. in the University of London and won distinction as a research student. His original work has been mainly cytological, and in this field he has made notable contributions to our knowledge of the life-histories of fungi, ferns and flowering plants. Both as a student and while on leave as a teacher at Colombo he made wide contacts, by working at the Royal Botanic Gardens, Kew, at the John Innes Horticultural Institution during the time of Bateson, at the Jodrell Laboratory with Miss Digby, and in Paris where he worked under Guillermond. For many years associated with the University of Ceylon, first as a lecturer and later as professor of botany, Sarbadhikari returns with a long and varied experience to the University of Calcutta where he had first graduated a quarter of a century ago.

Civil Engineering at King's College, London : Prof. A. D. Ross

Dr. A. D. Ross, who will succeed Prof. C. H. Lobban in the University of London chair of civil engineering at King's College (see *Nature*, July 20, p. 91), graduated at Edinburgh in 1929. After some years in professional civil engineering on railway and road construction, he returned to the University of Edinburgh as an assistant in the Engineering Department under the late Sir. T. Hudson Beare. He left Edinburgh to serve for a time as an education officer with the Air Ministry, and since 1935 he has held the appointment of lecturer in the Department of Civil and Mechanical Engineering at King's College, London. Dr. Ross's main interest has been in the field of concrete and reinforced concrete, and he has studied especially the non-elastic deformations in this material and their effects on the stress distribution in structures. His earlier work was concerned with an analysis of the numerous factors controlling creep, and he has devoted attention to the influence of the ratio of surface area to volume on the magnitude and distribution of shrinkage. Subsequent work has been concerned with the application of the knowledge of creep and shrinkage to reinforced concrete structures, and he has obtained solutions to a variety of problems in the distribution of stress by means of an idealized Voigt model. The results of his researches have been communicated in papers published by the Institution of Civil Engineers and other technical bodies.

International Federation of University Women

The International Federation of University Women is holding its twenty-sixth Council meeting—the first since the War—at Crosby Hall, Chelsea, by

invitation of the British Federation of University Women, during July 27–August 1. Crosby Hall, which was requisitioned during the War, is re-opening as an international hall of residence and club for university women on August 6, immediately after the Council meeting. A large number of countries will be represented at the Council, including the Argentine, Australia, Belgium, Brazil, Denmark, Finland, France, India, Ireland, Luxemburg, the Netherlands, Norway, Palestine, Poland, Sweden, Switzerland and the United States. At a discussion meeting: "Bridging the Gap—1940 to 1945" on Sunday, July 28, three speakers will describe the experiences of university women during the War in the occupied, non-occupied and neutral countries respectively; and on July 30, Prof. Lise Meitner will give a public lecture on "Atoms and Atomic Energy" at Chatham House. The International Federation of University Women, which was founded in 1919 to promote understanding and friendship between university women of different nationalities, and thus to develop co-operation between their countries, had in 1939 a membership through its affiliated associations of nearly 80,000; there has been a considerable growth in membership during the war years, the estimated total being now about 94,000. The greatest proportionate increase has been recorded in the associations of the liberated countries. Since the liberation, several schemes have been launched by different national associations, including the British Federation, to help university women in the liberated countries to recuperate after the strain of enemy occupation, and to resume their professional careers and intellectual life.

D.D.T.

1.1-*bis*-(4 chlorophenyl)-2.2.2.-trichloroethane, produced in Switzerland in the early years of the War, was the first synthetic contact insecticide which could rival in efficiency and cost the vegetable products pyrethrum and derris. Information about it reached Great Britain and the United States at a time when the world shortage of pyrethrum, combined with increasing demands from the armies of the United Nations, was causing great anxiety among those responsible for military hygiene. On both sides of the Atlantic official committees of experts were convened to advise and to co-ordinate research. In Great Britain most of these activities were centred in the Insecticides Development Panel of the Ministry of Production under the chairmanship of Sir Ian Heilbron. The work of these committees largely resolved itself into the development of applications of D.D.T. for the special purposes of controlling mosquitoes, flies, lice and other insects of military importance. The results of investigations and trials were circulated in numerous reports produced in Britain, the Dominions and the United States, and freely interchanged. Many of the reports were at the time marked 'Secret' or 'Confidential' and the information appearing in the popular press was apt to be highly coloured or inaccurate. Some of these reports have since been published; but the main results, both published and unpublished, have now been brought together in the form of a pamphlet issued by the Ministry of Supply, entitled "Some Properties and Applications of D.D.T." (London: H.M. Stationery Office. 6*d*. net). This pamphlet includes a brief summary of some of the agricultural and horticultural uses of D.D.T.

Research on Rodent Control

THE Department of Animal Health of the University College of Wales, Aberystwyth, has accepted the offer of the Universities Federation for Animal Welfare to endow a research studentship for work in rodent ecology, the object of such work being the search for humane and efficient methods of controlling rodent populations; and Miss Winifred Maisie Phillips will be the first holder of the studentship. The grant (£180 for the research student and up to £170 for travelling and subsistence expenses) has been made for one year in the first instance, but it is understood that the Federation is prepared to continue the support for up to three years should the results justify this. It is anticipated that the greater part of the field experimentation will be carried out on territory covered by the West Wales Field Society, to which the Federation has made an initial grant of £150 for the current year. The programme of work now envisaged falls into three parts: (*a*) A survey of the mammalian fauna of the islands visited by the West Wales Field Society and of selected mainland territory. The survey of the islands was suggested by Mr. Charles Elton and the estimates made should form the basis of future studies upon the effects of certain treatments. (*b*) Research on humane poisons for rats. This work follows from the Conference held at Oxford on May 10, 1945, between members of the staff of the Bureau of Animal Population and nominees of the Federation. (*c*) The control of rabbits with special reference to surface-dwelling rabbits in woodlands. Preliminary ecological work upon the rabbit was carried out before the War at the Bureau of Animal Population, Oxford, by Mr. H. N. Southern, with the aid of a grant from the Federation. The special study of surface-dwelling rabbits in woodlands was also suggested by Mr. Elton, and it is expected that suitable territory for investigation will be found on farms operated by, or associated with, the Department of Animal Health of University College, Aberystwyth.

The Carlsberg Laboratory

WE are pleased to announce the resumption of the receipt of the *Comptes Rendus* of the Carlsberg Laboratory, published in Copenhagen. The Chemical Section, covering the period 1940–45, comprises twenty-eight parts, and it is not possible to summarize such a large amount of material. It is hoped, however, to deal with some of the papers in due course. The following may be mentioned: K. Linderstrøm-Lang and C. F. Jacobsen on the number of peptide bonds in insulin (23, No. 13), and on the properties of 2-methyl-thiazoline and their relation to the protein problem (23, No. 20); A. Søeborg Ohlsen on the histochemistry of the stomach (23, No. 21); A. Grönwall on the solubility of lactoglobulin (24, Nos. 8–11); K. Linderstrøm-Lang on solutions of diffusion equations (24, No. 13); H. Holter and K. Linderstrøm-Lang on the theory of the Cartesian diver (24, Nos. 17–18) and E. Zeuthen on a Cartesian diver micro-respirometer (24, No. 19).

Commonwealth Fund Fellowships Awards

The Fellowships offered by the Commonwealth Fund of New York to British graduates for tenure in American universities have now been resumed after interruption by the War, and the Committee of Award has made the following appointments for

RECENT SCIENTIFIC and TECHNICAL BOOKS

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

BAUER, E., et SURDIN, M.; ROUAULT, M., et AUGER, P. Ionisation, emission thermionique, potentials critiques; Rayons électroniques. (Tables Annuelles de Constantes et Données numériques, 36.) Sup. Roy. 8vo. Pp. iii +50. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1941.) 75 francs.*

DEBYE, P., et SACK, H. Constantes diélectriques, moments électriques. (Tables Annuelles de Constantes et Données numériques, 32.) Sup. Roy. 8vo. Pp. iii +58. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1939.) 100 francs.*

JACQUINOT, P., et FORTRAT, R. Effet Zeeman. (Tables Annuelles de Constantes et Données numériques, 35.) Sup. Roy. 8vo. Pp. iii +19. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1941.) 40 francs.*

MAGAT, M., et MAIER, N. Spectres d'absorption, des liquides, solutions et solides. (Tables Annuelles de Constantes et Données numériques, 39.) Sup. Roy. 8vo. Pp. iii +243. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1943.) 280 francs.*

OSTROWSKI, A. Vorlesungen über Differential- und Integralrechnung. Band 1: Funktionen einer Variablen. (Lehrbücher und Monographien aus dem Gebiete der exakten Wissenschaften, 8.) Sup. Roy. 8vo. Pp. xii + 373. (Basel: Verlag Birkhäuser, 1945.) 47.50 Schw. francs.*

PROCA, A., BAUMGARDT, E., et BRUINS, H. R. Acoustique; Diffusion-osmose. (Tables Annuelles de Constantes et Données numériques, 33.) Sup. Roy. 8vo. Pp. iii +14. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1941.) 40 francs.*

SCHRÖDINGER, ERWIN. Statistical Thermodynamics: a Course of Seminar Lectures delivered in January–March 1944 at the School of Theoretical Physics, Dublin Institute for Advanced Studies. Cr. 8vo. Pp. vii +88. (Cambridge: At the University Press, 1946.) 6*s.* net.*

SWIETOSLAWSKI, W., LAZNIEWSKI, M., et POMORSKI, J. Cryométrie, ébulliométrie. (Tables Annuelles de Constantes et Données numériques, 34.) Sup. Roy. 8vo. Pp. iii +20. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1941.) 40 francs.*

TAYLOR, H. S., and WOODMAN, J. F. Adsorption. (Tables Annuelles de Constantes et Données numériques, 37.) Sup. Roy. 8vo. Pp. iii +67. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co. Inc., 1941.) 90 francs.*

Engineering

BERTHAUME, MAURICE. Les vibrations sur les avions: calculs, essais, remèdes. (Guide du calculateur d'avions.) Roy. 8vo. Pp. xii +79. (Paris: Libr. Dunod, 1946.) 275 francs.*

CAMBOIS, MAURICE. Considérations sur la conduite et l'exploitation des essais de qualités de vol des avions. (Les essais en aéronautique, 1.) Roy. 8vo. Pp. xv +126. (Paris: Libr. Dunod, 1945.) 240 francs.*

FITZGERALD, W. E. Basic Electrical Engineering. Demy 8vo. Pp. 444. (New York and London: McGraw-Hill Book Co., Inc., 1946.) 22*s.* 6*d.* net.

HUSSENOT, FRANÇOIS. Les essais de performances en aéronautique. (Les essais en aéronautique, 2.) Roy. 8vo. Pp. x +151. (Paris: Libr. Dunod, 1946.) 455 francs.*

NORRIS, C. R. Principles of Electricity Illustrated. Demy 8vo. Pp. 384. (London: Odhams Press, Ltd., 1946.) 8*s.* 6*d.* net.

SEELYE, ELWYN E. Data Book for Civil Engineers. Vol. 1: Design. Med. 4to. Pp. xxxii +540. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1946.) 45*s.* net.

SKRITSKI, B. S. A., and VOPOV, W. A. Applied Energy Conversion. Cr. 8vo. Pp. 509. (New York and London: McGraw-Hill Book Co., Inc., 1946.) 30*s.* net.

Chemistry : Chemical Industry

BERRY, A. J. Modern Chemistry: some Sketches of its Historical Development. Demy 8vo. Pp. x +240. (Cambridge: At the University Press, 1946.) 10*s.* 6*d.* net.*

BRANDENBERGER, E. Röntgenographisch-analytische Chemie: Möglichkeiten und Ergebnisse von Untersuchungen mit Röntgeninterferenzen in der Chemie. (Lehrbücher und Mongraphien aus dem Gebiete der exakten Wissenschaften, 7.) Sup. Roy. 8vo. Pp. 287. (Basel: Verlag Birkhäuser, 1945.) 28.50 Schw. francs.*

DERVICHIAN, D. Colloïdes. (Tables Annuelles de Constantes et Données numériques, 40.) Sup. Roy. 8vo. Pp. iii +82. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1945.) 200 francs.*

GRIFFITH, R. O., McKEOWN, and SHUTT, W. S. Vitesse de reaction. (Tables Annuelles de Constantes et Données numériques, 38.) Sup. Roy. 8vo. Pp. iii +96. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1941.) 120 francs.*

HÖBER, RUDOLF, with the collaboration of HITCHCOCK, DAVID I., BATEMAN, J. B., GODDARD, DAVID R., and FENN, WALLACE O. Physical Chemistry of Cells and Tissues. Roy. 8vo. Pp. xiii +676. (London: J. and A. Churchill, Ltd., 1945.) 42*s.*

KEFFLER, L. Thermochimie. (Tables Annuelles de Constantes et Données numériques, 31.) Sup. Roy. 8vo. Pp. iii +35. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1939.) 60 francs.*

KING, E. J. Micro-analysis in Medical Biochemistry. Demy 8vo. Pp. viii +168. (London: J. and A. Churchill, Ltd., 1946.) 10*s.* 6*d.*

LUCAS, A. Forensic Chemistry and Scientific Criminal Investigation. Fourth edition. Demy 8vo. Pp. 340. (London: Edward Arnold and Co., 1945.) 25*s.* net.*

McLAUGHLIN, GEORGE D., and THEIS, EDWIN R. Chemistry of Leather Manufacture. Demy 8vo. Pp. ix +800. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1946.) 60*s.* net.

MANTELL, C. I., and HARDY, CHARLES. Calcium Metallurgy and Technology. Demy 8vo. Pp. 148. (New York: Reinhold Publishing Corporation: London: Chapman and Hall, Ltd., 1946.) 21*s.* net.

SACHANEN, A. N. Chemical Constituents of Petroleum. Demy 8vo. Pp. 452. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1946.) 51*s.* net.

Technology

FRAPRIE, F. R., and JORDAN, F. I., Edited by. American Journal of Photography, 1946. Cr. 4to. Pp. 200. (Boston, Mass.: American Photographic Publishing Co.; London: Chapman and Hall, Ltd., 1946.) 12*s.* 6*d.* net.

GLOVER, B. J. T., and WAKEFIELD, G. L. Perfect Negatives. New edition. Cr. 8vo. Pp. 110. (London: Fountain Press, Ltd., 1946.) 5*s.* net.

LIDDELL, DONALD M. Handbook of Non-Ferrous Metallurgy. Vol. 2. New edition. Med. 8vo. Pp. 722. (New York and London: McGraw-Hill Book Co., Inc., 1946.) 42*s.* net.

WAKEFIELD, G. L. Dye Retouching and Print Finishing. New edition. Cr. 8vo. Pp. 78. (London: Fountain Press, Ltd., 1946.) 5*s.* net.

WAKEFIELD, G. L., and SMITH, N. W. Synchronized Flashlight Photography. Cr. 4to. Pp. 130. (London: Fountain Press, Ltd., 1946.) 17*s.* 6*d.* net.

Meteorology : Geophysics

BERRY, F. A., BOLLAY, E., and BEERS, Norman R. Handbook of Meteorology. Demy 8vo. Pp. 1068. (New York and London : McGraw-Hill Book Co., Inc., 1946.) 45*s.* net.

JOHNSON, Maxwell O. Correlation of Cycles in Weather, Solar Activity, Geomagnetic Values, and Planetary Configurations. Med. 8vo. Pp. viii +149. (San Francisco, Calif. : Phillips and Van Orden Co., Inc., 1946.)*

General Biology : Natural History Botany : Zoology

BRACHET, Jean. Embryologie chimique. Sup. Roy. 8vo. Pp. 509. (Paris : Masson et Cie. ; Liège : Éditions Desoer, 1944.) 420 francs.*

BRIMBLE, L. J. F. Trees in Britain : Wild, Ornamental and Economic, and some Relatives in Other Lands. Med. 8vo. Pp. x +352 +8 plates. (London : Macmillan and Co., Ltd., 1946.) 15*s.* net.*

BUZZARD, C. N. Shining Hours. Ex. Cr. 8vo. Pp. 192 +8 plates. (London and Glasgow : Wm. Collins, Sons and Co., Ltd., 1946.) 10*s.* 6*d.* net.*

HIGHAM, Walter B. Birds in Colour. Cr. 4to. Pp. 176 +48 plates. (London and Glasgow : Wm. Collins, Sons and Co., Ltd., 1946.) 25*s.*

HOWES, F. N. Plants and Beekeeping : an Account of those Plants, Wild and Cultivated, of Value to the Hive Bee, and for Honey Production in the British Isles. Demy 8vo. Pp. 224 +32 plates. (London : Faber and Faber, Ltd., 1946.) 12*s.* 6*d.* net.*

PRINGSHEIM, E. G. Pure Cultures of Algæ : their Preparation and Maintenance. Cr. 8vo. Pp. xii +119. (Cambridge : At the University Press, 1946.) 7*s.* 6*d.* net.*

SMITH, George. An Introduction to Industrial Mycology. Third edition. Demy 8vo. Pp. xv +271. (London : Edward Arnold and Co., 1946.) 20*s* net.*

SPÄRCK, Ragnar. Den Danska Dyreverden : dyregeografisk og indvardringshistorisk belyst. Sup. Roy. 8vo. Pp. 116. (København : Ejnar Munksgaard, 1942.) 7.50 kr.*

STILES, Walter. An Introduction to the Principles of Plant Physiology. New edition. Demy 4to. Pp. 615. (London : Methuen and Co., Ltd., 1946.) 30*s.* net.

TEMPLE, Vere. Butterflies and Moths in Britain. Demy 8vo. Pp. 120. (London : B. T. Batsford, Ltd., 1946.) 12*s.* 6*d.* net.

ZoBELL, Claude E. Marine Microbiology : a Monograph on Hydrobacteriology. (Plant Science Books, Vol. 17.) Sup. Roy. 8vo. Pp. xvi +240. (Waltham, Mass. : Chronica Botanica Co. ; London : Wm. Dawson and Sons, Ltd., 1946.) 5 dollars.*

Agriculture : Horticulture : Forestry

BOULTON, E. H. B., and JAY, B. Alwyn. British Timbers. Second edition. 4to. Pp. 120 + 31 plates. (London : Adam and Charles Black, Ltd., 1946.) 12*s.* 6*d.* net.

FAULKNER, R. P. Simple Science for the Gardener. Cr. 8vo. Pp. 86. (London : Sir Isaac Pitman and Sons, Ltd., 1946.) 4*s.* 6*d.* net.

HOLMES, G. A. Revolution in Agriculture. Cr. 8vo. Pp. 128. (London : Todd Publishing Co. ; George G. Harrap and Co., Ltd., 1946.) 6*s.* net.

MIDDLETON, C. H. All the Year Round Gardening Guide. Edited by P. Dyer. Revised edition. Cr. 8vo. Pp. 146. (London : Shaw Publishing Co., Ltd., 1946.) 2*s.* 6*d.* net.

Anatomy : Physiology

GOTTHOFFER, N. R. Gelatin in Nutrition and Medicine. Med. 8vo. Pp. xii +162. (Grayslake, Ill. : Grayslake Gelatin Co., 1945.)*

LEHMANN, F. E. Einführung in die physiologische Embryologie. (Lehrbücher und Monographien aus dem Gebiete der exakten Wissenschaften, 5.) Sup. Roy. 8vo. Pp. 414. (Basel : Verlag Birkhäuser, 1945.) 38 Schw. francs.*

SPENCER, A. M. Nurse's Textbook of Anatomy and Physiology. Demy 8vo. Pp. 286. (London : Faber and Faber, Ltd., 1946.) 8*s.* 6*d.* net.

Anthropology : Archæology

BROOM, R., and SCHEPERS, G. W. H. The South African Fossil Ape-Men—The Australopithecinae. (Transvaal Museum Memoir No. 2.) Demy 4to. Pp. 272 +18 plates. (Pretoria : Transvaal Museum, 1946.)*

FORD, Chellan Stearns. A Comparative Study of Human Reproduction. (Yale University Publications in Anthropology, No. 32.) Sup. Roy. 8vo. Pp. 112. (New Haven, Conn. : Yale University Press ; London : Oxford University Press, 1945.) 10*s.* net.*

MALINOWSKI, Bronislaw. The Dynamics of Culture Change : an Inquiry into Race Relations in Africa. Edited by Phyllis M. Kaberry. (Published on the Louis Stern Memorial Fund.) Roy. 8vo. Pp. xv +172. (New Haven, Conn. : Yale University Press ; London : Oxford University Press, 1945.) 16*s.* 6*d.* net.*

SAVE, K. J. The Warlis. Demy 8vo. Pp. x +280 +15 plates. (Bombay : Padma Publications, Ltd., 1945.) 10 rupees.*

Philosophy : Psychology

HARRIMAN, Philip Lawrence, Edited by, with the assistance of FREEMAN, Graydon LaVerne, HARTMANN, George W., LEWIN, Kurt, MASLOW, Arthur H., and SKINNER, Charles E. Twentieth Century Psychology : Recent Developments in Psychology. Med. 8vo. Pp. xv +712. (New York : Philosophical Library, Inc., 1946.) 6 dollars.*

HAVAS, F. de. The Equilibrium Theory of the Human Consciousness. Demy 8vo. Pp. 16. (Glasgow : W. and R. Holmes, 1946.) 2*s.* 8*d.*

KLEIN, Viola. The Feminine Character : History of an Ideology. (International Library of Sociology and Social Reconstruction.) Demy 8vo. Pp. xv +228. (London : Kegan Paul and Co., Ltd., 1946.) 12*s.* 6*d.* net.*

MacKINNEY, Loren C., ADAMS, Nicholson B., and RUSSELL, Harry K., Edited with a Foreword by. A State University Surveys the Humanities. (University of North Carolina Sesquicentennial Publications.) Med. 8vo. Pp. xi +262. (Chapel Hill, N.C. : University of North Carolina Press ; London : Oxford University Press, 1945.) 24*s.* net.*

PEPPER, Stephen C. The Basis of Criticism in the Arts. Demy 8vo. Pp. xi +177. (Cambridge, Mass. : Harvard University Press ; London : Oxford University Press, 1945.) 14*s.* net.*

Miscellany

BARLOW, K. E. A Home of Their Own. Demy 8vo. Pp. 96. (London : Faber and Faber, Ltd., 1946.) 4*s.* 6*d.* net.*

BUSH, Vannevar. Endless Horizons. Med. 8vo. Pp. ix +182. (Washington, D.C. : Public Affairs Press, 1946.) 2.50 dollars.*

GLOVER, A. H. T. New Teaching for a New Age. Ex. Cr. 8vo. Pp. ix +188 +20 plates. (Edinburgh and London : Thomas Nelson and Sons, Ltd., 1946.) 15*s.* net.*

JACKS, M. L. Total Education : a Plea for Synthesis. (International Library of Sociology and Social Reconstruction.) Demy 8vo. Pp. vii +160. (London : Kegan Paul and Co., Ltd., 1946.) 10*s.* 6*d.* net.*

OSBORN, F. J. Green-Belt Cities : the British Contribution. Demy 8vo. Pp. 191 +12 plates. (London : Faber and Faber, Ltd., 1946.) 12*s.* 6*d.* net.*

ROYAL SOCIETY. The Year Book of the Royal Society of London, 1946. (No. 50.) Demy 8vo. Pp. 196. (London : Royal Society, 1946.) 5*s.*

SMITH, Wilfred. Physical Survey of Merseyside : a Background to Town and Country Planning. Demy 8vo. Pp. v +97. (Liverpool : University Press of Liverpool, 1946.) 5*s.* net.*

WIGHT, Martin. Power Politics. (Looking Forward Pamphlets, No. 8.) Cr. 8vo. Pp. 68. (London and New York : Royal Institute of International Affairs, 1946.) 1*s.* net.*

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1946–47 : Dr. Ronald Bentley, Imperial College of Science and Technology, University of London, to Columbia University, in chemistry ; Dr. K. L. Blaxter, University of Reading, to the University of Illinois, in agriculture ; Dr. A. H. Cruickshank, University of Aberdeen, to Johns Hopkins University, in medicine ; Dr. C. E. Dalgliesh, Trinity College, Cambridge, to Harvard University, in chemistry ; P. V. Danckwerts, Balliol College, Oxford, to the Massachusetts Institute of Technology, in engineering ; A. B. Drought, University of Liverpool, to the Massachusetts Institute of Technology, in architecture ; J. W. Garmany, Rhodes University College, University of South Africa, and Queen's College, Oxford, to Princeton University, in economics ; G. O. Jones, Emmanuel College, Cambridge, to the Massachusetts Institute of Technology, in engineering ; J. P. Keane, University of Wales, Cardiff, and University of London, to Harvard University, in economics, political theory and public administration ; Charles Kemball, Trinity College, Cambridge, to Princeton University, in chemistry ; A. M. McKelvie, University of Glasgow, to the Mayo Clinic, in medicine ; F. S. Miles, University of St. Andrews, to Harvard University, in political science ; D. G. Northcott, St. John's College, Cambridge, to Princeton University, in mathematics ; Dr. D. J. O'Connor, Birkbeck College, University of London, to the University of Chicago, in philosophy ; W. M. Ogston, New College, Oxford, to the California Institute of Technology, in engineering ; D. J. Price, University of London, to the University of Pittsburg, in physics ; J. H. Read, University of St. Andrews, and Emmanuel College, Cambridge, in cinematography ; Cyril Reid, Imperial College of Science and Technology, University of London, to the University of California, in engineering ; I. P. Watt, St. John's College, Cambridge, to the University of California, in English literature ; D. H. Whiffen, St. John's College, Oxford, to Cornell University, in chemistry.

The Night Sky in August

Full moon occurs on August 12d. 22h. 26m. U.T. and new moon on August 26d. 21h. 07m. The following conjunctions with the moon take place : Aug. 3d. 01h., Jupiter 4° S. ; Aug. 24d. 16h., Saturn 3° S. ; Aug. 25d. 11h., Mercury 4° S. ; Aug. 29d. 18h., Mars 5° S. ; Aug. 30d. 11h., Venus 6° S. ; Aug. 30d. 18h., Jupiter 3° S. In addition to these conjunctions with the moon, the following conjunctions occur : Aug. 9d. 14h., Venus in conjunction with Mars, Venus 0·6° S. ; Aug. 31d. 00h., Venus in conjunction with Spica, Venus 0·2° N. Occultations of stars brighter than magnitude 6 are as follows : Aug. 15d. 23h. 00·8m., 24 B. Ceti (*R*) ; Aug. 21d. 00h. 10·7m., 129 H^1 Taur. (*R*). *R* refers to reappearance and the latitude of Greenwich is assumed. Mercury rises at 3h. 27m. and 3h. 52m. at the middle and end of the month respectively, and is visible in the eastern sky before sunrise. The planet is in inferior conjunction on Aug. 2 and is stationary on Aug. 12. Venus is a conspicuous object in the west, its times of setting being 21h. 12m., 20h. 36m., and 19h. 53m., at the beginning, middle and end of the month respectively. During the month the stellar magnitude of Venus varies from — 3·7 to — 3·9. Mars can be seen in the earlier part of the month, setting at 21h. 18m. on Aug. 1, but as the planet sets 1h. 10m. after the sun on Aug. 15, it is not well placed for observation after that date. Jupiter sets at 22h. 04m. on Aug. 1 and can be seen in the western sky in the constellation of Virgo. Towards the end of the month the planet is drawing too close to the sun for favourable observation. Saturn can be seen in the morning hours, rising at 3h. 40m. and 2h. at the beginning and end of the month respectively. The stellar magnitude of Saturn varies from 0·4 to 0·5 during August. The Perseid meteors attain their maximum about Aug. 10–12, but moonlight will prevent observations of any but very bright meteors during this period.

Announcements

The Royal Society is prepared to consider applications, through fellows of the Society, for a contribution towards the cost of travelling expenses when a scientific worker is invited for a specific purpose overseas by a national academy or other scientific institution of high standing.

Dr. H. T. Openshaw, lecturer in chemistry in the University of Manchester, known for his research work in the field of alkaloid chemistry, has been appointed to the Purdie lectureship in the Chemistry Department of the United College of St. Salvator and St. Leonard, University of St. Andrews.

Dr. F. D. Richardson, of University College, London, and Commonwealth fellow at Princeton University, has been appointed head of the Chemistry Department of the British Iron and Steel Research Association. During the War Dr. Richardson, who is a physical chemist, served in the Royal Navy in a scientific capacity ; he was associated with the development of equipment for dealing with magnetic mines, and eventually became deputy director of Miscellaneous Weapon Development.

On the recommendation of the honorary managing committee of the Bureau of Hygiene and Tropical Diseases, the Secretary of State for the Colonies has confirmed the appointment of Dr. Charles Wilcocks as director of the Bureau, and has appointed Dr. H. J. O'D. Burke-Gaffney to be assistant director. Dr. J. F. Corson, who since July 1943 had given his help as acting assistant director of the Bureau, retired on June 30, 1946.

The following have been elected officers of the Electrodepositors' Technical Society for 1946–47 : *President :* Dr. S. Wernick ; *Immediate Past President :* Dr. J. R. I. Hepburn ; *Vice-Presidents :* Dr. H. J. T. Ellingham, Dr. G. E. Gardam, F. L. James ; *Honorary Treasurer :* F. L. James ; *Deputy Hon. Secretary :* S. W. Baier.

The McGraw-Hill Book Co., Inc., New York, will publish shortly the complete texts of the papers and centennial addresses delivered at the George Westinghouse Centennial Forum, "Science and Life in the World", held under the sponsorship of the Westinghouse Educational Foundation during May 16–18. These symposia and addresses will be issued in the form of five books. In addition to the papers and addresses, the books will contain biographies of all of the speakers, a biographical sketch of George Westinghouse and his achievements, numerous portraits, text illustrations, and most of the audience questions and speakers' answers relative to each of the several papers. A list of all papers and addresses can be obtained from the McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York.

LETTERS TO THE EDITORS

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

Distribution of Wet Bulb Potential Temperature in Latitude and Altitude

If potential temperature is denoted by θ and wet bulb potential temperature by θ′, then log θ is proportional to the entropy of dry air and log θ′ to the entropy of the mixture of air and water vapour. Because air is compressible, entropy is a guide to its motion, and Sir Napier Shaw was the first to prepare a diagram of the variation of log θ or θ with latitude and height, and to use it as a text on which to expound the stratification of the atmosphere. When, however, cloud in convection penetrates the air strata, log θ′ takes the place of log θ as an operative factor. A world picture of θ′ is required to complement that of θ.

During the War, we prepared the diagram that is reproduced here, basing it upon the upper-air humidity data then available in India, namely, those of Batavia, of Indian stations up to 1940, English and German data up to 1937, and American *radio-sondes* of 1939–41. The data therefore were not representative of a single meridian, but the requisite smoothing has, it is believed, conserved the main features of the distribution, which may be summarized as follows.

1. Around the thermal equator, where much of the heat in the lower layers is in the form of latent heat, the θ′-lines assume the shape of a fountain, in marked contrast to the θ-lines, which by themselves are more suggestive of horizontal stratification[1]. On the other hand, wherever the concentration of water vapour is small, as it is near the poles and near and in the stratosphere, the lines of θ′ and θ approximately coincide.

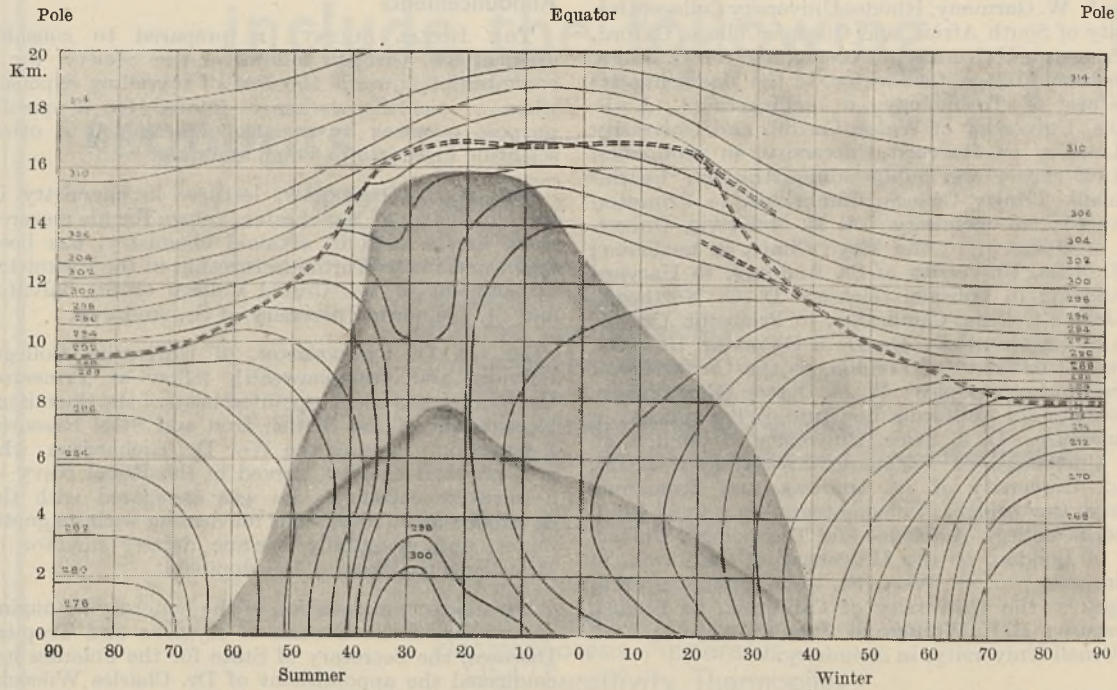
2. At all levels below 8 km., θ′ is maximum at the equator and minimum at the poles; but above 15 km. the minimum is over the equator and the maxima at the poles. Between 10 km. and 15 km. maxima occur both at the poles and near the equator, with minima between.

3. The lower shaded area around the thermal equator on the diagram marks out the region of *convective instability* within which θ′ normally diminishes with height and the lapse-rate of entropy is negative. This region appears to stretch from about lat. 40° in winter to lat. 60° in summer and to rise to a height of 6–8 km. near lat. 20° in summer.

4. The upper shaded area marks off the region in which θ′, though rising with height, is lower than the surface value θ'_0. The upper shaded boundary is drawn through the heights at which θ′ is equal to θ'_0. For example, at the equator, θ′ normally falls from a value of 295° A. at the surface to about 292° A. at 4 and 5 km., then rises slowly at higher levels and regains the surface value of 295° A. at a height of 13 km. When rising air becomes saturated, one would expect it normally to continue to rise out of the region of convective instability and to cease rising below the level at which θ′ regains the surface value. The total shaded area of the diagram may be termed the region of convective liability.

5. The shaded region nowhere extends into the stratosphere, the base of which is denoted by the broken double line. Over the thermal equator, however, the shaded area is seen to rise much higher than the polar stratosphere and almost to touch the equatorial stratosphere, thus giving support to the belief that convection is a main cause of the higher stratosphere over the equator. A critic may ask why, if this is so, the stratosphere is so much higher than the shaded convective area between lat. 10° and lat. 30° in winter; in other words, why is the convective region in this diagram so asymmetrical about the equator, whereas the height of the stratosphere is fairly symmetrical? This discrepancy is more apparent than real, at least in Indian longitudes, where the base of the stratosphere is always sharp and clear-cut and single-valued in summer, but is just one of several inversions in winter, from which the final choice is arbitrarily made by arithmetical rule rather than by any uniquely significant physical change.

It is to be noted that the tropical values in this diagram are drawn mainly from those of the Indian monsoon area, where the values of θ′ aloft are perhaps too great to be representative of all meridians. Between 1943 and 1945 the number of *radio-sonde* stations became so great that their unpublished observations may now be sufficient to show how the meridional sectional diagrams of θ and θ′ vary from one meridian to another.



Distribution of wet bulb potential temperature (θ′) with height

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K. Nagabhushana Rao

Poona, India.
June 13.

[1] See Brunt, "Physical and Dynamical Meteorology" (2nd edn.), 415.

Research on Free Animals, with Particular Reference to Fisheries

Management of animals that are free to wander presents man with a difficult problem. The Fisheries Research Board of Canada has been attempting for a dozen years or so to make rapid progress in solving that problem for Atlantic salmon. A certain measure of success has been attained and a pattern for treatment of the matter has gradually developed.

There have been two objectives: the first has been to make the salmon available for the best use—for angling, in which they are of high value for sport as well as for food; the second has been to increase their numbers. The problem presents two great difficulties: (1) the complexity of conditions in Nature, and (2) enumeration of animals wandering in a medium (water) foreign to man. Practice in fishery management has largely been rational, that is, based upon reasoning from the limited knowledge available. Empirical practice, based upon successful trial, has had little chance to develop, owing to difficulty or failure in assessing the results. Scientific practice, in which the result is predicted accurately, and economic practice, in which there is a proper relation between effort and result, are only for the future.

Three courses are open. (*a*) Rational practice may be continued indefinitely, as governmental fish culture has been in Canada and the United States for more than seventy years. (*b*) Scientific workers

may with their limited knowledge of the factors involved and with very considerable effort assess the result in a sufficiently great number of cases for statistically sound practice or non-practice in relation to presumed factors. (c) By research it may be possible to discover the most significant factors as a basis for scientific practice with the possibility of developing economic practice. Only the last should be recommended by the scientific worker, except when empirical success warrants continuation of practice.

To make salmon available for angling, they must be brought into the river from the sea. For this, knowledge is required of the factors determining salmon migration. In spite of an outstandingly successful trial on the River Grimersta in 1888[1], regular empirical use of artificial freshets to bring salmon in from the sea has not developed[2], and the rationale of the action of freshets has not been worked out. This is perhaps owing to man's thinking being preoccupied with the idea that the mature salmon in the sea is trying to find its way back to its home stream and that the scientific problem is to discover how it finds its way[3]. However, the facts indicate that, when at the river mouth, salmon may not try to enter for weeks on end until stimulated in some way. A freshet may provide the stimulus. In the very dry summer of 1942 on the Moser River, Nova Scotia, sharp artificial freshets resulted in the numbers of entering salmon and 'brook trout' (*Salvelinus fontinalis*) being doubled, as judged by the preceding three years[4]. This would not have been possible if these fish return only to the home stream. (Smolt marking indicated the next year that almost half the salmon were foreign.) High temperatures (higher than 70° F.) were considered responsible for the fact that very few of the salmon crowding the small river were taken with the fly. In 1943, the freshets were started as soon as salmon were moving in the estuary, and within a month a quarter of 474 salmon that had entered were taken by angling[5]. Then, a heavy flood and rising temperature stopped the angling and swept away counting fences and traps. Regular practice in water control is in prospect, and attempts are being made to elucidate factors that determine migration, such as current, turbulence, temperature, light and salinity.

To increase the salmon stock demands knowledge of the factors determining survival and growth of the fish. Since a female produces thousands of eggs, supply of new individuals is not apt to be much of a problem. Experiments are in progress to discover how cheaply salmon smolts can be produced in streams lacking native young salmon, by planting the young from hatcheries. Unless they can be produced economically as a preliminary to getting adult fish, there is no object in trying to compete with natural reproduction by planting hatchery fish in streams with native fish. Very great complexity of conditions in each stream makes scientific progress slow. Assessment of smolts, which was thought at first to be easily feasible by trapping them during descent, has given considerable trouble: (1) through failure of the trapping, as during heavy floods; (2) through the smolts not all descending, as with very low water or from above beaver dams; and (3) through anglers sometimes (low water) taking a very large proportion of them, and sometimes (high water) taking none. Assessment in the parr stage is seen to be needed and is being attempted. As the parr wander more or less, knowledge is required of the factors affecting not only their survival and growth, but also their movement. So far, predators are seen as the main explanation of disappearance of parr, so that control of bird predators[6] and provision of protective cover for the parr[7] are seen as promising practices.

This is an ecological problem, and the crux of it seems to have been given very little attention, doubtless because of the difficulties involved. In every case, the outcome depends upon *the response of the animal as a whole to what it faces where it lives.* To refer readily to this, a name is needed. 'Zoapocrisis' (ζῷον = animal, ἀπόκρισις = response) has been suggested. Its elucidation requires rather detailed knowledge of what the animal actually faces where it lives, which presents an initial task that is far from being an easy one. As an illustration, it is becoming apparent that salmon are, when in the sea, oriented riverward where there is a sufficiently steep gradient in salinity. Also, salmon evidently respond to current, which will take them upstream, only when it is sufficiently and finely turbulent. Zoapocrisis presents an almost virgin field for discovery.

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[1] Calderwood, W. L., "The Salmon Rivers and Lochs of Scotland", 312 (London, 1921).
[2] Coston, H. E. T., Pentelow, F. T. K., and Butcher, R. W., "River Management", 245. Philadelphia (Edinburgh, 1936).
[3] Chidester, F. E., *Brit. J. Exp. Biol.*, 2, 79 (1924).
[4] Huntsman, A. G., Ann. Rep. Fish. Res. Bd. Canada, 1942, 29 (1943).
[5] Huntsman, A. G., Ann. Rep. Fish. Res. Bd. Canada, 1943, 34 (1944).
[6] White, H. C., *Bull. Fish. Res. Bd. Canada*, **58** (1939).
[7] Huntsman, A. G., Ann. Rep. Fish. Res. Bd. Canada, 1945, 32 (1946).

Establishment of Cytochemical Techniques

IN his article on the "Establishment of Cytochemical Techniques"[1], Dr. J. F. Danielli directly or by inference questions the validity of very nearly the whole of cytochemistry. While there is no doubt that many workers have used cytochemical methods without fully considering the evidence for their validity, we feel that Dr. Danielli has gone to the opposite extreme.

Some of the tests that he mentions are usually made on fixed materials, where it must be supposed that part at least of the cell has been made insoluble. This process will cause just as much adsorption and shifting of substances as any cytochemical test applied afterwards. While it may be argued that artificial appearances are produced, yet something is shown that can be interpreted later in the light of our knowledge of the effects of reagents on cells. Every procedure that involves fixation is itself an experiment on a cell. The appearances produced by classical cytological methods do not represent exactly the structure of the living cell, but they enable us to make inferences about that structure. The same argument applies to cytochemical techniques.

The images given by different processes of fixation and staining are often so similar that one can scarcely doubt that the picture of the fixed material bears a close relation to the living structure, whatever the submicroscopic changes may be. For example, in the case of salivary gland chromosomes, different fixatives may be used, or unfixed cells may be photographed in ultra-violet light, and the picture is essentially the same.

The fact that the bands in salivary gland chromosomes that react positively to the Feulgen test correspond exactly to those that strongly absorb ultra-violet light of 2675 A. must mean one of two things: either (1) the bands that absorb ultra-violet light contain desoxypentose nucleic acid, or (2) the 'diffusible' Feulgen reaction product always diffuses to those very places that have an absorption spectrum that indicates that they could contain nucleic acid. The principle of 'Occam's razor' surely decides in favour of the first alternative. If the reaction product is in fact diffusible in the circumstances under which the test is performed, are we to suppose that it diffuses into the fluid in the jar in which the reagents do their work and then attaches itself to certain other parts of the cell selectively? Or does it migrate through the section? The first alternative seems unthinkable, for the reaction product would be far too dilute to produce a perceptible result; and the second is also very unlikely, because if the reaction product can diffuse through the tissues away from the place where it was first formed, it can also diffuse into the fluid in the jar and thus be lost.

It must be allowed that metallic impregnations are far less trustworthy than staining methods. The minute structure of a metallic precipitate is irrelevant. The position of the precipitate as a whole within the cell, however, is not necessarily so.

Dr. Danielli seems to doubt whether nuclei can in fact be isolated by maceration. In certain cases they cannot; but there seems to be no doubt that when the cell membrane is weak and the nuclear membrane strong, such isolation is possible. It is true that nuclei may be changed by such isolation, but there is no special reason for supposing that the process would cause substances formerly present in the cytoplasm to migrate into the nucleus and collect there in appreciable quantities. This would be particularly unlikely in the case of substances with large molecules. The identification of isolated mitochondria is less certain than that of nuclei, but when the shape, size and staining reactions resemble those of mitochondria *in situ*, there is a high degree of probability as to their identity; in fact, there are not many more bases on which identity could be assumed. It is a debatable point, however, whether the submicroscopical particles exist as such in the living cell.

Dr. Danielli's criticisms of maceration techniques apply as much to bio- as to cyto-chemistry, for many of the classical biochemical methods of making tissue extracts are themselves maceration procedures.

It is true that many enzymes are not specific as to substrate; but ribonuclease, a depolymerase, is highly specific for ribonucleic acid. There may be slight proteolytic activity even in crystalline preparations, but this is destroyed by heating to 80°–100° C. at slightly alkaline *p*H, while the action on ribonucleic acid remains intact. Purified enzymes are beginning to open out a new and promising line of attack on cytochemical problems. Long ago, Unna thought that one could stain a particular object in a cell, apply various solvents, and then draw conclusions as to the chemical composition of the object from a knowledge of its solubility or insolubility. We know now that Unna's 'chromolysis' was invalid: the solubilities of cell-constituents are profoundly changed by association with other substances. Reactions to certain purified enzymes, however, are invariable, and thus a new and valid chromolytic cytochemistry is made possible, the lysis being achieved by the action of enzymes instead of solvents.

Dr. Danielli suggests that if an object were composed of nucleic acid, but were covered by a monolayer of protein, nuclease would be unable to exert any effect. We question the existence of such monolayers in the fixed tissues to which the nuclease is applied.

Although we cannot accept all Dr. Danielli's criticisms, for the reasons we have given, yet we fully appreciate the need for greater care in accepting the results of cytochemical tests at their face value. We think, however, that the tests themselves should be the main targets for criticism, rather than the localization of the reaction products. We suggest that any change of position, particularly in the case of large molecules, may be an affair of A. rather than of μ; and it is with μ that cytologists are at present concerned. Many so-called histochemical and cytochemical tests are used without full consideration of the bases of their supposed validity. If Dr. Danielli's article encourages a more critical attitude in this respect, it will serve a very useful purpose.

We thank Prof. A. C. Hardy, Mr. P. B. Medawar, Dr. G. Bourne and Mr. A. J. Cain, with whom we have discussed Dr. Danielli's article.

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June 15.

[1] Danielli, J. F., *Nature*, **157**, 755 (1946).

WHILE I welcome a measure of support which Drs. Baker and Sanders give to my criticisms of cytochemical techniques, their letter leaves no doubt that the principle underlying my article has evaded them. My remarks do not, and were not intended to, invalidate "nearly the whole of cytochemistry". What my article does is point out that, in cytochemistry, too much reliance has been placed on arguments which have not been rigorously demonstrated as true. There are suggestive inductive arguments in favour of many techniques in current use, and these arguments have in the past been of great value as a guide to further research. But the time has now come when their premises must be critically examined by experiment,

and the range of their validity established by deductive reasoning. As this is the main point at issue, I shall not endeavour to answer Drs. Baker and Sanders point by point, but shall restrict myself to illustrating the difference in our points of view from three of their points, one of which is a false deduction; the others illustrate the weakness of induction.

1. Drs. Baker and Sanders are strongly tempted to deduce that all regions absorbing strongly in the vicinity of 2675 A. must contain desoxypentose nucleic acid. This is not the only possible deduction. Absorption at 2675 A. is a characteristic of purine-pyrimidine and other groups, so that many compounds other than nucleic acid may absorb in this region. Thus a possible alternative cause of absorption in this region would be the presence of a protein containing purine-pyrimidine groups. Between this and nucleic acid there is a profound difference. To proceed with their argument on this matter, the principle of 'Occam's razor' is invoked. But this principle cannot be used to decide which of two alternatives is true. The correct use of the principle is in deciding which alternative appears the more sensible working hypothesis to adopt. That Feulgen's reaction indicates the site of desoxyribose nucleic acid seems to me to be a very sound working hypothesis. But let us not elevate this hypothesis to the plane of fact without conclusive (and this at the moment means new) evidence.

2. Apropos of my point that a monolayer of protein would protect nucleic acid from the action of nuclease, these authors remark, "We question the existence of such monolayers in the fixed tissues". But it is not sufficient to question their existence. The facts of Nature are not affected by questioning. What is established is that monolayers of protein exist in cells, and no one who has had practical experience in studying these monolayers can fail to be impressed by the mechanical strength they may exhibit[1,2]. What is necessary is investigation of the extent to which protective action against enzymes is in fact provided by monolayers and thin polymolecular layers.

3. Consider one of Drs. Baker and Sanders' final remarks: "We suggest that any change of position, particularly in the case of large molecules, may be an affair of A. rather than of a". How very much simpler cytochemistry would be if we were certain this were true! And how difficult it is to establish this for any particular molecular species! But, as my teacher, N. K. Adam, once remarked to me (with due cause), that a task is difficult does not make its performance any the less essential.

Every cytologist must appreciate the valuable contributions of Drs. Baker and Sanders to cytology. I am most appreciative of the interest they and their distinguished colleagues have taken in my views, and regret that I had not made the main point of my article clearer to them.

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[1] Harvey, E. N., and Danielli, J. F., *Biol. Rev.*, 13, 319 (1938).
[2] Höber, R., "Physical Chemistry of Cells" (Philadelphia: Blakiston, 1945).

Source and Fate of the Zooxanthellæ of the Visceral Mass of *Tridacna elongata*

Zooxanthellæ have been recorded from the visceral mass of *Tridacna* by Yonge[1], who assigned to them together with those of the mantle edge a very significant role in nutrition. According to this author the zooxanthellæ are transported, by means of the blood-cells via the blood stream, from the mantle edge where they are 'farmed' to the visceral mass where they undergo phagocytic digestion.

The food and the digestive processes of the Lamellibranchiata in general and *Tridacna* in particular were referred to in my previous communication[2]. As to the blood-cells and the blood-stream being means of transportation of the zooxanthellæ from the mantle edge to the visceral mass, it must be mentioned that in both *Tridacna elongata* and *T. squamosa* the zooxanthellæ in the mantle edge were never seen within amœbocytes, nor was the blood in the heart or in the main vessels ever found containing zooxanthellæ of any description.

Examination of a number of specimens of *Tridacna elongata* differing in age showed that it is only in the visceral mass of young individuals that the zooxanthellæ actually occur. In the youngest specimen examined (2 cm. in length) the zooxanthellæ were found in the delicate layer lining the muscular wall of the visceral mass, especially in the dorsal region below the heart. In this site the zooxanthellæ are free not engulfed, in amœbocytes, but simply exist in the meshes of this very delicate layer where they form a distinct bed reaching in some places eight zooxanthellæ in depth. In such young specimens zooxanthellæ, either free or within amœbocytes, were found also in the deeper regions of the visceral mass. Here also some zooxanthellæ were found in groups surrounded by aggregations of both ordinary and granular blood-cells. In slightly bigger specimens (5 cm.) the zooxanthellæ-bed referred to above was comparatively thin. In the same specimens, the groups of zooxanthellæ surrounded by blood-cells showed definite signs of degeneration (Fig. *a*). In still bigger specimens (10 cm.) the delicate layer lining the muscle-wall was found to be almost free of zooxanthellæ while the surrounded zooxanthellæ were reduced to a mass of unrecognizable debris.

This debris seems to be cleared out mainly through the agency of the kidneys. Paired well-defined openings (Fig. *b*) were found to put in direct communication with one another the cavity of the visceral mass and the intertubular spaces of the kidneys. Through these openings pass numerous zooxanthellæ, whole or in different stages of destruction, as well as plenty of debris-loaded blood-cells.

It is clear, therefore, that the zooxanthellæ in question are quite independent of those of the mantle edge. In all probability they started life in the visceral mass itself after a separate infection at an early stage. With the growth of the animal, the light penetrating into the visceral mass decreases, to the detriment of these zooxanthellæ, and thus the blood-cells are given a chance to clear them out of this region of the body in the way mentioned above.

The processes leading to the ultimate disappearance of the zooxanthellæ and their remains after transportation to the kidneys are still unknown.

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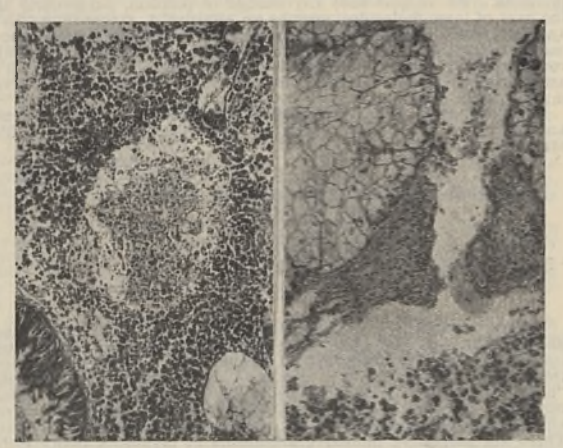
Cairo.
June 9.

[1] Yonge, C. M., Great Barrier Reef Expedition Sci. Rep., 1, No. 1 (1936).
[2] Mansour, K., *Nature*, 157, 482 (1946).

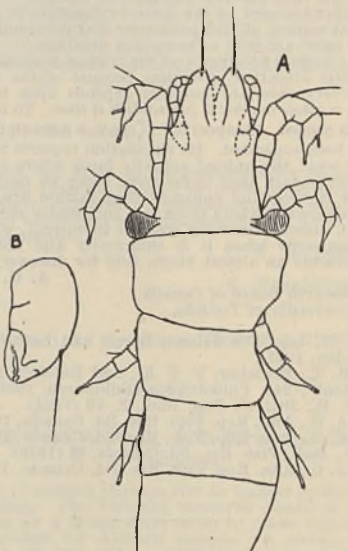


(*a*) (*b*)
× 100.

A New Acarine Parasite of Bees

While conducting a survey of the ectoparasites of bees in and about Durban, Natal, during 1940, five specimens of the adult females of a remarkable new acarine were collected from two species of bees, *Apis unicolor* var. *adamsoni* Latr., and *Anthophora fallax*.

The female, which shows very definite segmentation, presents the general facies of the family Tarsonemidæ and is provided with large pseudostigmatic clavate organs as shown in the drawing, between legs I and II.



Pediculochelus raulti sp. nov.: (*a*) female in ventral view; (*b*) 'pincer' of chelicera in side view

The mouthparts, however, revealed the most extraordinary features. The cheliceræ instead of being very slender and needle-like, as in the Tarsonemidæ, are powerful structures consisting of two arms, the movements of which take place in a vertical direction. They resemble very powerful pincers. It is interesting to note that the upper arm of each chelicera is provided with a prominent seta as shown in the accompanying figure. The palps are not filiform but free and limb-like, being divided into six distinct segments.

There are four pairs of well-developed legs. No claws could be distinguished, but the legs terminate in a sort of sucking disk. It was impossible to find any trace of a respiratory system.

The genital opening, which is located just behind the level of coxal IV, is represented by a longitudinal slit with a pair of minute sucker-like structures on each side. As can be seen in the accompanying figure, the anus is terminal.

These mites are extremely minute, measurements of four specimens studied being as follows.

Specimen	I	II	III	IV
Length	240 μ	196 μ	184 μ	220 μ
Breadth	64 μ	56 μ	64 μ	48 μ

The length was measured from the tip of the cheliceræ to the tip of the abdomen; the breadth at the level of leg II.

No males were recovered, though a large number of bees were examined.

A new family Pediculochelidæ and genus *Pediculochelus* is erected to receive this most interesting species, which is named *Pediculochelus raulti* after Mr. P. Rault, of Mount Edgecombe, who was instrumental in discovering the new species.

A further communication will appear shortly.

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May 20.

A New Method for the Study of Renal Tubular Excretion in Birds

THE existence of a renal portal circulation in birds has hitherto lacked experimental confirmation. In order to investigate this question, the following method has been adopted.

At each ureteral opening in the cloaca of a chicken, a small funnel is attached by sutures. The operation is performed under local anæsthesia of the cloacal mucosa. This arrangement permits the separate collection of the urine from each kidney. Phenol red is then injected intramuscularly into one of the legs, and the amount of the dye excreted by each kidney is determined.

In every instance far more phenol red (on an average about three times as much) is excreted by the kidney on the side of the injection than by the other. It is clear that at least part of the venous blood from the legs passes through the capillaries of the kidney.

The arrangement used in these experiments seems to be well suited to the study of tubular excretion. By using this method it has been possible to show that hippuric acid and menthylglucuronide are excreted by the tubules in the chicken. Hippuric acid depresses the excretion of phenol red and menthylglucuronide.

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June 4.

Transformation of the Kidney into an Exclusively Endocrine Organ

USING a special surgical technique, it is possible to transform one of the kidneys of the rat into an exclusively endocrine organ.

The technique is based upon the fact that, in order to permit filtration, the hydrostatic pressure in the glomerular capillaries of the kidney must be much higher than in the other capillary territories. Indeed, it is indispensable for urine formation that the hydrostatic pressure in the tuft capillaries be greater than the sum of the osmotic pressure of the blood and the hydrostatic pressure of the filtrate in the spaces of Bowmann's capsules.

By placing the style of a subcutaneous injection needle parallel with the aorta and tying a silk thread around both aorta and style, a partial constriction of the aorta can be obtained which decreases the lumen approximately to the width of the style. The latter is subsequently removed, so that circulation re-establishes itself, but the constriction, if placed between the origins of the two renal arteries, decreases the pressure in the left (lower) renal artery far below the level required for normal filtration. By choosing styles commensurate with the size of the rat, it is possible to decrease filtration pressure exactly to the level where urine formation ceases, but the nutrition of the renal parenchyme does not suffer.

Since the exact gauging of the degree of constriction needs considerable practice, a greater safety margin may be secured by simultaneously occluding the left ureter, transecting it between two ligatures. Under such conditions, a slight and transitory hydronephrosis builds up some hydrostatic pressure; but afterwards, when filtration ceases and the fluid in the renal pelvis is absorbed, the kidney is transformed into an exclusively endocrine organ. Ureter occlusion without preliminary arterial constriction would result in pronounced and permanent hydronephrosis with pressure atrophy of the entire renal parenchyme.

Histological study has shown that the tubular epithelia of such kidneys lose their brush border, and the lumina of the nephrons become filled with proliferating, well-preserved parenchymal cells. Treatment with renotrophic steroids or renotrophic pituitary extracts may even induce active mitotic proliferation in the completely 'endocrine kidney'.

The increased pressor substance production of such kidneys manifests itself, within a period of about ten days, by the development of myocarditis, nephrosclerosis of the contralateral kidney and widespread periarteritis nodosa. No such lesions are observed if the 'endocrine kidney' is removed, and hence these pathological lesions are regarded as due to the increased hormone production of the transformed kidney

A detailed communication on this subject will appear in the *Journal of Urology*.

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June 25.

Reciprocal Effects due to Stimulation of the Spinal Cord by Constant Currents of Opposite Direction

ALTHOUGH the occurrence of slow electrotonic potentials which act as exciting agents has been demonstrated in the spinal cord, only a few investigations in which the cord was stimulated artificially by constant currents have been reported. Barron and Matthews[1] showed that polarization of the central part of the motor neurons evoked rhythmical responses when the cathode was placed on the cord and the anode on the root, whereas regular responses were only occasionally obtained if the current was reversed.

In the course of an analysis of the activity in the spinal cord, in which a special technique[2] involving stimulation with slowly rising currents was used, I observed that the extent to which extensor and flexor responses predominated was partly determined by the direction of the stimulating current. Many different electrode positions were tried, but only the results from a few typical arrangements will be described here. In ten cats the lumbar region of the spinal cord was exposed and the dorsal roots cut, while in five others the ventral surface of the medulla and the cord between the base of the skull and the first vertebra was laid bare and the dorsal roots left intact. The strength of the stimulating current was gradually increased to threshold and supra-threshold values. In some experiments a simultaneous recording of the action currents from two opposed muscles was made; in others the effects were determined by observation of the movements of the intact leg.

In one arrangement, in which both stimulating electrodes were placed on the lateral surface of the lumbar cord, one above the other and several centimetres apart, it was found that when the upper (cranial) electrode was the anode, stimulation with currents of moderate strength caused extension, while a reversal of the current gave flexion of the corresponding hind leg. When only one electrode was placed on the cord (near the entrance of a motor root) and the other (indifferent electrode) on the dorsal muscles, the effects were most pronounced in the extensors when the cord electrode was positive and in the flexors when it was negative. The reciprocal effects were more or less selective in different experiments. In some of these, in which the muscle action currents were recorded, considerable activity was found in the active muscle (for example, tibialis anticus) but none in the opposing muscle (soleus). However, if the stimulation was sufficiently great, both groups of muscles were activated. Under some conditions, breaking the current produced an effect in the muscles opposed to those activated during the current flow.

When the stimulating electrodes were placed on the cord or the medulla below the decussation of the pyradimal tracts, the reciprocal effects were still more pronounced. With one electrode on the cord, some millimetres from the mid-line, a pronounced extension of both fore and hind legs of the same side was produced if the active electrode was the anode, while flexion resulted from a reversal of the current. If both electrodes were placed on the cord at the same level, the positive on one tract and the negative on the other, an extension of the limbs on one side simultaneously with flexion on the other was observed. Selective responses to different directions of the stimulus in functionally different parts of one and the same muscle were also seen.

The effects described may be due either to different inherent properties of the excitable structures (cf. Skoglund[3]) or to differences in anatomical orientation of the elements in relation to current flow.

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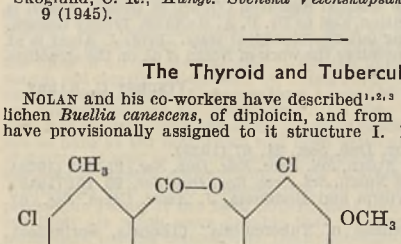
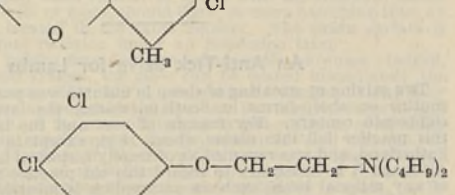
[1] Barron, D. H., and Matthews, B. H. C., *J. Physiol.*, **92**, 276 (1938).
[2] Skoglund, C. R., *Acta physiol. Scand.*, **4**, Suppl. 12 (1942).
[3] Skoglund, C. R., *Kungl. Svenska Vetenskapsakademiens Handl.*, **21**. 9 (1945).

The Thyroid and Tuberculosis

NOLAN and his co-workers have described[1,2,3] the isolation from the lichen *Buellia canescens*, of diploicin, and from constitutional studies have provisionally assigned to it structure I. Diploicin is insoluble



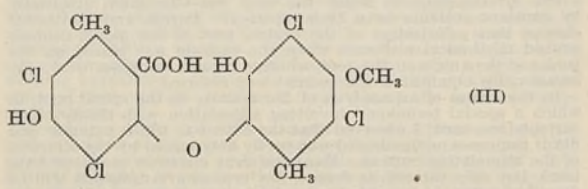
(I)



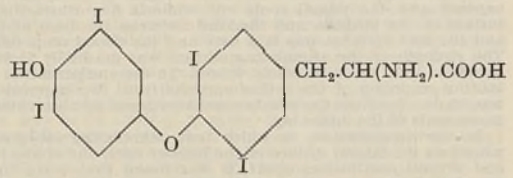
(II)

in water, and for this reason its antibacterial activity was not examined by us *in vitro*. Iodinated and chlorinated phenyl ethers of type II have been shown, however, by Burger, Brindley, Wilson and Bernheim[4] to have tuberculostatic activity *in vitro*. A closer study of the diploicin molecule was, therefore, considered desirable.

As every position in the benzene nuclei in I is occupied, the simplest method of rendering the molecule soluble is by opening the depside ring, thus introducing an extra phenolic hydroxyl and a carboxyl group into the molecule. When this change is brought about by the action of alcoholic potash, under mild conditions, an ester is formed. With aqueous alkali, however, a solution of the sodium salt of the acid is readily obtained. A neutral solution of this compound, III, inhibits completely the growth *in vitro* of *Mycobacterium smegmatis* at a dilution of 1/70,000 and *Myco. tuberculosis* at a dilution of 1/100,000 for 42 days.



(III)



(V)

The carboxyl group in III is very unstable and in the presence of alkali readily loses carbon dioxide, forming a decarboxylated compound, IV, which is very much less soluble. It has not, however, suffered any diminution in antibacterial power. It is of interest that both III and IV inhibit completely the growth *in vitro* of *Corynebacterium diphtheriæ* (*mitis*) at a dilution of 1/100,000.

The only known substance, of the halogenated diphenyl ether type, occurring normally in the animal body is thyroxine (V), and its resemblance to diploicin suggested to me that hyperactivity of the thyroid gland, resulting in excessive secretion of thyroxine, might provide a defence against the spread of tubercular infection in the animal body.

Subsequent examination of the literature has shown considerable evidence that tuberculosis rarely develops in association with hyperthyroidism, and that the thyroid gland is seldom attacked by tuberculosis. It is also believed that hypothyroidism predisposes to tuberculosis[5].

The experimental fact which would serve as a connecting link between diploicin and thyroxine has not so far been found. Thyroxine does not appear to exert any effect on the growth *in vitro* of the tubercle bacillus. Neither has it been possible to show, so far, that oral administration of diploicin to guinea pigs produces any of the symptoms usually associated with hyperactivity of the thyroid gland. A limited animal protection experiment with diploicin is at the moment being carried out.

The amount of thyroxine in the animal body at any time is probably too small, in any event, to have a direct effect on the tubercle bacilli, and possibly the resistance to the spread of tubercular infection in hyperthyroid cases is due to an indirect action as, for example, the hyperplasia of lymphoid tissue which takes place. While admitting that the hypothesis may prove to be invalid, the coincidence is too striking to be passed over without thorough investigation.

I am grateful to the Medical Research Council of Ireland, which is financing this investigation, and to Dr. P. A. McNally, Trinity College, Dublin, who is carrying out the biological tests. Prof. J. Algar is at present engaged in completing the work of Nolan *et al.* on the structure of the diploicin molecule.

VINCENT C. BARRY

University College,
Dublin.
June 22.

[1] Nolan, *Sci. Proc. Roy. Dub. Soc.*, **21**, 67 (1935).
[2] Spillane, Keane and Nolan, *Sci. Proc. Roy. Dub. Soc.*, **21**, 333 (1936).
[3] Davidson, Keane and Nolan, *Sci. Proc. Roy. Dub. Soc.*, **23**, 151 (1943).
[4] Burger, Brindley, Wilson and Bernheim, *J. Amer. Chem. Soc.*, 67 1416 (1945).
[5] Rich, "The Pathogenesis of Tuberculosis" (Thomas, Springfield, Illinois, 1944).

An Anti-Tick Salve for Lambs

THE salving or smearing of sheep in autumn was part of the normal routine on sheep-farms in Scotland during the latter half of the eighteenth century. For reasons of cost and the labour involved, this practice fell into disuse about 1860, except in the County of Sutherland, and was regarded as of merely historical interest by 1900. Although it is customary to regard this old practice as being devoid of any rational basis, such an assumption is incorrect, since it was generally recognized that, as well as receiving increased protection from adverse weather, salved sheep yielded heavier fleeces of washed wool than sheep whose fleeces had not been 'laid', when the animals were herded under comparable conditions.

One of the main purposes of salving, however, was to combat external parasites; and, although the subject is controversial it may not be entirely fortuitous that complaints of losses from 'trembling' *rise* steadily during the years following the cessation of this ancient practice in sheep husbandry. It is now known that the sheep tick, *Ixodes ricinus*, is involved in the transmission of three fatal or highly debilitating diseases of sheep, namely, (i) trembling or louping-ill, (ii) tick-borne fever, and (iii) tick-pyæmia; but whereas measures have been devised which give considerable protection to adult sheep against these diseases or their vector, no really effective and practical measure for lambs has hitherto been found.

With the objective of remedying the defect, field trials were conducted this spring in west Perthshire, Argyll and Islay, using an anti-tick salve on lambs throughout the seasonal period of tick activity—a period which closely coincides with the lambing season. In former times, the standard smear or salve consisted of a mixture of lard and wood-tar (applied to the skin after parting the wool at intervals of about two inches), but in the above trials the salves used were—(*a*) dibutyl phthalate, 20 per cent; and (*b*) dibutyl phthalate, 10 per cent plus D.D.T., 10 per cent; both chemicals being incorporated in a lanoline base. The salve was applied to the lambs on the regions of the body where ticks tend to congregate, namely, lower jaw, ears, belly, legs and particularly the axillæ and groin. Each lamb received 2 oz. of salve within four days of birth, although experience indicates that 1·5 oz. is enough.

From the results of salving 160 lambs in heavily tick-infested districts, it was found that the lambs were given a very high degree of protection from ticks for one month, and considerable protection for an additional fortnight. An unexpected feature is that the two salves are almost equally effective. These salves are, therefore, valuable aids in protecting lambs from the direct and indirect effects of 'tick-bite', during the most critical period of their lives: and should greatly minimize the inordinate losses and unthriftiness among hill-lambs.

I take the opportunity of expressing my thanks to Dr. D. D. Pratt of the Chemical Research Laboratory, Teddington, for his invaluable assistance, and also to the agricultural organisers in the respective counties for their enthusiastic co-operation.

D. STEWART MACLAGAN

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June 21.

An Agent Delaying the Absorption of Penicillin

THE rapid absorption and excretion of penicillin necessitates frequent injections at short intervals. Polyvinyl alcohol and a beeswax-peanut oil mixture have been suggested as agents causing slow release of injected penicillin. The successful use of the beeswax-peanut oil mixture, and a number of reports in the literature, seem to point to the advantage of suspended dry penicillin in a water-free base. The beeswax-peanut oil mixture has the disadvantage that the insect wax is foreign to the mammalian body. In the preparation described below, a highly purified fat, extracted from normal mammalian depot fat, is used in a certain mixture with peanut oil. In this way the portion which has the higher melting point is not foreign to the body. Peanut oil has a low melting point and is known to be easily dealt with in the body.

Depot fat from oxen was carefully freed from connective tissue, blood, etc., finely cut and extracted with acetone in a Soxhlet apparatus. The extract was dried under reduced pressure. The dried material was then extracted with ether in a Soxhlet, the extract dried with anhydrous sodium sulphate and the ether removed under reduced pressure. The melting point was adjusted to 35–36° by addition of peanut oil. The preparation was sterilized and further dried in a dry oven (45 min., 160°). This altered the melting point but little. Finely powdered penicillin was suspended evenly throughout the molten mixture at 37°, approximately 50,000 units/ml. For injection the preparation was melted again in a water bath. Controls received the same amount of penicillin in an aqueous solution.

Owing to a fortunate hysteresis, the once molten mixture solidified much below its melting point. The needle only needed slight warming, and injection was easy by means of a syringe which was not warmed beforehand. The molten mixture passed easily through needles of a size often used for injections in man (8/10 mm.).

Blood was taken from the rabbits by cardiac puncture under sterile conditions, at intervals after the injection. Typical results (penicillin units/ml. serum) are shown in the following table.

Hours after subcutaneous injection (45,000 units)	3	4	6	8
Control		<0·03	<0·03	<0·03
Slow release prep. No. 3	1·06		0·26	0·06
Slow release prep. No. 3	1·06		0·26	>0·03
Slow release prep. No. 4		1·06		0·26

In no case was a local irritation, or indeed any marked reaction, seen on the site of the injection, at various intervals after it. Fourteen days after injection of 2·5 ml. into one rat, only small round and oval particles with smooth surfaces were found locally. To the naked eye these appeared very much like normal depot fat. Sections stained with Ehrlich's hæmatoxylin and Sudan IV showed no trace of local inflammation or any pathological reaction around the numerous fat particles; the immediately adjoining muscle and connective tissue were of normal appearance.

We are greatly indebted to Dr. A. P. Peeney of the Department of Bacteriology, Queen Elizabeth Hospital, for having determined the

concentrations of penicillin in the rabbit sera. Trials on man are being carried out by Dr. Peeney, and will be communicated by him. We are also indebted to Mr. G. A. Rowe for the histological sections, and to Glaxo Laboratories for presenting us with a generous supply of penicillin.

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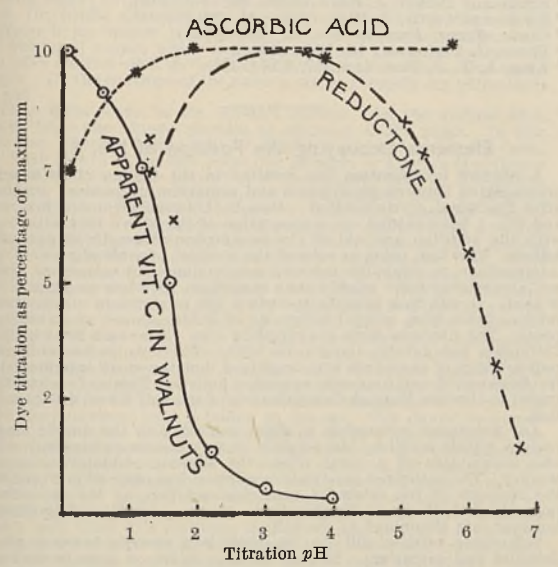
Effect of *p*H in the Dye Titration of Vitamin C in Certain Plant Materials

In the estimation of vitamin C in plant materials by titration with 2 : 6 dichlorophenolindophenol, it has hitherto been generally assumed that the dye titration value is sufficiently independent of the titration *p*H to make it unnecessary to control the latter at all precisely. The usual procedure of preparing extracts with metaphosphoric or trichloracetic acid solutions to inhibit the action of ascorbic acid oxidase results in a *p*H which may range from 0·8 to 1·5, or even higher, according to the experimental conditions.

So far as ascorbic acid *per se* is concerned, this assumption may be justified by the findings by Martius and Euler[1] in 1934 that the dye titration value is practically constant from *p*H 4 down to *p*H 2, and then falls only slightly until the *p*H is reduced well below 1. When, however, ascorbic acid is being estimated in the presence of certain substances such as reductone, it has to be borne in mind that the dye titration value of the latter is not so constant as that of ascorbic acid. Martius and Euler found that under certain conditions the dye titration value of reductone falls rapidly as the *p*H is lowered below its optimum of 3–4, and that at *p*H 1 it might be decreased by 30 per cent. Their results for reductone and ascorbic acid are collated in the accompanying graph, and are in general agreement with results obtained here.

Recent work in these laboratories has shown the presence in different walnut extracts of a non-specific dye reductant clearly differentiated from ascorbic acid spectroscopically and by its reaction with formaldehyde and ascorbic acid oxidase and closely resembling reductone in its properties, especially in regard to its reaction with the above dye. It differs from reductone in the effect of *p*H on its dye titration value, which is at a maximum at a *p*H below 0·2–0·3 and falls as the *p*H rises until it reaches a minimum at *p*H 3·5–4·0. The graph includes a typical curve obtained with an extract of the mesocarp of *Juglans regia*, in which ascorbic acid had first been removed by treatment with formaldehyde at *p*H 4·5. (This treatment has no appreciable effect on the non-specific dye reductant, which is practically unattacked by formaldehyde during the time necessary for carrying out an estimation.) The results were obtained by visual and potentiometric methods previously described[2], and have been confirmed in numerous experiments on different walnut tissues in which the titration time ranged from 1 to 11 minutes. Taken in conjunction with the findings of Martius and Euler they indicate that:

(*a*) When ascorbic acid is being estimated by the dye titration in materials containing interfering substances such as have been encountered in walnuts, considerable errors may be caused by failure to allow for the effect of the titration *p*H, especially with a method employing titrations at two widely different *p*H values[3]. This may, in fact, explain certain discrepancies previously encountered[4] between results given by different methods.



Effect of titration *p*H on dye titration value of ascorbic acid and reductone (taken from data of Martius and Euler) and of apparent vitamin C in walnuts (obtained by destroying true vitamin C with formaldehyde at *p*H 4·5)

(*b*) Walnuts may contain interfering dye reductants other than the glucoreductone and closely related compounds such as reductic acid and dihydroxymaleic acid, which are sometimes included in the generic term 'reductones'. In order to avoid premature conclusions, it would therefore seem advisable at present to avoid applying the name 'reductones' to substances in walnuts.

Full details of these results will be published elsewhere.

Frank Wokes

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June 25.

[1] Martius, C., and Euler, H. V., *Biochem. Z.*, **271**, 9 (1934).
[2] Wokes, F., Organ, J. G., and Jacoby, F. C., *J. Soc. Chem. Ind.*, **62**, 232 (1943).
[3] Mapson, L. W., *J. Soc. Chem. Ind.*, **62**, 223 (1943).
[4] Melville, R., Wokes, F., and Organ, J. G., *Nature*, **152**, 447 (1943).

Enzymic Oxidation of Ascorbic Acid by Apples

In 1937, Johnson and Zilva[1] confirmed the fact that cabbage, cauliflower, cucumber and marrow contained an enzyme capable of oxidizing ascorbic acid directly, but reported that no such enzyme could be found in apple or potato. In respect of apples they pointed out that in the presence of catechol or of apple juice, the phenolases of apple oxidized ascorbic acid indirectly, but that ascorbic acid oxidase activity could not be demonstrated in the absence of phenolase activity, either in crude juice, filtered juice, or tissue extract.

Experiments carried out in this laboratory on the respiration of slices of apple tissue indicated that in Granny Smith apples ascorbic acid might be directly oxidized by an enzyme. The presence of this enzyme was confirmed by cutting Granny Smith apples into small pieces, freezing them, and expressing the juice by squeezing the tissue through muslin. The filtered juice oxidized ascorbic acid but showed no phenolase activity. Filtered juice which had been boiled for a few seconds showed very little activity towards ascorbic acid. The rate of oxidation was measured in a Warburg apparatus.

Attempts to isolate the enzyme responsible for the oxidation of ascorbic acid, using the method of Tauber, Kleiner and Mishkind[2], have so far yielded precipitates with little or no activity, but by the use of Szent-Györgyi's method[3] precipitates of relatively high activity were obtained. The yields were of the order of 1 milligram of dry precipitate per gram of fresh tissue. At *p*H 5·9 and 25° C., the specific activity of the preparation towards ascorbic acid,

$$W, \left(\frac{\text{mm.}^3\ O_2\ \text{taken up}}{\text{mgm. enzyme} \times \text{minutes}}\right),$$

varied from 0·02 to 0·1. The enzyme preparation had no phenolase activity; this indicates that ascorbic acid was oxidized directly.

Enzyme preparations showing similar behaviour have been obtained from Jonathan and from Cox's Orange Pippin apples.

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Frances M. V. Hackney

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[1] Johnson, S. W., and Zilva, S. S., *Biochem. J.*, **31**, 438 (1937).
[2] Tauber, H., Kleiner, I. S., and Mishkind, D., *J. Biol. Chem.*, **110**, 211 (1935).
[3] Szent-Györgyi, A., *J. Biol. Chem.*, **90**, 385 (1931).

Thermally Evaporated Anti-Reflexion Films

In a recent communication[1], J. Bannon has described a technique for hard-baking magnesium fluoride films on glass surfaces; this prompts us to discuss briefly our own experience.

These laboratories have been engaged in large-scale production of hard-bake magnesium fluoride since 1943. From this year until October 1946 both the quality of our films as well as the production efficiency has steadily improved. In the initial experiments we baked the films in an air oven at 390° C. for the harder glasses. For some reason not clearly understood, we were able to harden films deposited on the softer glasses at temperatures around 375° C. On the basis of our earlier attempts we believe that: (1) films baked in an air oven were not consistently satisfactory for mass production; (2) films were not so hard as the best which had been vacuum-baked; (3) the type of source, as well as the degassing procedure followed in conditioning the fluoride before coating, affects the hardness.

Although U.S. Army Specification No. 51–70–4B was used as a production check, it has been noticed that more than 90 per cent of our films are much more durable than the test would indicate. A really hard coating deposited on the hypotenuse of a 7 × 50 binocular prism, for example, when rubbed 20 cycles with the standard eraser at pressures of 10 lb. or more, should show no more hairlining than an uncoated prism treated in the same manner. The prism surface is viewed by internal reflexion under an inspection lamp.

The length of baking time does not influence the hardness. Indeed, in a well-degassed system, the glass can be coated immediately the working temperature (250°–300° C.) is reached. Longer baking may help to condition a contaminated system, but the hardness is not improved thereby. A factor contributing to soft coatings, even under adequate heating conditions, is the deposition of 'slow fluoride' on the glass as an undercoat. By the use of this term we indicate molecular rays, the components of which have been slowed down by collision (*a*) at the walls of the chamber, (*b*) with other molecules in space, (*c*) by energy absorption in the molten material of the fluoride source, or (*d*) by low-temperature evaporation. Such molecular rays, it is safe to assume, impinge on the glass surface at low velocity. As an undercoat they give rise to films having poor adhesion to the surface no

matter what the deposition velocity of the molecules constituting the outer layers may be. Conditions (*a*) and (*b*) can be avoided by properly placed shields and by fast pumping; conditions (*c*) and (*d*) are improved by the use of a radiant heater source in preference to a boat.

Closely associated with the foregoing phenomena is the trouble experienced when coating optics on two surfaces. We had noticed that it was difficult to secure a really hard coating on the second side of two-surface optics. The effect was investigated by covering one half of the rear surface of a flat specimen with a cover glass. The front surface was then coated in a normal manner, after which the specimen was turned over and coated on the second side without the cover. Interference colour showed the presence of a thicker layer on that portion of the second surface left unprotected. Moreover, when the eraser test was applied across the line dividing the two halves, hairlining started abruptly at the exposed portion, thus indicating a softer coat. To make sure that the extra deposit was not caused by the heaters (behind the holding fixture), the same experiment was performed with the half-covered side facing the source. The latter was baffled with a cover plate and run for the normal length of time. Next the cover-glass was removed from the specimen and a coating applied in the usual way. The results were identical with the first experiment. Even low-temperature degassing of the source with baffle in position was found to deposit a noticeable undercoat. We surmise that the undercoating observed in the foregoing experiments was a deposit of 'slow fluoride' which reaches the glass by successive collisions rather than direct evaporation from the source. The installation of faster pumps, namely, Distillation Products, Inc.—MC 500, and the development of a special pellet source, which requires no degassing, has practically eliminated trouble due to secondary coating.

It is imperative to avoid the formation of magnesium oxide by excessive muffling or similar treatment in the preparation of pure magnesium fluoride: otherwise a magnesium oxide 'skin', which has a higher melting point than the magnesium fluoride, will form during evaporation and completely cover the surface of the material. It is this layer which causes 'spatter' and consequent pitting of the optics to be filmed.

It might be of interest to mention that with the pellet source and faster pumps, a complete coating cycle from load to unload has been reduced to twenty minutes.

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May 21.

[1] Bannon J., *Nature*, **157**, 446 (1946).

Molecular Rotation in Keratin

It has been shown by Fricke and others[1,2] that the dielectric constant of gelatin-water systems may rise to abnormally large values as the water content is increased to about 50 per cent, with a consequent increase in the dielectric dispersion. They suggest that these phenomena may be either due to rotation of dipole ion groups present in gelatin which have been loosened by the sorbed water, or alternatively to the outer layers of less firmly bound water, in excess of the monolayer, which by concerted rotation exhibit 'ferro-electric' properties.

Recent work in these laboratories has shown that such abnormal phenomena are apparent in the case of the sorption of polar substances such as water, formic acid, and methyl alcohol by horn keratin. Moreover, even in the case of water where the mol fraction of the absorbate is greatest for a given mass absorbed, Cassie's[3] values show that there is insufficient water present in excess of the monolayer to allow the formation of groups of preferentially orientated water molecules in reasonable numbers, even for water contents so high as 20 per cent.

If the increase in dielectric constant were a function of the absorbate only, one should expect some correlation between the increase in dielectric constant and the dipole moment of the absorbate, assuming the increase to be due chiefly to the mobile fraction of the absorbate.

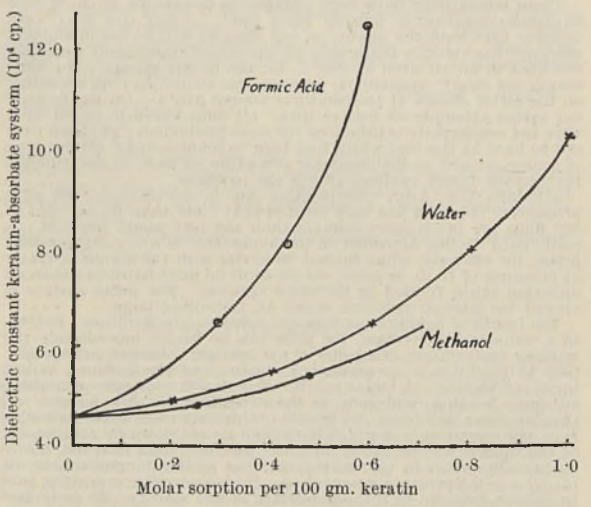

Fig. 1

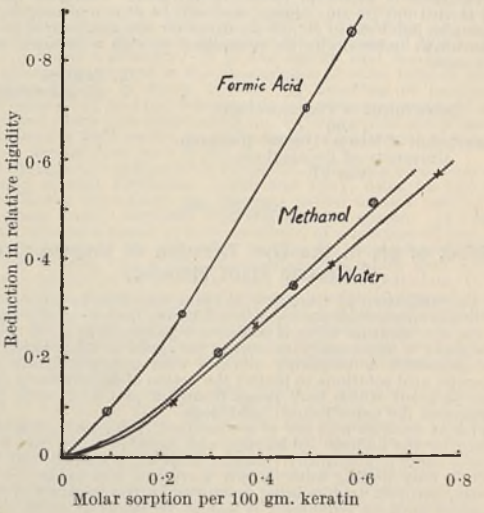

Fig. 2

Fig. 1 shows that this is not true for all three cases investigated. For a given mol fraction absorbed, formic acid, with a dipole moment of about 1·2 E.S.U., produces a much greater increase in dielectric constant of the keratin sorbate system than either water (dipole moment 1·85 E.S.U.) or methyl alcohol (dipole moment 1·7 E.S.U.).

Fricke and his collaborators point out the connexion between the dielectric dispersion and the mechanical properties of the gelatin-water system; namely, factors which increase the dispersion give rise to increased elasticity of the gelatin. Experiment shows this to be also true for keratin. The modulus of rigidity of a wool fibre was determined by the method of torsional oscillation[4] for increasing mol fractions of absorbate, using water, formic acid, and methyl alcohol (Fig. 2). Swelling corrections were obtained from A. T. King's[5] results for a wool-water system, assuming similar relations to hold for the other absorbates; any errors involved should not affect the general trend of the results.

It is seen that methyl alcohol and water have roughly the same effect on both the rigidity and dielectric constant of keratin, while formic acid exhibits a greatly enhanced effect in either instance for equal molar sorption. Such evidence supports the hypothesis that increased rotation of polar groups in the polypeptide chains is responsible for both effects.

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June 22.

[1] Fricke and Parker, *J. Phys. Chem.*, **44**, 716 (1940).
[2] Fricke and Curtis, *J. Phys. Chem.*, **41**, 729 (1937).
[3] Cassie, *Trans. Faraday Soc.*, **41**, 450 (1945).
[4] Pierce, *J. Text. Inst.*, **15**, T501 (1924).
[5] King, A. T., *J. Text. Inst.*, **17**, T53 (1926).

Elements Occupying the Position of No. 61

A recent investigation has resulted in the finding of actinium[1] accumulated between neodymium and samarium magnesium nitrates after fractional crystallization; that is, between elements Nos. 60 and 62. I have carried out a separation of the above two salts, but with the addition and aid of the isomorphous bismuth magnesium nitrate. This last, using as solvent the weakest possible nitric acid, is intermediate in solubility between neodymium and samarium, and not appreciably more soluble than samarium, as when stronger acid is used. It was thus possible to reduce the neodymium – samarium intermediates from several kilograms of oxides almost to vanishing point. The products were examined by Drs. Collie and Roaf in the Clarendon Laboratory, Oxford, in 1937. The now well-established radioactivity of samarium was confirmed, but the small intermediate fractions were found to possess a stronger activity. This was eventually traced to thorium through determination of the half-life of the emanation.

Any substance possessing a slight solubility in the double magnesium nitrate solution, but tending to accumulate at the head, will also accumulate at a point where the solution suddenly becomes weaker. The saturated neodymium solution has only 40 per cent of the strength of the saturated samarium solution, so the ascending impurity is held up at the junction. Gross quantities of thorium, however, are eliminated at the tail.

Sometimes yttrium will also be found in a position between neodymium and samarium. Though its ionic radius is close to that of holmium, in atomic volume as determined from the metal density[2] it is slightly less than neodymium and would be greater than samarium if the decrement between neodymium and samarium was normal. Actually, however, samarium has an abnormally large atomic volume, a peculiarity which it shares with the other two lanthanates

having bivalent properties. In the solubility of the ferricyanide[3] and in several basic precipitation processes[4], yttrium is intermediate between neodymium and samarium. No abnormalities associated with bivalency are observed in these cases. In the atomic state, yttrium appears to be interpolated six places earlier, that is, larger, in the lanthanide series than when in the ionic form. Its electron density is lower, and the three additional electrons cause a greater proportional increase in size than in the lanthanide series.

The position which should be occupied by element No. 61 in the rare-earth series appears to be capable of being filled in various circumstances by actinium, thorium, bismuth or yttrium.

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[1] Takvorian, *Ann. chim.*, (xi), **20**, 113 (1945).
[2] Klemm and Bommer, *Z. anorg. Chem.*, **231**, 138 (1937).
[3] Prandtl and Mohr, *Z. anorg. Chem.*, **236**, 243; **237**, 160 (1938).
[4] See Moeller and Kremers, *Chem. Rev.*, **37**, 130 (1945).

Supersonic Cries of Bats

DR. GRIFFIN has recently published[1] some further observations on the cries of bats, which are of great interest. He demonstrates clearly that the pulse of sound is often extremely short, having a duration which usually does not exceed 2·3 milliseconds. He also finds that the frequency of the supersonic tone alters during the pulse, having a frequency, for example, of 80 kc. at the beginning, dropping to less than 50 kc. at the end. This drop of somewhat less than an octave seems to be typical. The records which Dr. Griffin has obtained are very convincing on both these points.

What are not so convincing are his arguments with regard to the mode of production of the supersonic tone. In my paper I advanced the hypothesis that this is emitted through the snout, rather than through the mouth. I also suggested that the buzz and click originated in different structures from those responsible for the production of the supersonic tone. With both these suggestions Dr. Griffin disagrees. He thinks emission takes place through the mouth, and that the three sounds just mentioned are all produced by the same structure.

With regard to the first point: he says that plugging the anterior nares of a bat does not prevent the production of the supersonic tone; secondly, when bats are feeding, the supersonic tone is interrupted; further, if the mouth is sealed with collodion, bats do not fly until they have scraped an opening into the mouth cavity; lastly, covering the nostrils causes an increase in the audible component of a bat's cry.

My comments on the above are as follows: Spallanzani found that plugging the nostrils of a bat caused acute respiratory embarrassment. Why was it that Dr. Griffin did not find the same thing? With regard to the second point, it seems to me much more likely that the interruption during feeding is not produced by the closure of the mouth cavity, but by the act of swallowing. No mammal can both swallow and speak at the same time, because the food-stream has to pass across the ducts which convey the air-stream from the nose to the larynx. Thirdly, since bats do not fly for fun, but to collect food, it would be quite useless for a bat to fly while its lips are sealed in such a manner that food cannot gain access to the mouth cavity. Lastly, it seems to me to be likely that the increase in the audible component of the bat's cry, on sealing the nose, is due to the increased efforts which are necessary in order to force a sufficiently intense supersonic tone for localizing purposes through the mouth cavity.

With regard to the click and buzz which accompany the supersonic tone, Dr. Griffin advances the following arguments: (1) there is no evidence in his records of the presence of a low frequency component; (2) whispered sounds which had approximately the same loudness as the bat's audible click gave cathode ray deflexions which were easily visible; (3) the envelope of the pulse is rather abruptly cut off towards its end.

These facts prove, in Dr. Griffin's opinion, that the audible click results from the abrupt starting or stopping of the pulse. In this case also, I have a feeling that Dr. Griffin is misinterpreting the facts. (1) With regard to the first point, the presence or absence of evidence depends entirely on the properties of the amplifier used by Dr. Griffin. It might be that such low-frequency components, even if present, do not adequately disclose themselves, because of amplifier defects. (2) The fact that whispered sounds produce a visible record does not throw any light on this point because, as is well known, such sounds consist essentially of quite high-pitched components. (3) With regard to the envelope of the pulse, it is true that there are some differences between their beginnings and endings. In Fig. 1 they are about equally abrupt; in Fig. 2 the beginning is much more abrupt than the end; in Fig. 3 the end is much more abrupt than the beginning; in Fig. 4 it is a little difficult to draw any exact conclusion, so that, to my mind, the evidence is far from clear on this point.

If the tympanic membrane and ossicles of a bat act together as a rectifier for the incoming sound, then on the analogy of electricity, one would expect a pulsating direct-current component to be present when the supersonic tone is falling on the ear. This should be appreciated as a musical tone, the frequency of which would depend on the number of pulses per second of the supersonic tone. It is not suggested that this musical tone would be a pure one: on the contrary, Dr. Griffin's records demonstrate clearly that some over-tones would be present. But a musical tone accompanied by over-tones is not at all what a human listener perceives, for Galambos and Griffin describe it as a buzz when it is recurring time after time and as a click when it takes place singly. Dijkgraaf describes the sound as a rattling one. These descriptions do not seem to me to tally at all with what I would have expected from audio-frequency components produced by the incidence of the supersonic tone on the ear. Is it not much more likely that the buzz, click or rattle is produced quite separately from the supersonic tone, that is, by a structure different from the vocal cords?

In my article in *Nature*, I suggested the false cords as the originators of these noises; it is possible that the laryngeal orifice is used instead. One or other of these structures being shut, the air pressure in the lungs is raised by muscular contraction, the orifice in question is then suddenly opened, causing a burst of high-pressure air to pass between the vocal cords; at first the pressure is high and the vibrations rapid, but as the pressure drops the frequency drops at the same time.

There are two further points in favour of the view that the supersonic tone is emitted through the nose. It was pointed out to me that the nasal cavities of a bat are almost in a straight line with its vocal cords, thus supersonic tones would have an uninterrupted course out through the anterior nares. Secondly, that the snout, modified into a flat plate as it is in some bats, would be a much more efficient emitting surface for a supersonic tone than would the mouth, which contains the soft structure of variable shape, namely, the tongue.

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[1] *Nature*, **158**, 46 (1946).

Chaos, International and Inter-molecular

STATISTICS of wars have been collected from the whole world for the 120 years beginning with A.D. 1820. Attention was directed to the number of nations, or other large belligerent groups, on each side of any war. Accordingly, wars were classified as 1 group versus 1 group, or as 2 versus 1, or as 2 versus 2, and in general as r versus s. The number of wars of each of these types was counted. The result was a fairly regular statistical distribution, having a peculiar shape. Among a total of 91 wars there were 42 of the type '1 versus 1', 24 of the type '2 versus 1', and not more than five wars of any one more complicated type. The simplest type of encounter was the most frequent.

In a gas at N.T.P. encounters of two molecules are much more frequent than encounters of three, as is well known from chemical experiments. This resemblance between a gas and the political world suggested a theory for each of them. The frequency of an encounter, of specified type, can be regarded, after the manner of Bernoulli, as the product of the following three factors. (i) The number of mutually exclusive encounters of that type. (ii) The probability that the opponents encounter one another. In this factor the probabilities for the separate pairs of opponents combine by multiplication. That is the chief reason why, in the chaos, complicated encounters are rarer than simple encounters. (iii) The probability that all the other nations, or molecules, keep out of the encounter. Strange to say, this third factor escaped the attention of the authors of the classical theory of gases. Consequently at high densities a proportion of the encounters which Guldberg, Waage and their modern successors have regarded as binary, are now shown to be ternary. How this affects the chemistry depends on whether, for molecules, 'two can be company but three none'.

Although three factors of the aforesaid sort are likely to appear in the theory of any chaos, yet their particular forms depend on circumstances; so that many varieties of chaos are conceivable. In the political world there were restrictions depending on geography and on sea-power. When they had been formulated, another effect became conspicuous, namely, the infectiousness of local fighting.

The justifications of the foregoing brief statements have been accepted for publication, those concerning gases in the *Proceedings of the Royal Society*, and those concerning the political world in the *Journal of the Royal Statistical Society*.

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Robert Hooke's Letter of December 9, 1679, to Isaac Newton

THE correspondence between Hooke and Newton in November and December 1679 dealing with experiments on falling bodies led to bitterness and to the final break between them. But "it must be looked upon as one of the greatest and most fortunate events, since it was the direct cause of the composition of the Principia".

When W. W. Rouse Ball published this Hooke–Newton correspondence in 1893, two of the letters were missing. Jean Pelseneer published one which had been found and which is now in the British Museum ("Une lettre inedite de Newton", *Isis*, **12**; 1929). Hooke's letter of December 9, 1679, the rough contents of which were known from the minutes of the meeting of the Royal Society on December 11, the last missing link in this correspondence, has just been rediscovered by me and is in my possession. It is the letter of which Pemberton says that it "put him [Newton] on inquiring what was the real figure in which a body, let fall from a high place, descends, taking the motion of the earth round its axis into consideration", and which caused Brewster ("Life of Newton", 1855, I, p. 291) to add "this gave occasion to his resuming his former thoughts".

The letter covers two folio pages with diagrams; it was at the end of the last century in the collection of Alfred Morrison (1821–97), the well-known collector. It is not described in the thirteen-volume catalogue of the "Morrison Collection of Autographs" (1883–96), nor was its importance recognized by later owners after it was sold on April 19, 1918, at Sotheby's. The publication of the full text is better left to other hands.

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ROYAL SOCIETY EMPIRE SCIENTIFIC CONFERENCE

Recommendations

AT the Royal Society Empire Scientific Conference during June 17–July 8, discussions took place on a number of topics, and recommendations representing interpretations of the general views of delegates and guests were framed by the steering groups for each of the discussions. We print the recommendations below.

Outstanding Problems in Agricultural Science in the British Empire

1. A Conference of soil surveyors and pedologists should be set up to consider the development of soil surveys in general and to co-ordinate methods of soil classification.

2. Work is required on the structure of clays, of humus, and of the clay-humus complex, requiring advance of technique in studying finely divided material.

3. Work is required on the ion-water atmosphere surrounding colloidal bodies, including living organisms, root hair, and on the structure and binding force of the water. This should include a study of reaction in interpenetrating atmospheres.

(2 and 3 together should throw much light on the agricultural problems of soil structures, aggregation and stability to alternations of wetting and drying, anti-erosion properties, availability and fixation of plant nutrients and inhibition of uptake of one plant nutrient in the presence of another, for example, Ca : K balance.)

4. Further study is required in the subject of soil microbiology. This should include the relation of soil micro-organisms to soil organic matter, the availability of inorganic plant nutrients and plant pathology as well as such taxonomic work as may be necessary.

5. It is recommended that efforts should be made to evolve both methods and apparatus for studying the nature of the stress-strain relationships in soil in particular relation to cultivations.

6. Special study is required of the developmental and physiological action of the root in relation to its environment. This involves the study of (*a*) the water relations, (*b*) the mineral relations of the root as well as root secretions and excretions.

7. Physiological development of plants in relation to environment, especially temperature and light (intensity, duration and quality and therefore artificial and natural 'shade') should be studied.

8. Investigations are required on the following problems : (*a*) quantitative inheritance ; (*b*) incompatibility and sterility of wide crosses ; (*c*) the induction of polyploids and the possibility of inducing desirable mutations ; (*d*) breeding methods.

9. Investigations are needed on the epidemiology of fungal, insect and virus organisms and on pathogenic species in relation to strain specialization.

10. Further investigation should be made into methods of control of fungal, insect and virus attacks, especially the possibility of breeding for disease resistance and the nature of such resistance.

11. Climatic surveys, both regional and local, are accepted as a pre-requisite to the investigation of agricultural problems. There should be provided throughout the Commonwealth and Empire a series of meteorological stations measuring daily rainfall, free water surface evaporation, relative humidity, day and night temperature of the shaded and unshaded atmosphere and the quality and intensity of daylight.

12. Both reconnaissance and detailed soil surveys should be available as a basis for ecological and physiological investigations of the field problems and concerning agriculture.

13. Ecological studies of the natural vegetation should form part of regional surveys designed to afford an integrated pattern of climatic and soil relationships. For this reason, vegetational surveys need, whenever possible, to accompany soil surveys.

14. Animal physiology on a general basis and including all the chief domestic animals should be specifically studied. This is the need basic to research on nearly all kinds of practical livestock problems, including those of pathology. The study (biochemical and microbiological) of ruminant digestion is a good example.

15. There is a dearth of men with ample knowledge of domestic animal physiology. Steps should be taken to encourage their training and their subsequent employment.

16. More knowledge is required of metabolism and enzyme systems of spermatozoa and of ova.

All through the session there was insistence on the manifest dependence of agricultural science on further developments in the basic sciences.

Physiological and Psychological Factors Affecting Human Life under Tropical Conditions and in Industry

General. The Conference surveyed certain of the results obtained during the War in the laboratories of the Medical Research Council at Cambridge and London, and in the Department of Physiology, University of Queensland. It was agreed that much of this work had a general application to many countries of the Empire. It was agreed further that facilities for developing this work, both in laboratories in the 'field' and in suitably equipped centres in the United Kingdom and Dominions, were desirable.

Special recommendations. 1. Physiological and psychological research carried out under artificial conditions for war-time purposes needs to be extended to actual conditions in the tropics and to industries in which high temperatures are encountered. This would require the establishment at suitable centres (for example, in Africa and in the Far East) of well-equipped laboratories. These should work in close contact with similar laboratories in the United Kingdom and Australia, in which the more basic research should be carried out.

2. Research on output in industry in the tropics needs to be done as data are practically non-existent. Investigation is required also into the habitability problems of clothing, housing and transport.

3. Attention is directed to the need for improvement of instruments for the study of climatic factors.

4. An authoritative guide on standards for building (domestic and industrial) in the tropics on the lines of the reports of the Building Research Station of the Department of Scientific and Industrial Research is desirable.

5. War-time standards of ventilating practice in the Services need to be reviewed in relation to civilian and industrial conditions in the tropics. A revision of existing scales of warmth and comfort is urgently required.

6. There is a definite need for co-ordination within the Commonwealth. This should take the form of exchange both of workers and of information. It is suggested that a co-ordinating Empire Committee on Human Climatology should be set up. This would include workers in physiology, psychology, industrial hygiene, the related aspects of nutrition and also representatives from the allied field of tropical animal physiology.

7. It is strongly recommended that provision be made for a number of research fellowships for Colonial medical graduates, to enable them to carry out research in climatological laboratories.

8. The participation, by the Commonwealth countries concerned, in a co-operative study of air-conditioning and the consequent engineering developments, is recommended.

Etiology and Control of Infectious and Transmissible Diseases

General. 1. The Conference, having regard to the present state of knowledge of the ecology of infectious diseases, feels that there are grave dangers of spread from one part of the Empire to another and within certain Empire countries. Particular attention was directed to malaria, yellow fever, schistosomiasis, trypanosomiasis, plague and cholera.

2. More knowledge of the ecology of infectious diseases, their arthropod vectors, their reservoir hosts and the reasons for the persistence of infection in localized endemic areas is needed. The attention of universities and other authorities should be invited to the need in many parts of the Empire for ecologists and entomologists, both medical and non-medical.

Special recommendations. 1. That an international organisation should be established under the United Nations Organisation to prevent the spread of diseases from endemic to non-endemic areas. Such an organisation would : (*a*) control vaccination and inoculation in connexion with diseases to which these or other such precautions may be held to be applicable ; (*b*) ensure the freedom of aeroplanes, aerodromes, ships and other facilities for travel between different countries, from insects and other media of infection ; (*c*) secure uniformity in regulations regarding certificates required by travellers between different countries ; (*d*) devise such methods of administration as would avoid vexations and unnecessary impediments to the movement of travellers or goods.

The Conference notes that existing regulations at airports and other transit centres are unsatisfactory owing to a shortage of trained sanitary inspectors and other medical personnel. It would direct attention to the availability of a substantial pool of junior personnel suitable for recruitment into the required sanitary service, among ex-Service men and women, particularly in India and the Colonies.

2. For the prevention of the spread of certain diseases from endemic to non-endemic areas within particular countries, the Conference urges that local and permanent organisations are required for containing and controlling the diseases in the endemic areas. Particular reference is made to cholera and plague.

The Science of Nutrition with Particular Reference to the Special Problems of the Empire, including the Nutritional Status of the Indigenous Peoples of the Colonies

Preamble. The Conference recognizes that the improvement of the nutritional status of the peoples of the Commonwealth is a part of general social and economic policy in the territories concerned. It urges the necessity for developing at all levels of Colonial government a proper awareness of the nutritional needs of the indigenous peoples.

The Conference strongly supports the need for integrating the efforts of producer, consumer, technical and administrative personnel in effecting improvements in nutrition. In this connexion the suggestion put forward at the first session of the Conference of the Food and Agriculture Organisation for the achievement of such integration is welcomed.

The Conference agreed upon the evidence of malnutrition in the Empire, both as to quantity and quality, and urges that measures should be applied immediately for the improvement of the present position.

Special recommendations. 1. Immediate therapy of vitamin-deficiency diseases, particularly vitamin B_1 for beriberi in Malaya and Hong Kong, iodine in goitrous areas in Nigeria, calcium and vitamin D in areas where rickets occurs in the Gold Coast, iron where anæmia is common, especially in British Guiana.

2. The introduction into the diet of indigenous peoples of nutritional supplements, such as iodine, calcium, iron.

3. Improved methods of storing, processing and distributing foodstuffs, such as better methods of milling wheat and maize, the parboiling of rice, the drying of fish, fruit and vegetables. The Conference urges the need for more food technologists in this connexion.

4. Increased production of the 'protective foods' through : (*a*) the control of livestock diseases ; improved animal husbandry and animal breeding, especially of local strains, with the object both of increasing the productivity of the native pastoralist's herds and of developing dairy types suited for use in native mixed farming areas ; (*b*) increased and improved fishing operations with the following general objectives : (i) fishery exploration and fish catching (fishery engineering) ; (ii) fish processing and technology ; (iii) fishery biology and hydrography ; (iv) development of great lake fisheries together with fish culture in fresh and brackish waters.

5. Increased food production generally by : (*a*) the greater use of fertilizers ; (*b*) the extension of plant breeding. More plant surveys and an increase in the number of trained plant breeders are urgently required for this purpose, particularly in the African Continent.

Modern Methods of Mapping and Exploration by Air

The Conference agreed that the use of radar would much reduce the time required for the making of maps. In view of the importance of completing the topographical mapping of various parts of the Commonwealth for the purpose of economic development, the Conference put forward the following recommendations :

1. Research and development in radar and photographic equipment and techniques in air survey

should be vigorously pursued, if the full scientific and economic advantages of these methods are to be obtained in all parts of the Commonwealth.

2. The appropriate authorities should be approached with the view of increasing the number of persons trained to conduct further research in these subjects.

Scientific Information Services

General. The Conference invites the Royal Society at an early date to convene a conference of the libraries, societies and institutions responsible for abstracting and information services, in order to examine the possibility of improvement in existing methods of collection, indexing and distribution of scientific literature, and for the extension of existing abstracting services. The Conference would pay particular regard to the cost of such services and to the need for funds from Government sources for their support.

In the proposed conference: (1) Representatives of the appropriate authorities in the Dominions, India and the Colonies should be included, together with observers from the United States. (2) The interests of scientific men as users of scientific information should be especially considered. (3) Consideration should be given to the abstracting of Dominion journals locally, for transmission to the main abstracting bodies in the United Kingdom.

Special recommendations. 1. Consideration should be given to the establishment of a network of information services throughout the Dominions. Such a network would provide central focal points and for a two-way transmission of matter (either direct or through existing local centres adapted for the purpose).

2. In view of the need of the scientific worker for possession of individual scientific papers on his own subject, the possibility of the publication, classification and distribution of papers in separate form or as reprints should be considered.

3. The issue of occasional reviews of special branches of science, both for the specialist and for the general scientific reader, is considered desirable as a supplement to other forms of publication.

4. The extended provision of micro-film and other forms of documentary reproduction is considered important for the rapid transfer of information throughout the Commonwealth. An economic service for the purpose requires centres in the United Kingdom and in each of the Dominions.

5. The Conference recognizes that the qualifications of staff in scientific information services and special libraries call for special training and selection, and recommends the provision of facilities for increasing the number of properly trained staff.

Interchange of Scientific Workers throughout the Empire, and the Future of War-time Scientific Liaison Offices

The Conference agrees that interchange of scientific staffs, both of universities and research institutions, is of vital importance to the maintenance and development of scientific research within the Commonwealth and Empire.

1. To promote such interchange the Conference strongly urges upon all the responsible authorities the urgent need for: (i) adequate provision by universities and research institutions to enable the senior and junior scientific staffs to take periodical leave for overseas visits, both short- and long-term; (ii) the raising of staff complements to a level sufficient to afford individuals adequate time for research and for study or for special leave without thereby placing additional burdens on their colleagues; (iii) provision of the largest practicable number of travelling scholarships for post-graduate work (see also 2 (ii) below); (iv) a system of adequate financial provision for travelling and subsistence allowances to avoid loss to the individual due to differences in living costs in different countries; this is to apply both for members of university staffs and for holders of travelling scholarships; (v) the provision of resources to enable the invitation of scientific workers from overseas for short periods to advise or for collaboration in specific research projects; (vi) the exemption of all travelling scholarships and allowances from income tax either in the country of origin or of reception.

2. To the same ends the Conference further recommends: (i) an official policy for continuance and development of a system of Commonwealth liaison offices as being an essential part of the machinery for facilitating interchange of scientific workers and activities connected therewith, and directs that the attention of the Official Conference be invited to the matter; (ii) urges the need for the central compilation and publication of a list of scholarship facilities existing within the Commonwealth and proposes that the task be entrusted to whatever organisation may be employed for centralizing scientific information services; (iii) invites the attention of the Official Conference to the need for the adoption of a uniform superannuation scheme for the Commonwealth to facilitate transfers without prejudice to such rights; (iv) notes with anxiety the serious handicap to interchange caused by the high cost of sea and air transport, and invites the Royal Society to initiate action with the appropriate organisations to remedy the position.

Empire Co-operation in the Scientific Field with Existing and Projected International Organisations

1. The Conference recommends that the delegations should advise their Governments to adhere to each of the international scientific unions, to the International Council of Scientific Unions and to other recognized international scientific organisations.

2. The Conference recommends that scientific correspondents be appointed in Colonial territories to establish and maintain direct contact in scientific matters with the operational agencies of the United Nations and with other recognized international bodies.

3. The Conference would heartily welcome a policy on the part of the United Nations and its operating agencies to make the utmost use of all scientific bodies which are doing valuable work of an international scientific character and would stress the importance of preserving the independence of such bodies and of leaving the control of their activities to scientific men.

4. The Conference recommends that each delegation should advise its Government and the established scientific institutions of its country to collaborate closely with any organisation of the United Nations concerned with the promotion of science and its applications.

Standards of Measurement

1. (*a*) It is considered highly desirable that early steps should be taken to eliminate the slight difference in the values of the yard and pound at present in use in the Commonwealth and in the United States of America.

(*b*) It is recommended that discussions should be pursued with the appropriate authorities in the United States with the view of reaching mutual agreement on this question (as a basis of recommendations to Commonwealth authorities) and that the Director of the National Physical Laboratory, Teddington, should act in this matter on behalf of National Laboratories in the Commonwealth.

The Conference suggests that: (i) the reformed units should be precisely related to the corresponding metric units; (ii) tentative values for conversion factors should be as follows: 1 yard = 0·9144 metre exactly, or 1 inch = 25·4 mm.; 1 lb. = 0·453 592 37 kgm. or 0·453 592 3 kgm.

2. The Conference advocates the adoption of the metric system in all fields of science. Examples of subjects in which an improvement in this respect is desirable are aeronautics and pharmaceutical science.

3. If text-books and scientific data or memoirs are expressed in systems other than the metric, conversion factors or the metric equivalent should be included.

4. The Dominions and India should participate in the organisation of the Convention du Mètre.

5. There should be meetings at suitable intervals of representatives of the Commonwealth National Laboratories to consider: (*a*) the maintenance of uniformity of standards of measurements; (*b*) general programmes of research in regard to fundamental scientific standards. The National Physical Laboratory in Great Britain should act as the co-ordinating body. The Conference emphasized the importance of mobility of workers between the various laboratories.

6. Within the Commonwealth there should be organised a service of radio transmissions at standard frequencies which, together with those of the United States, would suffice to meet the needs of the Empire.

7. The United Nations Standards Organisation be asked to give consideration to the question of nomenclature and symbols at the international level, taking into account, so far as is practicable, both scientific and industrial usages.

8. The Conference records its appreciation of the advances which have been made in the international standardization of biological materials and noted with satisfaction that much of this standardization is now brought on to a physical and chemical basis.

Collection of Scientific Records and Material and Risks Involved in the Distribution of Plants, Seeds and Animals

1. Having regard to the limitations of space and scientific man-power, we recommend a policy of rationalization in respect to research collections for taxonomy. To this end the avowed scope and objective should be publicly stated by each institution, especially as to the particular groups for which it accepts responsibility of intensive representation.

2. When new species are described, replicates should, where possible, be provided for major cosmopolitan collections and for those institutions where the group concerned is intensively studied. For unique specimens, microfilms, casts, etc., should be similarly provided.

3. Increased provision be made for the training of taxonomists and that an increased number of taxonomic posts be created.

4. Better facilities be provided for the collection of living material, for its reception when collected, and its subsequent maintenance.

5. To ensure early action and continuing attention for varietal collections of economic species, for genetic and breeding purposes, one organisation in the Commonwealth should be specifically entrusted with the essential central co-ordination.

6. Adequate quarantine measures should be taken respecting new introductions to ensure their supervision before release and competent diagnosticians be available. Such quarantine measures to be supplemented by a good intelligence service.

7. Information regarding the geographical distribution of pests and diseases should be made readily available.

8. Steps should be taken to preserve native breeds of livestock.

Land Utilization and Conservation throughout the Empire

In view of the gravity of the situation caused by the loss of and damage to the soil in many parts of the Commonwealth, the Conference attaches great importance to the carrying out of the following recommendations, with the help of trained agricultural scientists: (*a*) erosion surveys; (*b*) soil surveys; (*c*) investigations relating to the maintenance and improvement of soil fertility.

In addition to the above investigations, the Conference urges the importance of surveys to determine the present pattern of and trends in land use, as a basis for the maintenance of soil fertility.

In view of the similarity existing between problems of soil conservation in different parts of the Commonwealth, the Conference would emphasize the importance of a continuous interchange of information and the need for periodic conferences of specialist officers engaged upon problems of soil fertility, erosion and land utilization.

A Co-ordinated Survey of the Mineral Resources of the Commonwealth

General. The Conference reviewed carefully the position regarding the mineral resources of the Commonwealth in relation to the serious present and threatened further shortage of many important key minerals; and agreed that a much increased Empire effort is required in all aspects of geology, geophysics, mineralogy, process metallurgy and in the compilation of reliable data on which estimates of present and future supplies of minerals may be made.

Special recommendations. 1. That a Commonwealth organisation be established with headquarters in Great Britain to include the following functions, some of which are performed already by the Imperial Institute: (*a*) To act as a clearing house for information, statistical and general, on the scientific and economic aspects of the mineral resources and mineral production metallurgical industries of the Empire. (*b*) To institute, in concord with the various Governments of the Commonwealth, standard methods of recording figures of production, trade and resources in mineral and metallurgical products. (*c*) To promote the exchange of information regarding the estimation of mineral reserves and/or to publish estimates at suitable intervals. (*d*) To provide an

information service dealing with publications concerning all branches of geology, mineralogy, palæontology, geochemistry, applied geophysics, ore-dressing and production metallurgy. (*e*) To refer to suitable specialist institutions for advice or investigation, mineral problems and specimens, for the study of which facilities may not be available at the time in most parts of the United Kingdom, Dominions, or Colonies; and to advise on the extension of existing, or establishment of new, institutions as may from time to time be considered necessary to meet the requirements in these respects of the Commonwealth.

2. That systematic geological survey work being the foundation of all progress in the mineral industries, in future much stronger geological organisations are essential for work in all parts of the Commonwealth.

3. That attention be given to proposals to assist established British journals of geology, mineralogy and palæontology, etc.

The Conference reviewed with approval the accompanying summary of the essential functions of a geological survey and agreed that anything short of this programme would generally prove to be an uneconomical investment of public funds.

Appendix. Essential Functions of a Geological Survey

Official geological surveys should be maintained in sufficient strength to permit of:

(*a*) The development of the general geological map, which will become the guide for all prospecting activities, official and private, as well as for operations regarding water supply and engineering projects.

(*b*) The preparation of a geological map by stratigraphical geologists is not possible without the constant reference of questions to specialists in palæontology, petrology, mineralogy and geophysics.

(*c*) For the development of the mineral resources of a country to the best advantage, it is important for a geological survey department to be familiar with the statistics of production, imports and exports. From the figures of such returns the department can advise its Government to direct its policy to the encouragement of industries based on raw mineral supplies, for it is obviously uneconomical to export raw minerals which might be smelted or otherwise processed near their sources, and equally uneconomical to import materials and articles which might be manufactured from minerals of domestic origin.

(*d*) It is essential to build up at the headquarters of a survey a reference library and a collection of reference specimens. It is equally important to maintain publications in recognized form, through the distribution of which geological officers will get the criticism as well as the appreciation of outside scientific and technical communities.

(*e*) The activities of a geological survey department should be purely advisory; but as the full list of specialists and equipment required is generally beyond the capacity of smaller States and Colonies to maintain, it is desirable to federate for such advisory functions suitable groups geographically and politically related to one another.

Natural Products of the Empire and the Chemical Industries that are or might be Based on them

In view of the varied nature of the natural products of the Commonwealth, their wide geographical dispersal and the diverse and often inadequate facilities in staff and equipment which may be available locally for their investigation, the Conference makes the following recommendations:

1. That a standing central committee, including representatives of the United Kingdom, the Dominions, India and the Colonies, should be set up to advise upon policy for the co-ordination of research, both scientific and economic, into the natural products of the Commonwealth. Such advice upon their own particular problems would be made available to all Commonwealth countries with the minimum of delay.

2. The Conference, while recognizing the desirability of centralizing research upon problems common to many parts of the Commonwealth, supports very strongly the view that research upon problems of more local interest should be co-ordinated within regions. It is anticipated that this would lead to increased efficiency and economy in man-power. The Conference regards advice upon the concentration or regionalization of the research in question as an important function of the central committee.

Post-War Needs in Fundamental Research

The Conference wishes to direct the attention of all concerned with the guidance of fundamental scientific research to the Royal Society's "Report on the Needs of Research in Fundamental Science after the War". It would also invite attention to the report on scientific man-power recently issued by the Government of the United Kingdom. The discussion at the Conference, which was of necessity limited in scope, revealed a particular shortage in the Commonwealth of scientific workers in such fields as taxonomy, genetics and microbiology.

1. The Conference is of the opinion that in each country of the Commonwealth the mechanism for guiding long-term research in fundamental science should be reviewed, in order to foster fertile research work in all important subjects. The systems for advice and financial assistance in this connexion should be studied carefully.

2. The needs of the future will require a great increase in the number of scientific workers, and it is considered important that plans for extending fundamental research in any field should be supported by measures designed to increase the number of trained scientific men able to carry out such plans.

3. In order to secure the proper flow of young scientific workers from educational establishments, it is considered of importance that the educational system of each country should be harnessed so far as may be necessary to this particular long-term need.

Africa as a Regional Area for Fundamental Scientific Research

1. The Conference considers that there is a growing need for the development of long-term fundamental research dealing with African problems on a regional, as distinct from a territorial, basis.

2. To meet this need there should be formed at an early date a Commonwealth African Research Committee with the following terms of reference: (*a*) to examine and put forward proposals for the centralization of fundamental research in African problems on a regional basis; (*b*) to plan such developments ahead so as to ensure the necessary financial support and the training of the specialist staffs needed; (*c*) to advise the Governments con-

cerned through the appropriate authorities on matters of regional development and co-operation in fundamental research.

3. The field of the Committee would in the main cover activities south of the Sahara, and foreign States with territories in this portion of Africa should be invited to be represented as observers.

Cosmic Rays

The Conference recommends that the following investigations of cosmic radiation would be of great scientific value and are also likely to have important meteorological applications.

1. Further measurements of the variation with time of the cosmic ray intensity at selected stations at sea-level and on mountains. Measurements in the southern hemisphere are of particular importance.

2. Further measurements of the variation of cosmic ray intensity with latitude and longitude by experiments in aircraft over a wide range of height.

The Conference recommends that the necessary organisation to carry out the work should be set up in the first instance on an Empire basis, but that the question of extending the organisation be raised at the next meeting of the International Union of Physics.

The Village Pond in the Rural Economy of India

The oceanographic and fisheries scientists present as delegates to the Royal Society Empire Scientific Conference request its Steering Committee to arrange that if possible a meeting be called during the period of the British Commonwealth Scientific Conference of these delegates, and other specialists available in Great Britain, to discuss methods for co-operation and co-ordination of fisheries and oceanographical research within the Commonwealth, and similar matters of common interest.

The above delegates also would appreciate any facilities which could be given for a tour to centres of fisheries research in the United Kingdom following the termination of the Official Conference.

[Action on the above recommendation was taken immediately.]

Geochemistry

Delegates attending this discussion endorse the recommendation contained in the Royal Society's Report on the needs of research in fundamental science after the War "that substantial provision should be made for quantitative spectrographic analysis of rocks, minerals and natural waters"; and further, recommend that adequate facilities in one or more institutions should be provided for like investigations (both fundamental and applied) on material which might be submitted from centres (including Colonial geological surveys and other geological organisations) within the British Empire.

Hormones

In view of the steady increase in the demand for insulin, the Conference urges that a strong recommendation be made to all the countries of the Commonwealth that every effort be made to collect, process and preserve all available pancreas. Purified insulin, which can be stored for long periods without loss of potency, will be needed on an increasing scale for the treatment of diabetes.

Fish Culture and Malaria Control

In view of the great possibilities of utilizing ponds for fish culture in various countries of the Commonwealth where malaria is prevalent, the Conference proposes that the attention of governments of countries so situated should be directed to the urgent need of integrating fish culture practice with measures for malaria control.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Tuesday, July 30

BRITISH FEDERATION OF UNIVERSITY WOMEN (at Chatham House, St. James's Square, London, S.W.1), at 8 p.m.—Prof. Lise Meitner: "Atomic Energy".*

APPOINTMENTS VACANT

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

PSYCHOLOGIST (part-time) for the Child Guidance Clinic at High Wycombe—The School Medical Officer, County Health Department, County Offices, Aylesbury (August 3).

PHYSICISTS (2) to carry out research work on instruments, electronics and automatic control—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1 (August 3).

DIRECTOR OF HORTICULTURAL STUDIES—The Registrar, University College, Nottingham (August 7).

LECTURER IN INVERTEBRATE ZOOLOGY—The Head of the Department of Zoology, Imperial College of Science and Technology, Prince Consort Road, London, S.W.7 (August 9).

LECTURER IN MECHANICAL ENGINEERING—The Registrar, The University, Sheffield (August 10).

DEMONSTRATOR IN ZOOLOGY—The Registrar, The University, Leeds 2 (August 10).

SENIOR ENGINEERING ASSISTANT to the Coventry Water Department—The Water Engineer and Manager, Spon House, 21 Allesley Old Road, Coventry (August 10).

HEAD OF THE NATIONAL COLLEGE OF HOROLOGY which is being established at Northampton Polytechnic, London—The Secretary of the Board of Governors, National College of Horology, at the Northampton Polytechnic, St. John Street, London, E.C.1 (August 10).

LECTURER IN ORTHOPÆDIC SURGERY—The Secretary, The University, Aberdeen (August 10).

DEMONSTRATOR IN BOTANY—The Registrar, The University, Leeds 2 (August 10).

SENIOR ASSISTANTS IN THE DEPARTMENTS OF PHYSICS, TELECOMMUNICATIONS, CHEMISTRY, CIVIL AND MECHANICAL ENGINEERING, and ELECTRICAL ENGINEERING—The Clerk to the Governors, Woolwich Polytechnic, Woolwich, London, S.E.18 (August 12).

LECTURERS IN THE DEPARTMENTS OF PHYSICS, TELECOMMUNICATIONS, CHEMISTRY, ELECTRICAL ENGINEERING, MATHEMATICS, and CIVIL AND MECHANICAL ENGINEERING—The Clerk to the Governors, Woolwich Polytechnic, Woolwich, London, S.E.18 (August 12).

PSYCHOLOGIST AND EDUCATIONAL ADVISER—The Secretary, County Buildings, Shrewsbury (August 12).

SENIOR SCIENTIFIC ASSISTANTS (2), and a JUNIOR SCIENTIFIC ASSISTANT, in the Agricultural Advisory Department—The Registrar, The University, Manchester (August 12).

FUEL TECHNOLOGIST to take charge of the Fuel Technology Division, Government Chemical Laboratories, Department of Mines, Perth—The Agent-General for Western Australia, Savoy House, 115 Strand, London, W.C.2 (August 15).

DEMONSTRATOR IN CHEMISTRY—The Registrar, Queen Mary College, Mile End Road, London, E.1 (August 15).

OFFICER-IN-CHARGE of a Section of Fisheries Exploration now being formed within the Division of Fisheries of the Council for Scientific and Industrial Research, Australia—The Secretary, Australian Scientific Research Liaison, Australia House, Strand, London, W.C.2 (August 17).

TEACHER (full-time) OF CHEMISTRY AND METALLURGY at the South-East London Technical Institute, Lewisham Way, London, S.E.4—The Education Officer (T.1), County Hall, London, S.E.1 (August 17).

SENIOR RESEARCH OFFICER at the University Institute of Colonial Studies—The Registrar of the University, Clarendon Building, Oxford (August 24).

G. F. GRANT CHAIR OF CHEMISTRY—The Registrar, University College, Hull (August 24).

HEAD OF THE PHYSIOLOGY DEPARTMENT—The Secretary, Rowett Research Institute, Bucksburn, Aberdeenshire (August 31).

LECTURER IN ANATOMY—The Secretary, The University, Aberdeen (August 31).

MARINE ZOOLOGIST—The Secretary, Marine Biological Association, The Laboratory, Citadel Hill, Plymouth (August 31).

REGISTRAR—The Registrar, University College, Leicester (August 31).

LECTURERS (2) IN EXPERIMENTAL PHYSICS—The Registrar, The University, Manchester 13 (August 31).

LECTURER (ungraded) IN PHARMACOLOGY—The Registrar, The University, Liverpool (September 7).

SUPERINTENDENT BACTERIOLOGIST, a SUPERINTENDENT BIOCHEMIST, PRINCIPAL SCIENTIFIC OFFICERS (3), SENIOR SCIENTIFIC OFFICERS (3), SCIENTIFIC OFFICERS (2), an EXPERIMENTAL OFFICER, and an ASSISTANT EXPERIMENTAL OFFICER, in the MICROBIOLOGICAL RESEARCH DEPARTMENT of the Ministry of Supply—The Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 1550 (September 10).

CHAIR OF MATHEMATICS, and the CHAIR OF PHYSICS—The Registrar, University College, Leicester (September 14).

LECTURER IN BACTERIOLOGY—The Secretary, The University, Aberdeen (September 14).

ASSISTANT LECTURER and a DEMONSTRATOR IN MATHEMATICS—The Head of the Department of Mathematics, Imperial College of Science and Technology, Prince Consort Road, London, S.W.7.

ASSISTANT MASTERS (with Honours Degree in Mathematics, Physics or Engineering, or equivalent qualifications) in H.M. Dockyard Schools—The Director, Education Department, Admiralty, London, S.W.1.

DEPUTY CHIEF CHEMIST AND JUTE TECHNOLOGIST—The Secretary, Indian Jute Mills Association Research Institute, Imperial Institute, South Kensington, London, S.W.7.

DEPUTY PRINCIPAL at the Stow College, School of Engineering—The Director of Education, 129 Bath Street, Glasgow, C.2.

JUNIOR RESEARCH WORKER—The Director, Department of Applied Economics, c/o Marshall Library, Downing Street, Cambridge.

LECTURER IN AUTOMOBILE ENGINEERING—The Registrar, North Gloucestershire Technical College, The Lypiatts, Lansdown Road, Cheltenham.

LECTURERS IN THE DEPARTMENTS OF CIVIL AND MECHANICAL ENGINEERING, ELECTRICAL ENGINEERING, APPLIED CHEMISTRY, and PHYSICS—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1.

LECTURER IN CHEMISTRY—The Principal, Sir John Cass Technical Institute, Jewry Street, London, E.C.3.

LECTURERS IN MATHEMATICS, APPLIED MECHANICS (2), and PHYSICS, at the Royal Naval College, Greenwich—The Director, Education Department, Admiralty, Whitehall, London, S.W.1.

LECTURER IN PHARMACEUTICAL CHEMISTRY at the Cardiff Technical College—The Director of Education, City Hall, Cardiff.

LECTURER IN PHYSICS—The Head of the Physics Department, Imperial College of Science and Technology, South Kensington, London, S.W.7.

LECTURERS AND DEMONSTRATORS to teach in English up to Matric. and Inter. Standards in PHYSICS, MATHEMATICS, and ENGLISH (General and Science)—The Polish Board of Technical Studies, 5 Princes Gardens, London, S.W.7.

RESEARCH ENTOMOLOGIST to study the field behaviour of wireworms in relation to baits and repellants—The Secretary, Rothamsted Experimental Station, Harpenden, Herts.

SPECIALIST (highly qualified and experienced) to take charge of the CHEMISTRY and PHYSICS DEPARTMENT—The Head Mistress, Luton High School, Luton.

TEACHERS (4, part-time) for training junior technicians in CHEMISTRY, PHYSICS, MATHEMATICS and BIOLOGY—The Establishment Officer, University College, Gower Street, London, W.C.1.

LECTURER IN PHYSICAL AND ENGINEERING METALLURGY, preferably with experience in Mechanical Treatment and Welding—The Secretary, Imperial College of Science and Technology, South Kensington, London, S.W.7.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Electrical and Allied Industries Research Association. Twenty-fifth Annual Report, October 1, 1944, to September 30, 1945. Pp. 136. (London: British Electrical and Allied Industries Research Association, 1946.) [52

Royal Geographical Society. The Making of a Map: Notes on the Exhibition in the Ambulatory, 31 December 1945–5 January 1946. Prepared by Brigadier Sir Clinton Lewis. Pp. 8. (London: Royal Geographical Society, 1946.) 6*d*. [52

Ministry of Health: Department of Health for Scotland. Final Report of the Inter-Departmental Committee on Dentistry. (Cmd. 6727.) Pp. 60. (London: H.M. Stationery Office, 1946.) 1*s*. net. [62

National Central Library. 28th and 29th Annual Reports of the Executive Committee, 1943–44 and 1944–45. Pp. 26. (London: National Central Library, 1945.) [62

Ministry of Production. Third Annual Report on the Work of the Combined Raw Materials Board to January 26th, 1945. Pp. 12. (London: H.M. Stationery Office, 1945.) 2*d*. net. [62

National Institute of Agricultural Engineering. Report for the Year ending August 31st, 1945. Pp. 12. (Askham Bryan, York: National Institute of Agricultural Engineering, 1946.) 3*d*. [72

Medical Research Council. Special Report Series, No. 253: Tables of Representative Values of Foods commonly used in Tropical Countries. By B. S. Platt. Pp. 41. (London: H.M. Stationery Office, 1945.) 9*d*. net. [112

Parliamentary and Scientific Committee. Annual Report, 1945. Pp. 19. (London: Parliamentary and Scientific Committee, 1946.) [112

Other Countries

Publications of the Isostatic Institute of the International Association of Geodesy. No. 7: World Maps for the Indirect Effect of the Undulations of the Geoid on Gravity Anomalies. By W. Heiskanen and Erkki Niskanen. Pp. 14. No. 8: On the Figure and Structure of the Earth. By W. Heiskanen. Pp. 46. No. 9: Gravity Formulas derived by the Aid of the Latitude and Longitude Zones. By N. Luoma. Pp. 19. No. 10: On the Structure of the Earth's Crust in the neighbourhood of the Ferghana Basin. By V. Erola. Pp. 77. No. 11: On the Isostatic Structure of the Earth's Crust in the Carpathian Countries and the related Phenomena. By L. Tanni. Pp. 100. No. 12: On the Deformation of the Earth's Crust under the Weight of a Glacial Iceload and related Phenomena. By E. Niskanen. Pp. 59. No. 13: The Gravity Anomalies on the Japanese Islands and in the Waters East of Them. By W. Heiskanen. Pp. 22. (Helsinki: International Association of Geodesy, 1941–1945.) [101

South African Archæological Society. Handbook Series No. 1: Method in Prehistory; an Introduction to the Discipline of Prehistoric Archæology, with special reference to South African Conditions. By A. J. H. Goodwin. Pp. 191. (Cape Town: South African Archæological Society, 1945.) 12*s*. 6*d*. [151

Colony and Protectorate of Kenya. Forest Department Pamphlet No. 11: The Management of Cypress Plantations in Kenya. By S. H. Wimbush. Pp. 32. (Nairobi: Government Printer, 1945.) [151

Nyasaland Protectorate. Annual Report of the Forestry Department for the Year ended 31st December 1944. Pp. 12. (Zomba: Government Printer, 1945.) [151

Report of the Anglo-American Caribbean Commission to the Governments of the United States and Great Britain for the Year 1944. Pp. 46. (Washington, D.C.: Anglo-American Caribbean Commission, 1945.) [151

U.S. Department of Agriculture. Miscellaneous Publication No. 511: Classification of the Dermestidæ (Larder, Hide and Carpet Beetles) based on Larval Characters, with a Key to the North American Genera. By Bryant E. Rees. Pp. 18. Technical Bulletin No. 897: Factors affecting Curly Top Damage to Sugar Beets in Southern Idaho. By D. E. Fox, J. C. Chamberlin and J. R. Douglass. Pp. 29. Technical Bulletin No. 901: Reaction of Small-Grain Varieties to Green Bug Attack. By I. M. Atkins and R. G. Dahms. Pp. 30. (Washington, D.C.: Government Printing Office, 1943–1945.) [151

U.S. Office of Education: Federal Security Agency. Bulletin 1945, No. 10: Education in Chile. By Cameron D. Ebaugh. Pp. vii + 123. (Washington, D.C.: Government Printing Office, 1945.) 25 cents. [151

Smithsonian Institution: United States National Museum. Bulletin 186: The Birds of Northern Thailand. By H. G. Deignan. Pp. v + 616 + 9 plates. 1.25 dollars. Bulletin 187: An Annotated Checklist and Key to the Snakes of Mexico. By Hobart M. Smith and Edward H. Taylor. Pp. iv + 239. 50 cents. (Washington, D.C.: Government Printing Office, 1945.) [151

Bulletin of the American Museum of Natural History. Vol. 86, Art. 2: Notes on Pleistocene and Recent Tapirs. By George Gaylord Simpson. Pp. 33–82 + plates 5–10. (New York: American Museum of Natural History, 1945.) [151

Proceedings of the American Academy of Arts and Sciences. Vol. 74, No. 14: Records of Meetings, 1940–1941, 1941–1942, etc. Pp. 441–488. 2 dollars. Vol. 75, No. 1: Papers on Post-War Problems. Pp. 54. Vol. 75, No. 2: The Lower Permian Insects of Kansas, Part 9: The Orders Neuroptera, Raphidiodea, Caloneurodea and Protorthoptera (Probnisidæ), with additional Protodonata and Megasecoptera. By Frank M. Carpenter. Pp. 55–84. 90 cents. Vol. 75, No. 3: Some Factors in the Defense Mechanism against Reinfection with *Trypanosoma lewisi*. By Donald L. Augustine. Pp. 85–94. 35 cents. Vol. 75, No. 4: Chao Hsüeh-min's Outline of Pyrotechnics; a Contribution to the History of Fireworks. By Tenney L. Davis and Chao Yün-ts'ung. Pp. 95–108. 80 cents. Vol. 75, No. 5: New Researches on Magnetization by Rotation and the Gyromagnetic Ratios of Ferromagnetic Substances. By S. J. Barnett. Pp. 109–130. 1.35 dollars. Vol. 75, No. 6: Presidential Address, Records of Meetings, 1942–1943, 1943–1944, etc. Pp. 131–208. 1.60 dollars. Vol. 76, No. 1: The Compression of Twentyone Halogen Compounds and Eleven other Simple Substances to 100,000 kg./cm.^{2}, by P. W. Bridgman; The Compression of Sixty-one Solid Substances to 25,000 kg./cm.^{2}, determined by a New Rapid Method, by P. W. Bridgman. Pp. 24. 1 dollar. (Boston, Mass.: American Academy of Arts and Sciences, 1942–1945.) [151

U.S. Department of the Interior: Geological Survey. Bulletin 928–B: Geology and Ore Deposits of the Shafter Mining District, Presidio County, Texas. By Clyde P. Ross. (Contributions to Economic Geology, 1941–42.) Pp. iv + 45–126 + plates 6–12. 65 cents. Bulletin 931–S: Manganese Deposits in the Paymaster Mining District, Imperial County, California. By Jarvis B. Hadley. (Strategic Minerals Investigations, 1941.) Pp. iii + 459–474 + plates 75–77. 30 cents. Bulletin 935–A: Chrome Resources of Cuba. By T. P. Thayer. (Geologic Investigations in the American Republics, 1941–42.) Pp. v + 74 + 20 plates. 1 dollar. Bulletin 935–D: Tungsten Deposits, Isla de Pinos, Cuba. By Lincoln R. Page and James F. McAllister. (Geologic Investigations in the American Republics.) Pp. iv + 177–246 + plates 32–43. 1.25 dollars. Bulletin 937: Bibliography of North American Geology, 1929–1939. By Emma Mertins Thom. Part 2: Index. Pp. 1065–1546. 2 parts, 2.50 dollars. Bulletin 940–B: Manganese Deposits of the Elkton Area, Virginia. By Philip B. King. (Strategic Minerals Investigations, 1943.) Pp. iv + 15–56 + plates 4–9. 75 cents. (Washington, D.C.: Government Printing Office, 1942–1944.) [151

U.S. Department of the Interior: Geological Survey. Professional Paper 142–G: The Molluscan Fauna of the Alum Bluff Group of Florida. By Julia Gardner. Part 7: Stenoglossa (in part). Pp. ii + 437–492 + plates 49–51. 25 cents. Professional Paper 196–D: Geology and Biology of North Atlantic Deep-Sea Cores between Newfoundland and Ireland. Part 5; Mollusca, by Harald A. Rehder; Part 6: Echinodermata, by Austin H. Clark; Part 7: Miscellaneous Fossils and Significance of Faunal Distribution, by Lloyd G. Henbest. Pp. xviii + 107–134 + plates 1–23. 30 cents. Professional Paper 196–F: Geology and Biology of North Atlantic Deep-Sea Cores between Newfoundland and Ireland. Part 9: Selenium Content and Chemical Analyses. By Glen Edgington and H. G. Byers. Pp. xvii + 151–156 + 2 plates. 15 cents. Professional Paper 197–D: The Basin and Range Province in Utah, Nevada and California. By Thomas B. Nolan. (Shorter Contributions to General Geology, 1941–42.) Pp. iii + 141–196 + plates 40–41. 15 cents. Professional Paper 197–E: Some Standard Thermal Dehydration Curves of Minerals. By P. G. Nutting. (Shorter Contributions to General Geology, 1941–42.) Pp. ii + 197–218. 5 cents. Professional Paper 197–F: The Action of some Aqueous Solutions on Clays of the Montmorillonite Group. By P. G. Nutting. (Shorter Contributions to General Geology, 1941–42.) Pp. ii + 219–236. 10 cents. (Washington, D.C.: Government Printing Office, 1942–1944.) [151

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.

CIVIL SERVICE COMMISSION

The Civil Service Commissioners invite applications for a limited number of appointments as Principal Scientific Officer at the Chemical Defence Experimental Station, Porton, under the Ministry of Supply for work in connection with specialised aspects of research in pathology, pharmacology, biochemistry and animal breeding. Candidates applying for posts as pathologists or pharmacologists should be Honours Graduates in natural and/or medical science with special qualifications in pathology and/or pharmacology and with at least 2 years post-graduate research experience. Possession of a recognised medical qualification is also essential. Applicants must be well versed in the experimental techniques of their particular field of research and will be required to conduct researches on the injuries caused by toxic materials and on measures for their treatment. Candidates applying for posts as biochemists should be Honours Graduates in natural science (chemistry or physiology) with special qualifications in biochemistry. Applicants must have had at least 2 years post-graduate research experience, preferably in connexion with enzymes, and will be required to undertake researches on the mechanism of action of toxic substances in relation to their effects on the human body.

Candidates applying for the post in connexion with animal breeding should be Honours Graduates in any of the biological sciences with special qualifications in genetics and with at least two years post-graduate research experience. It is desirable also that the applicants should possess a recognised qualification in veterinary science. Applicants must have had practical experience in the management of large colonies of animals for experimental purposes since the duties entail the control and management of an animal-breeding establishment for the production for experimental purposes of standard strains of disease-free animals. Salaries (men) £800 ×£30–£1,100 (less provincial differentiation, which at present ranges from £50 at the minimum of the scale to £80 at the maximum). Salaries are increased by a consolidated addition (in place of war bonus) which ranges from £90 at the minimum of the scale to £105 at the maximum. Salaries and consolidation additions are somewhat lower for women than for men. Candidates must be of British nationality and not more than 50 years of age. They must possess the stipulated qualifications and experience. The posts are permanent with superannuation benefits under the Federated Superannuation Scheme for Universities.

Further particulars and forms of application are obtainable from the Civil Service Commission, 6 Burlington Gardens, London, W.1, to whom completed applications must be returned not later than September 14, 1946.

ROYAL SOUTH HANTS AND SOUTHAMPTON HOSPITAL, SOUTHAMPTON

Applications are invited for the post of Assistant Physicist to the Radiotherapy Department. The salary will be £400 per annum and be subject to annual increments. Superannuation benefits of the Federated Superannuation Scheme for Nurses and Hospital Officers will be available. The person appointed will be made an honorary member of the Staff of the Physics Department of University College, Southampton.

Applicants, who should have an Honours Degree in Physics, should state age and give details of education and experience together with the names of two referees. Applications should be made to the undersigned before August 17, 1946.

FRANK JENNINGS,
House Governor and Secretary.

CITY MENTAL HOSPITAL

WINSON GREEN, BIRMINGHAM 18

Applications are invited for the post of Psychiatric Social Worker at the above hospital. Candidates must hold the certificate of the Mental Health Course of London University, or that of some similar recognised examining body. The post is whole-time, non-resident, and will be subject to the provisions of the Asylums Officers' Superannuation Act, 1909. The salary will be £320 rising by annual increments of £20 to £480 per annum, plus cost of living bonus. Applications, together with copies of not more than three testimonials, or three references, should be ent to the Medical Superintendent.

COMMONWEALTH OF AUSTRALIA

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

DIVISION OF INDUSTRIAL CHEMISTRY

APPOINTMENT (No. 900) OF RESEARCH OFFICER—CHEMICAL PHYSICS SECTION

Applications are invited for appointment to a position of Research Officer in Mass Spectroscopy, Division of Industrial Chemistry, Melbourne, Australia. Duties: The officer appointed will be responsible for the development of the techniques of mass spectroscopy as applied to chemical problems and will be required to perform investigations into problems of molecular structure, complete organic analysis and isotopic tracer methods. The successful applicant will be required to proceed to the U.S.A. immediately for a period of three (3) months to gain experience in the operation and maintenance of the instrument. Qualifications: University degree in science, with physics and chemistry as major subjects, or equivalent qualifications. Experience in the field of mass spectroscopy is not essential. Salary: Dependent on qualifications and experience, commencing salary will be determined within the range of Research Officer (male: £A560–£A640 p.a. actual; Female: £A485–£A565 p.a. actual; four equal increments, first automatic, remainder discretionary). The above actual salaries include cost-of-living adjustment (at present an additional £A40 in respect of males and £A27 p.a. in respect of females). Note: salary will commence from the date the successful applicant takes up duty in England, if required to do so, or one fortnight before scheduled date of departure for Australia, whichever is the earlier, and will be paid in sterling until embarkation for Australia; thereafter in Australian currency. Fares (including those of wife and family) to Australia will be paid. The appointment will be conditional on a satisfactory medical examination, and the successful applicant may be asked to serve for an initial probationary period of up to twelve months before being confirmed in his appointment as an officer of the Council. If so confirmed, he will be eligible to contribute to, and receive benefits from, either the Commonwealth Superannuation Fund or Commonwealth Provident Account.

Applications, referring to appointment No. 900, and stating date of birth, nationality, present employment, particulars of qualifications and experience, accompanied by copies of not more than four testimonials, should reach the undersigned not later than August 24, 1946.

LEWIS LEWIS,
Secretary, Australian Scientific Research Liaison, Australia House, Strand, London, W.C.2.

CROWN AGENTS FOR THE COLONIES

COLONIAL GOVERNMENT APPOINTMENTS

Applications from qualified candidates are invited for the following post: Principal Research Officer required by the Government of Ceylon for the Department of Commerce and Industries. The appointment is non-pensionable and will be on a five year agreement but may be extended with mutual consent. The salary attached to the post will be according to qualifications. The officer will be required to contribute to the Public Service Provident Fund at 5 per cent of his salary and will be eligible to contribute a further 5 per cent if he so desires. In either case the Government contribution will be equal to 7½ per cent of the salary paid in at the close of each financial year. Leave, travelling allowances and other conditions of service will be in accordance with regulations at present in force for officers recruited on agreement for a fixed term of years. Rent allowance of Rupees 150 per mensem if married, or Rupees 75 per mensem if single, will be paid, or quarters in lieu (if available) will be given for which rent is payable at 6 per cent of the salary. Before appointment, the officer will be required to furnish a medical certificate as to his physical fitness. Applicants must have high Honours Degrees in Chemistry from a recognised University or Universities. They should be between 35 and 45 years of age and should have had considerable industrial and research experience preferably in applied chemistry. The officer will be in charge of and direct the research work of the Industrial Laboratory of the Department of Commerce and Industries. He will also attend to such administrative work as is incidental to these main functions. Applicants should give full particulars as regards their age, nationality, academical qualifications, any special qualifications such as experience in research work and publication of original research in accepted journals if any, and any other claims which the applicants would wish to urge. They should also state the salary they would expect in the event of their appointment to the post. Applications should be addressed to The Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M/N/16727.

SUDAN GOVERNMENT

Research Division, Department of Agriculture and Forests requires a Soil Chemist for service in the Sudan, for laboratory and field investigations both research and advisory on soils. The selected candidate who may be required to work in any part of the Sudan should be between 22½ and 45 and should possess a good honours degree in chemistry or equivalent qualifications with some research experience preferably on soils. Terms of service: Pensionable scale of the post ranges from £E480 to £E1,080 (£E1 equals £1 0s. 6d.), which could be increased by 15 to 25 per cent for Provident Fund Contract and Short Term Contract rates. Appointment will be on Short Term Contract (initially for two years) without post service benefits, or possibly on Provident Fund Contract (with security for seven or more years after probationary period). In certain special instances a candidate under 35 years of age may be offered a probationary contract with the view to pensionable service. Starting rates would be determined according to age, qualifications and experience. On appointment an outfit allowance at the rate of £60 is payable provided salary on appointment does not exceed £E600 pensionable, £E700 Provident Fund or £E800 Short Term Contract. Cost of Living allowance. A cost of living allowance at the rate of 35 per cent of pay, subject to a maximum of £15 per month, is now payable on all salaries up to £1,200 per annum. A progressively reduced allowance is payable to officials on higher salaries. At present there is no income-tax in the Sudan. Free passage on appointment. Strict medical examination.

Papers containing full information for candidates are obtainable from the Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1. Please mark envelopes "Soil Chemist."

NEWFOUNDLAND GOVERNMENT LABORATORY

Applications are invited for the following fisheries research posts in the Newfoundland Government Laboratory:

(1) Senior Chemist—Candidates should possess Doctor's degree in Chemistry and have had experience in research on fisheries products. Salary $5,000 rising by annual increments of $200 to $6,000, or $4,000 rising by annual increments of $100 to $5,000, according to experience and ability.

(2) Chemist—Candidates should possess good qualifications in Chemistry with post graduate experience. Salary $3,000 rising by annual increments of $100 to $4,000.

(3) Marine Biologist—The post involves research on one or more of the ground fishes and also some hydrography. Candidates should be able when necessary to carry out biological and hydrographical work at sea. Salary $3,000 rising by annual increments of $100 to $4,000.

All posts are non-contributory pensionable posts in the Newfoundland Civil Service. Further particulars can be obtained on request. Applications, stating age, qualifications, experience and the names of two or three references should be sent to the Director, Newfoundland Government Laboratory, St. John's, Newfoundland.

MIDDLESEX COUNTY COUNCIL

EDUCATION COMMITTEE

ACTON TECHNICAL COLLEGE, HIGH STREET, ACTON, W.3.

POST-GRADUATE LECTURES IN CHEMISTRY

(THIRD SESSION 1946–47)

A course of thirty-seven lectures will be given on Fridays at 7.30 p.m. commencing on Friday, September 13, 1946.

Lecturers: R. C. Chirnside, W. Davey, B. A. Hems, E. R. H. Jones, J. O'M. Bockris, L. N. Owen, H. N. Rydon, C. W. Shoppee. Particulars on application to the Principal.

T. B. WHEELER,
Chief Education Officer to the Middlesex County Council.

THE UNIVERSITY OF SHEFFIELD

Applications are invited for the Chair of Mathematics in the University. Salary £1,300 a year, with war-time allowances in respect of marriage and children, and with Superannuation provision under the Federated Superannuation Scheme for Universities. Applications (six copies) with testimonials and the names and addresses of referees should be sent to the undersigned (from whom further particulars may be obtained).

In order to allow time for candidates now abroad or in H. M. Forces to apply, the last date for receipt of applications has been fixed at September 14, 1946. A referee who is abroad should send a confidential report direct to the Registrar without waiting for an enquiry from the University.

A. W. CHAPMAN,
Registrar.

UNIVERSITY OF DURHAM
THE MEDICAL SCHOOL, KING'S COLLEGE
LUCCOCK MEDICAL RESEARCH FELLOWSHIPS

The Council of King's College will shortly proceed to the appointment of one or more Senior and Junior Luccock Research Fellowships of the minimum annual value of £600 and £300 respectively. Fellows are required to pursue full-time research in the University in an approved subject in the Faculty of Medicine (including Dental Surgery). Senior Fellowships are open to any person who, by publication or otherwise, has proved himself able to carry out original research. Junior Fellowships are open to any person holding medical, dental or scientific qualifications and are intended to provide opportunities for training in research.

Applications giving a statement of the proposed research and giving the names of not more than two persons prepared to act as referees, should be sent, not later than August 31, 1946, to the undersigned from whom further particulars may be obtained.

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

CARDIFF CITY MENTAL HOSPITAL

Applications are invited for the appointment of Director of Research to the above Hospital. There are in existence well appointed laboratories and liaison with the School of Medicine and University. Candidates must be highly qualified and experienced with ability to plan, promote and supervise research into fundamental problems, either biochemical, physiological, clinical, etc., connected with or allied to the field of psychological medicine. Commencing salary £1,000 per annum. The appointment is established and subject to the provisions of the Asylum Officers' Superannuation Act, 1909. Applications with full particulars and the names of three referees and, if desired, testimonials, to the Medical Superintendent, Cardiff City Mental Hospital, Whitchurch, Cardiff, before August 25, 1946.

ROYAL HOLLOWAY COLLEGE
(UNIVERSITY OF LONDON)

PRINCIPAL: MISS E. C. BATHO, M.A., D.LITT.

The Michaelmas Term commences on Thursday, October 3, 1946. The College prepares women students for the London degrees in Arts and Science. Entrance Scholarships, varying in value from £40 to £80 a year, and several Exhibitions, all tenable for three years, will be offered for competition in January 1947. The last date for the receipt of entry forms is November 23, 1946. For further particulars apply to the Registrar, Royal Holloway College, Englefield Green, Surrey.

UNIVERSITY COLLEGE, NOTTINGHAM
FACULTY OF AGRICULTURE AND HORTICULTURE
(MIDLAND AGRICULTURAL COLLEGE)
DIRECTOR OF HORTICULTURAL STUDIES

Applications are invited for the above post, which will be developed later into a Chair of Horticulture. Candidates should be University graduates and will be required to live at the Midland Agricultural College, where a house is provided. Total commencing salary £1,000 per annum. Further information and forms of application, which should be returned not later than Wednesday, August 7, may be obtained from the Registrar.

THE SIR JOHN CASS TECHNICAL INSTITUTE
JEWRY STREET, LONDON, E.C.3

The Governors of the Institute invite applications for the post of Lecturer in Chemistry. Good honours degree or its equivalent essential and experience in micro-chemistry desirable. Preference will be given to candidates with experience in research and in spectroscopy. The successful candidate will be expected to carry out research as part of his duties.

Salary in accordance with the Burnham (Technical) scale for London. Details and form of application may be had from the Principal, to whom applications, together with copies of three recent testimonials, should be sent as soon as possible.

THE UNIVERSITY OF MANCHESTER
SECRETARY OF APPOINTMENTS BOARD

Applications are invited for the post of Secretary of the Appointments Board. Candidates should be males under the age of 40 and preference will be given to those having scientific and administrative experience. A University degree though desirable is not essential. Salary from £500 to £750 according to age and experience. Applications should be made not later than August 5, 1946, to the Registrar, from whom further particulars may be obtained.

W. MANSFIELD COOPER,
Registrar.

UNIVERSITY OF CAPE TOWN
VACANT LECTURESHIPS

(1) Permanent Posts: Applications are invited for lectureships in the following departments: Applied Mathematics (One) Ref. A. 204; Physics (One) Ref. A.205; Pure Mathematics (One) Ref. A. 206.

These posts are vacant from 1947. The salary scale is £450 × 25–500 × 50–675 per annum (plus a temporary cost of living allowance).

(2) Temporary Posts: (two years). Ref. A.207. Applications are invited for a lectureship in Pure Mathematics for two years (salary £450 per annum for the first year and an increment of £25 per annum for the second year), and for a Junior Lectureship in Pure Mathematics for two years (salary £250 per annum for the first year, and an increment of £25 per annum for the second year). There is also a temporary cost of living allowance.

Applications from candidates who have been on military or other national service will be given special consideration; applicants are advised to give particulars of such service.

Write quoting appropriate reference number to Ministry of Labour and National Service, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, for application forms which must be returned in duplicate by August 8, 1946.

UNIVERSITY OF CAPE TOWN
VACANT LECTURESHIPS

Permanent posts: applications are invited for lectureships in the following departments: (1) Botany (2) Ref. G.239; (2) Geography (1) Ref. G. 240; (3) Geology (1) Ref. G. 241; (4) Zoology (1) Ref. G. 242. The posts are vacant from 1947. The salary scale is £450×25–500×50–675 p.a. (plus a temporary cost of living allowance.)

Write quoting appropriate reference number to Ministry of Labour and National Service, Technical and Scientific Register, Room 572, York House, Kingsway, London, W.C.2, for particulars and application forms which must be returned in duplicate by August 8, 1946.

CITY OF LEICESTER EDUCATION COMMITTEE
LEICESTER COLLEGE OF TECHNOLOGY AND COMMERCE

PRINCIPAL: L. W. KERSHAW, O.B.E., B.Sc., A.M.INST.C.E.

Applications are invited for the post of Full-Time Lecturer in Metallurgy in the School of Chemistry. Applicants should have a degree in Metallurgy or Chemistry, or an equivalent qualification, together with practical experience in some branch of industrial metallurgy. The salary will be in accordance with the Burnham Scale for Technical Teachers, including increments for research and industrial and teaching experience.

Application by letter, giving full particulars of qualifications, training and experience, and accompanied by copies of two recent testimonials, and giving the names of two referees, should be addressed as soon as possible to the Principal of the College,

ELFED THOMAS,
Education Department, Director of Education.
Newarke Street, Leicester.

BRITISH RUBBER PRODUCERS' RESEARCH ASSOCIATION

Vacancies exist for two assistants to carry out computing work as members of the X-ray Crystallography Research team in the Association's Laboratories in Welwyn Garden City. Applications are invited from candidates of either sex having B.Sc. in mathematics or with similar qualifications. Commencing salary £4 per week. Facilities will be offered to enable successful applicants to qualify for a degree. Applications to be addressed to The Secretary, The British Rubber Producers' Research Association, 19 Fenchurch Street, London, E.C.3.

THE UNIVERSITY OF MANCHESTER

Applications are invited for Two Lectureships in Experimental Physics. Duties to commence preferably on September 29, 1946. Commencing stipend according to qualifications within the range of £400–£650 per annum. All applications should be sent not later than August 31, to the Registrar, The University, Manchester, 13, from whom further particulars may be obtained.

UNIVERSITY OF LEEDS
DEPARTMENT OF ZOOLOGY

Applications are invited for the post of Demonstrator in Zoology at an initial salary of £250–£300 according to qualifications. The appointment will be for one year in the first instance but will be renewable up to three years. Further particulars may be obtained on request. Applications should reach the Registrar, The University, Leeds, 2, not later than August 10, 1946.

UNIVERSITY OF OTAGO
DUNEDIN, NEW ZEALAND
LECTURESHIP IN PHYSIOLOGY

Applications are invited for the position of Lecturer in Physiology. Salary £750 rising to £900 N.Z. currency. Half-time available for research. Duties commence not later than March 1, 1947. Further particulars as regards tenure, research facilities, travelling allowances, etc., may be obtained from the Registrar, University of Otago, or from the High Commissioner for New Zealand, 415 Strand, London, W.C.2.

Applications giving full particulars of qualifications and including a recent photograph, a medical certificate, testimonials (not more than three) and the names and addresses of three referees should be in the hands of the Registrar, University of Otago, by September 16, 1946.

THE UNIVERSITY OF SHEFFIELD
LECTURER IN MECHANICAL ENGINEERING

Applications are invited for appointment as Lecturer in the Department of Mechanical Engineering. Salary £450 to £600 a year according to qualifications, experience and other relevant circumstances, with war-time marriage and children allowance, and superannuation provision under the Federated Superannuation Scheme for Universities. Further particulars may be obtained from the undersigned, with whom applications should be lodged by August 10.

A. W. CHAPMAN,
Registrar.

UNIVERSITY OF ABERDEEN
LECTURESHIP IN THE DEPARTMENT OF PHYSIOLOGY

Applications are invited for a Lecturer in the Department of Physiology. Salary £600–£750, placing according to qualifications and experience.

Applications should reach the Secretary to the University (from whom forms of application and conditions of appointment may be obtained) not later than September 6, 1946.

H. J. BUTCHART,
The University, Aberdeen. Secretary.

UNIVERSITY COLLEGE OF NORTH WALES, BANGOR

The Council of the College will shortly proceed to fill the post of Lecturer in Agriculture. Initial salary £575 per annum. 12 copies of applications with testimonials and/or references should be sent to the Secretary and Registrar, from whom further particulars should be obtained, not later than August 7, 1946.

GLYN ROBERTS,
Secretary and Registrar.

UNIVERSITY COLLEGE, LEICESTER

The College invites applications for the Chairs which are about to be set up in the following subjects: Mathematics; Physics. Salary not less than £1,000 p.a. with participation in the Federated Superannuation System for Universities. Duties to commence as soon as possible. Further particulars may be obtained from the Registrar, to whom applications should be submitted not later than September 14.

ST. MARY'S HOSPITAL
INOCULATION DEPARTMENT
PADDINGTON, LONDON, W.2.

Applications are invited immediately from honours graduates in Chemistry for the post of Research Assistant in the above Department for work on Antibiotics. Write giving age, qualifications, etc., to the Secretary.

UNIVERSITY OF DUBLIN, TRINITY COLLEGE
PHYSICS AND CHEMISTRY

Applications are invited for (a) a Junior Lecturer in Physics at £400 a year, (b) an Assistant to the Professor of Chemistry at £350 a year. Further particulars may be obtained from the Registrar, Trinity College. Final date for application, September 1, 1946.

MALVERN COLLEGE

Experienced Laboratory Assistants will be required at Malvern College early in September in each of the subjects Chemistry and Biology. Applications should be addressed to the Senior Science Master, Malvern College, Great Malvern, and should contain particulars of experience. Salaries will be paid according to qualifications.

Chemist required by manufacturers

animal feeding stuffs. Inter.B.Sc. standard. Good prospects. Apply in writing with details, qualifications, to: British Feeding Meals Co., Ltd., Carpenter's Road, Stratford, London, E.15.

(*Continued on page* xxxii)

(*Continued from page* xxxi)

Measurement, Ltd., Dobcross, Lanca-shire, require Senior Development Engineer. Company produces high technique electro mechanical apparatus. Applicants must have experience in initiating and controlling experimental and design work particularly in instrument and relay fields, and must be combination physicist and electrical engineer with flair for electro mechanical mechanisms. Experience in integrating watt hour meters very desirable. Only technicians of high calibre should apply, stating age, experience, qualifications and salary required, to Box 993, 191 Gresham House, London, E.C.2.

Applications are invited for the post of Director of Research, British Baking Industries Research Association.

The initial salary offered is not less than £2,000 per annum with superannuation. Applicants must have a first class scientific training, extensive experience in fundamental and/or applied research, and administrative capacity. Further particulars are obtainable from the Secretary, British Baking Industries Research Association, 8, Bolton Street, London, W.1, with whom applications should be lodged not later than September 30, 1946.

Chambers's Encyclopaedia requires university graduate with higher degree in zoology as Editorial Assistant, for one year, to work under Professor H. Munro Fox, Editor-in-Charge of the Zoological section. The post involves either half-time editorial work and half-time zoological research at Bedford College, or whole-time editorial duties. Salary £300 or £500 according as half- or whole-time editorial work. Apply stating qualifications to Box 648, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

The British Council invites applica-tions for appointment to the staff of the British Council Cultural Scientific Office in China from well qualified scientists, with research, and/or teaching and administrative experience. Period of contract one or two years. Candidates should apply in writing to the British Council (Appointments Department), 3 Hanover Street, London, W.1, giving age and a summary of qualifications and experience.

Electrical Engineer or Physicist required to assist in high-voltage testing and research on practical aspects of dielectric problems. Employment is in Manchester district. University graduate preferred, and some previous experience of similar work essential. Salary £350–£500. Apply, stating age, qualifications and experience, and giving references to Box 646, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Messrs. Samuel Hanson & Son, Ltd., require an Assistant Chemist for their Research Laboratories. Essential qualifications are a good honours degree in Chemistry with specialisation in Organic Chemistry. An interest in natural products and some knowledge of microbiology are desirable. Age about 25. Commencing salary about £300–£350. Post suitable for a recent graduate wishing to do research for a higher degree. Apply to Technical Director, Orchard Factory, Toddington, Glos., before August 10.

Microbiologist, preferably honours graduate with two or three years' research experience, required for research work in fermentation industry. State salary required. Box 647, T. G. Scott & Son, 9 Arundel Street, London, W.C.2.

Factory situated in East London has a vacancy for Production Chemist. Progressive and interesting job dealing with all aspects of plant control required in the manufacture of chemicals. Qualifications: B.Sc. or A.R.I.C. This vacancy would be suitable for University graduate willing to undertake shift work. Basic minimum salary £375 per annum. Box 649, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Wanted: Responsible Laboratory Steward for botanical laboratories, to work under senior steward. Some scientific knowledge and previous experience of an appropriate kind essential. Commencing salary 90 to 105 shillings per week according to age and experience. Apply to the Professor of Botany, Leeds University, enclosing testimonial and marking envelope "Laboratory Steward."

Chemists required by large oil organi-zation to act as Technical Advisers to Sales Departments overseas. Candidates must have first or second class honours degree or equivalent and previous industrial experience. Age 25/30. Initial training will be given in this country. Salary dependent on age, qualifications and experience, details of which please supply, also availability, to Box 651, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

University of London.—The Senate invite applications for the University Readership in Theoretical Physics tenable at Birkbeck College (salary not less than £700). Applications must be received not later than first post on August 27, 1946, by the Academic Registrar, University of London, Senate House, W.C.1, from whom further particulars should be obtained.

University of London.—The Senate invite applications for the Chair of Physics tenable at Royal Holloway College (salary not less than £1,400). Applications must be received not later than September 5, 1946, by the Academic Registrar, University of London, Senate House, W.C.1, from whom further particulars should be obtained.

Chemists and Chemical Engineers required for large industrial petroleum organization. Candidates must have first or second class honours degree (or equivalent) and aged not over 30. Must be prepared to serve overseas as required. Salary according to age, qualifications and experience. Reply stating when available to Box 650, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Bio-chemist wanted with a knowledge of food values and milling and experience in infant foods. Willing to go overseas (Dominions). Excellent salary and prospects for right man. Reply in confidence, stating particulars of training and experience, with copies of testimonials. Interview in London. Write R., Box 523, c/o Erwoods, Ltd., 30 Bouverie Street, London, E.C.4.

Senior Physical Chemist for research work on chemistry of liquid hydrocarbons; Ph.D. or equivalent, and 3/5 years post-graduate research experience necessary. Salary dependent on age, qualifications and experience, details of which please supply, also availability, to Box 652, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Several Organic Chemists (age 21–25), with degree (preferably Honours or higher), required for interesting research work on Rubber and Plastics. Apply to: Personnel Manager, Fort Dunlop, Birmingham, 24. Ref: PM/LVG/15.

King Edward VI Grammar School, Louth, Lincs. Master (preferably) or mistress required in September, resident or non-resident, to teach Biology to Higher Certificate standard, and General Science to School Certificate standard if possible. National salary scale: permanent post, 250 boys. Apply with testimonials to Headmaster.

The British Drug Houses, Ltd., Graham Street, N.1, requires the services of research workers in organic chemistry, physical chemistry, biochemistry and pharmaceutical chemistry. Salaries in the range £350 to £700 per annum, according to qualifications. Applications, giving details of training and experience, should be addressed to the Director of Research.

Assistant required for Food Research Laboratory at Oxford. Graduate in Chemistry and Bio-Chemistry. The duties include routine analysis and assisting in research problems. Salary £300 per annum. Write, stating full particulars, to "Research," Peter Merchant, Ltd., 25 Denmark Street, London, W.C.2.

Mould Culture Flasks, 2 litre flasks, pyrex or similar, surplus from penicillin surface culture factories, available free of charge to hospitals and research institutions, and at low cost to others interested. Apply Development Division, Glaxo Laboratories, Ltd., Greenford, Middlesex.

Required immediately, young man or woman as assistant to soil chemist. Must have working knowledge of elementary chemistry. References essential. Apply in writing to Box 145, c/o A. H. Grantham & Co., Advertising Agents, Reading.

Young Chemist, University degree essential, age below 30. Occupation: manufacture of colours and essences. No previous training needed. Salary £350 progressively increasing. Apply Drake-Law Laboratories, Carpenters Road, Stratford, E.15.

University of Leeds.—Research Assis-tant in Agricultural Chemistry. Initial salary £300–£350 and F.S.S.U. Names of three references required. Further particulars from Registrar, who will receive applications up to three weeks after the publication of the advertisement.

Chemist: male, age 25/35, graduate, for research in connection with laminated plastics. Write age, experience and salary required, Advertising Department, Tufnol, Ltd., Perry Barr, Birmingham, 22B.

Chemist: female, graduate standard, for tests in connection with laminated plastics. Write age, experience and salary required, Advertising Department, Tufnol, Ltd., Perry Barr, Birmingham 22B.

Translations from and into English, French, German, Italian; also correspondence tuition in those 3 languages on a good grounding for scientists. Box P. 205, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Microscopes and other relative instru-ments, accessories and books on the subject. List free. Chards (established 1869), Forest Hill, S.E.23. Phone Forest Hill 5946 and Springpark 1629.

Scientific Consultant Service, 68 Victoria Street, S.W.1. Technical Investigations.

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