NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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NATURE

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AN INTERNATIONAL SCIENCE CO-OPERATION SERVICE

WHILE scientific workers may well find it scarcely less difficult than their fellow citizens to grasp as yet the full implications of the new force resulting from scientific discovery which we have seen in action in the atomic bomb, they will unhesitatingly endorse Mr. Attlee's view that a re-evaluation of the whole situation, especially in the sphere of international relations, is required. This is particularly true in respect of the exchange and dissemination of information and of the organization of defence, to both of which questions scientific men in Britain have been giving close attention during recent months. Nothing can stop the progress of research and experiment in every country ; but although research will no doubt proceed in many places, the immense plants necessary to transform theory into action cannot well be constructed in countries not possessing the necessary resources. Our organization of scientific research and development, the whole system of the organization and co-ordination of the nation's resources for defence purposes, which Lord Hankey reviewed under a somewhat misleading title in his recent book, "Government Control in War", must be reconsidered in the light of this new situation.

This no doubt will be one of the prime tasks of the new Atomic Energy Advisory Committee which, as announced on August 21, the Government has set up, under the chairmanship of Sir John Anderson, to assist in dealing with the many far-reaching questions raised by this new discovery, in connexion with its international treatment and its further development in Britain, for both industrial and military purposes. This Committee is not intended to deal with policy, which no doubt will be fully considered not only by the Government itself, but also, if not by the Executive Committee of the Preparatory Commission of the United Nations, then by the Security Council, as Mr. Bevin's statement on August 16 indicated. The exchange of scientific information and of scientific co-operation is thus again to the fore, and the ideas put forward last year by Dr. Joseph Needham for the organization of an international science co-operation service acquire fresh significance.

The choice is in fact not between secrecy and disclosure, but between co-operative and competitive knowledge. It might be held a sensible precaution for the United States to hold her secret until agreement has been reached upon the form of the new world control and until the appropriate machinery has been built into the United Nations organization ; but that control must be based on the pooling of knowledge, upon the recognition that, as the Archbishop of Canterbury pointed out, it is the duty of men of science to explore and to find out with all the abilities they have, and to extend the knowledge of this universe. That duty can only be discharged while there is the fullest communication between scientific men of all countries ; and although there may be room for much discussion as to the form the control now required should take, it must be recognized from the start that full freedom of scientific

intercourse is a first condition. Without that there can be neither effective control in seeing that this discovery is not turned to destructive ends, nor the best use made of it for peaceful purposes.

One of the first steps to be taken is thus, as Sir Henry Dale suggested in his letter in *The Times*, the encouragement of the fullest possible publication of the results of scientific research and of the full freedom of science for which he pleaded. It is not merely that progress in science really depends on such freedom of intercourse; from the point of view of world order and security, such freedom would also be a useful means of indicating danger points. Restrictions or refusal to participate would not be easily concealed from the scientific community; and once the existence of such an attitude was established, the world organization should be able to deal appropriately with the situation before it became unmanageable. Furthermore, the historical survey of the scientific discoveries which led to the idea of the atomic bomb contained in the Statement issued by the Department of Scientific and Industrial Research on August 12, 1945, well illustrates the truth that scientific effort proceeds on parallel lines in different countries, and effective contact and intercourse between the scientific men of the United Nations should in itself be a safeguard against any sudden advance elsewhere, the application of which might endanger the peace of the world.

Dr. J. Needham, writing from Chungking, has now prepared for private circulation a memorandum on the place of science and international scientific co-operation in post-war world organization, in which he reviews the reception of his earlier proposals and discusses their incorporation in a United Nations organization such as that which was recently considered by the Conference of Allied Ministers of Education. Prof. A. V. Hill's address on "Scientific Co-operation within the British Commonwealth" before the Royal Empire Society on January 31 (see *Nature*, **155**, 373; 1945) elaborated proposals for a more limited field, but with their bearing on international scientific co-operation clearly in mind. The recent visit of British and other men of science to Moscow for the anniversary celebrations of the U.S.S.R. Academy of Sciences has provided further evidence of the concern and desire of scientific men everywhere for fuller and free international contacts.

The dependence of all modern world civilization on applied science must find its expression in the sphere of international relations, and Dr. Needham notes that this desire is more strongly expressed the further one goes away from the great scientific and industrial centres of Europe and the United States. One reason for this is, as he shows in his memorandum, that the picture of world science looks very different when seen from Rumania, Peru, Siam or China, where it may be very difficult for one man of science to establish contact with another in a different part of the world. It is particularly the scientific workers and technologists in the far larger regions of the world outside Western Europe and North America who need the help of an international science co-operation service.

Dr. Needham points out that such a service should be directed and limited to doing those things that are not being done, and cannot be done in other ways. It must also avoid the danger of a paper organization incapable of functioning effectively, and undue bureaucracy through failure to select the right staff. Adequate office management would avoid the first danger, and full participation by scientific men themselves the second. He should also have added, however, that no new organization should be established where the development or modification of existing organizations would serve.

Since these proposals were advanced last year, draft proposals for an educational and cultural organization of the United Nations have been published (see *Nature*, Sept. 1, p. 263). The purposes of this organization are "(1) To develop and maintain mutual understanding and appreciation of the life and culture, the arts, the humanities and the sciences of the peoples of the world as a basis for effective international organization and world peace". The principal functions of the organization would be to assist the free flow of ideas and information among the peoples of the world through schools, universities and other educational and research institutions, libraries, publications and the Press, the radio and motion picture, international conferences and the exchange of students, teachers and all other representatives of educational and cultural life, with special attention to the exchange of information on major educational and cultural developments, including advances in scientific knowledge. They also include fostering the growth of educational and cultural programmes which give support to international peace and security, and conducting and encouraging research and studies on educational and cultural problems related to the maintenance of peace and the advancement of human welfare.

The activities thus contemplated cover most of the twenty-four specifically listed in the draft cited in Dr. Needham's memorandum, and scientific activities are more implicitly covered, though the restoration of physical facilities including laboratories and equipment and scientific libraries in the liberated and ravaged countries is not mentioned. Since, however, the word 'culture' does not possess in all countries the wide connotation it has in the United States, Dr. Needham is on firm ground in insisting that the word 'science' should appear in the actual title of the organization, and in suggesting that it should be termed the United Nations Educational, Scientific and Cultural Organization. Moreover, the Organization should cover both pure and applied science, which cannot be separated.

Dr. Needham sets forth thirteen aims for the scientific division of the new Organization which overlap with those already mentioned but cover the field of science more adequately, and have much in common with the agenda Prof. A. V. Hill suggested for the Empire Scientific Conference. First, there is the general aim of promoting international scientific co-operation in all its aspects. Next, he puts organization of the better exchange of scientific information and research services between scientific men and their

organizations in the different countries. Here Dr. Needham refers to the enormous task of seeing that the information actually published by government scientific organizations reaches those who need it, both far and near. In this connexion his work in China has clearly impressed upon him the need for increasing the availability of scientific periodicals, both current issues and the back runs of the more important periodicals. Besides the question of reproduction which may be involved here, there is the exchange of reprints, and Dr. Needham suggests that a central stockpile might be of great value to scientific workers by facilitating distribution.

In elaborating this point, Dr. Needham ventures into a highly technical field ; but it may well be argued that some such organization as he advocates would prove the best means of securing an objective study of the problems and encouraging, not the development of a number of new *ad hoc* organizations, but rather the expansion of existing organizations so that they could serve adequately the needs of to-day. He also suggests in the same connexion that much help could be given to scientific workers by arranging for the wider use of special apparatus only available at certain places, while a specific aim should be that of assisting the free flow of essential research apparatus, chemicals and equipment across national frontiers. This function would involve assisting a wide distribution of the catalogues of firms producing scientific equipment, and possibly some assistance in the matter of customs dues and procedures. Some of these points have already been emphasized by the Committee on Scientific Equipment of the Conference of Allied Ministers of Education. As one of three short-term aims, Dr. Needham mentions the elaboration of a plan for utilizing surplus war material and equipment suitable for use in research and its transfer to the more scientifically backward countries.

Another aim would be the maintenance of contact between government organizations concerned with science, pure and applied, when necessary, and advising government and diplomatic personnel on scientific matters. This applies to the smaller Powers particularly, for even if the practice of appointing scientific attachés in the embassies of the larger Powers becomes established, the smaller Powers may well lack the personnel to make such appointments. Again, the need is stressed for assisting the free flow of scientific books, periodicals, manuscripts for publication, translations, abstracts, etc., across national frontiers, and especially between world regions of widely different linguistic pattern. Here he has in mind both encouraging the publication of scientific results in the major scientific periodicals in the better-known languages, and also the rationalization of the present system of abstracting scientific publications. An International Science Co-operation Service should be able to do something to prevent the dissipation of scientific publication on purely nationalistic grounds. It might assist the effort which the British Commonwealth Science Committee contemplates in its report for a common abstracting service for the English-speaking nations, and develop this ultimately into a central abstracting organization issuing the abstracts in the three or four main world languages simultaneously.

Realization of such plans at present lies far ahead, but progress is scarcely possible except through an organization of the type Dr. Needham has in mind. Even within a single country, there is still much parochialism among scientific workers to be broken down before co-operative enterprises in such fields as abstracting can achieve full success. Probably Dr. Needham's next objective, assisting the free flow of scientific workers across national boundaries, is one where the organization he suggests might function with more immediate effect. Dr. Needham quotes Sir David Rivett, Dr. Coumoulos and Prof. J. B. S. Haldane to illustrate the importance of this objective, and refers also to such matters as the preparation of scientific expeditions in zoology and astronomy, and for the investigation of the natural products of interesting parts of the world where local effort would be unable to finance such projects. Dr. F. W. Went's proposal for the organization of temporary research groups in specific topics in fields such as genetics, cytology, physiology and morphology is a further example of how valuable such an international science co-operation service might prove.

Overlapping with this aim, Dr. Needham suggests the promotion of plans for international collaboration in research, and has in mind both close contact with the international scientific unions which, in such sciences as astronomy, geophysics, geodesy and radio physics, have been outstandingly successful in the past, and the establishment of similar bodies for other sciences, as well as encouraging the activities of such organizations as the International Committee on Zoological Nomenclature. He illustrates his point by showing how an international science co-operation service could help in rapidly supplying contacts needed in research and by rendering the dissemination of scientific information less haphazard. This aim would also cover the preparation and maintenance up to date of a register of scientific institutions of all kinds and of their staff members and specialities.

Again, the new organization would support all international activities of the various national academies of science, and assist the work of other international organizations, such as the United Nations Food and Agriculture Organization and Relief and Rehabilitation Administration, the International Labour Office, etc., in scientific questions. Such development would be greatly facilitated by the development of the expected science co-operation service of the British Commonwealth after the War and like bodies, the International Resources Office, or the International Development Authority called for at the Bretton Woods Conference. On the other hand, the organization suggested by Dr. Needham might be able to combine into one body some of the smaller international scientific bodies such as the United Nations Standard Co-ordinating Committee, the World Power Conference, the International Fisheries Board, and also provide central secretariat facilities for the international scientific unions and congresses.

From Dr. Needham's experience with the British Council Scientific Office in Chungking, and from the work of the United States Interdepartmental Committee of Cultural and Scientific Co-operation with the American Republics, he is able to supply concrete examples of the kind of work which the organization he suggests might do. Furthermore, while the work of the organization would chiefly be related to that of the Social and Economic Council of the United Nations, in one matter at least it would be related to that of the Security Council. Dr. Needham suggests that the organization should be concerned with the control of the activities of scientific workers in the ex-Axis countries so as to prevent the building up of war potential while permitting the renaissance of scientific thought which must have a place in the re-education of these peoples. With an international science co-operation service, it should be almost impossible for the significance of such developments as the Haber ammonia synthesis to be overlooked, and this factor has a vital bearing on the elaboration of any plans for the control of atomic energy.

As to further association of the organization with industrial activity, Dr. Needham is a little vague. He thinks that some help might be offered in the simplification of world patent law and that by means of such an organization the maximum goodwill could be focused on the development of the backward countries. Dealing with the probable cost and structure of the proposed organization, from the cost of the British scientific office in Washington and in China and the United States Cultural Division of the State Department (Far East Section), he suggests that the annual budget should be about three million dollars, providing for a liberal number of field offices. It is essential, however, that the scientific organization be not radically understaffed or starved of funds, and the headquarters' secretariat must be supported by a resident staff in the more backward countries, where the prestige of science is weak and the influence of local politicians with no understanding of science is strong. Not more than two or three of the scientific representatives in such a field office need be of outside nationality, and for some regions a field office could cover several national entities or domains.

Dr. Needham is not pessimistic as to the possibility of securing the right staff, and points to the fund of wisdom and experience which could be drawn upon by utilizing men in the five-year period after retiring age. The business of the scientific liaison officer, he emphasizes, is not necessarily to know the answer; but to know where the answer can most probably be obtained. He also emphasizes the need for assuring the officials of the organization of some kind of diplomatic status, with guaranteed facilities for transport and communication.

Dr. Needham has been at some pains in formulating his scheme to avoid the weaknesses in the International Institute of Intellectual Co-operation, but although it may be assumed that the principal place for science in the international scheme is the United Nations Educational and Cultural Organization, with the title modified as suggested, many scientific men will be working with other functional organizations, such as the Radio Communications Organization, the Civil Aviation Board, the Food and Agriculture Organization, the International Health Organization. Accordingly, it has been proposed that a scientific body might be introduced at a higher level than any one of the functional organizations; so Dr. Needham suggests that the United Nations should include, as a counterpart of the Economic Commission and the Social Commission, a Scientific Commission and a Scientific Secretariat. The Commission might consist of about a dozen eminent men of science of the older generation, and the secretariat of a score or so younger men of science, mostly on a short-term service basis. This Scientific Commission of the Economic and Social Council would provide an easy means of linking the work of all scientific men in the functional organizations; but Dr. Needham himself appears to lean rather to the idea of an Educational, Scientific and Cultural Organization, functioning on the lines already indicated, and worked out in detail by a world conference of science; such a conference has already been recommended by the National Academy of Sciences of the United States. Nevertheless, although most of Dr. Needham's suggestions are to be found in current discussions on problems of scientific relations, it may well be open to question whether the time is really ripe for such a world conference. So far as the British Commonwealth is concerned, these questions will largely be covered by the Empire Science Conference to be called next summer by the Royal Society, and the improvement of scientific co-operation and communications within the British Commonwealth is an essential factor in promoting any wider schemes.

What appears to be of the first importance at the present moment is to see that the full fruits of war-time experience are reaped, and that machinery for co-operation for war purposes, whether within or without the British Empire, which has proved its value, should not be thrown away. To develop and utilize fully existing organizations rather than to elaborate fresh organizations should be a guiding principle. It is true we may well hope for the establishment of an Indian Scientific Office with an Indian Scientific Liaison Service, and the position with regard to the Middle East Supply Centre may require careful watching if the valuable scientific work already initiated under it is not to be jettisoned. That in itself is a matter for international collaboration, and the Empire Science Conference is unlikely to disregard the work of the British Central Scientific Office in Washington, the Scientific Office of the British Council in China, or the experiment with scientific attachés which Australia has initiated. Furthermore, those considerations of imperial defence to which Prof. A. V. Hill referred in his address to the Royal Empire Society on January 31 have been powerfully reinforced by the advent of the atomic bomb; and policy in this matter cannot be worked out in isolation. Dr. Needham's proposals may appear premature in some respects, but between now and the meeting next summer of the Empire Scientific Conference there should be clear thinking among scientific workers of the Commonwealth as

to the precise ways of improving means of communication and co-operation within and without the British Empire, and the extent and delimitation of any new organization to be established for such purposes. Such consideration must necessarily take account of the draft proposals for a United Nations Educational and Cultural Organization, and a decision reached as to how far such an organization can serve the needs of science, what modifications, if any, are required in title or in structure, and whether or not scientific organizations can usefully co-operate. Dr. Needham has at least challenged the constructive thinking which is essential in order to seize the opportunities of the post-war world.

PROTEINS, AMINO-ACIDS AND PEPTIDES

Proteins, Amino-Acids and Peptides as Ions and Dipolar Ions

By Edwin J. Cohn and John T. Edsall, with chapters by John G. Kirkwood, Hans Mueller, J. L. Oncley and George Scatchard. Pp. xviii+686. American Chemical Society Monograph Series. (New York: Reinhold Publishing Corporation, 1943.) 13.50 dollars.

THE misfortunes of war have rendered this impressive book, published in 1943, inaccessible in Britain until recent months. No shorter description is possible than to say it is worthy of those great men to whom it is dedicated, Bate Hardy, Loeb, Osborne and Sørensen.

The book is wholly devoted, except for one chapter, to physico-chemical aspects of proteins and their simpler constituents, and, until very recent times, such books have been exceedingly few. The earlier ones by Robertson (1920), Loeb (1922), Pauli and Valkó (1933) were of classical calibre (this one no less), and they were for the most part an interpretation of those properties of proteins directly dependent upon the ampholytic character of the molecule; little was known of the size and shape of the protein molecule. In the last decade, however, we have seen the fruition of Svedberg's monumental researches in this latter field, researches which reoriented the type and scope of physico-chemical research, and we now mark a point at which much is known of what we might call the morphology of the protein molecule, and almost nothing of its fine structure. The present volume incorporates this newer knowledge, yet the emphasis, like that of its antecedents, is upon those properties of proteins arising from their dipolar ionic character. This does not imply a bias: it merely recognizes a fundamental character which makes the protein molecule the great architect of biological reactions.

The outstanding feature of the book is that it presents, both in trend and treatment, the individual approach which Prof. Cohn and his colleagues have consistently followed in the long series of papers from the Harvard laboratories; that is, the properties of proteins reflect in large degree the properties of the simpler peptides and amino-acids, and are explainable, also in large degree, from the more straightforward studies on these simpler compounds. The first part, therefore, is devoted to amino-acids and peptides, thus: spectroscopy and dipolar ionic structure; thermodynamics and simple electrostatic theory; dipolar ions and acid-base equilibria; relations between acidity and chemical structure; dielectric constants and dipole moments; apparent molal volume, heat capacity, compressibility and surface tension; solubility in water and in organic solvents; interactions between organic solvents and dipolar ions; interactions between amino-acids and peptides, etc.; interactions between ions and amino-acids; theoretical interpretation of the properties of dipolar ions in solution.

The second part is devoted to the proteins: structural basis from analysis and proteolysis; X-ray diffraction studies; amino-acid composition; density and apparent specific volume; osmotic pressure and molecular weights; translational diffusion; sedimentation and diffusion; proteins as acids and bases; rotary Brownian movement; electric moments and relaxation times; solubility of proteins; interactions of proteins with ions and dipolar ions; theory of electrophoretic migration.

It must be admitted that the book, though lucidly written, will not be readily assimilated except by the physico-chemical expert, and no review can dismiss that large section of less specialized readers who must enlarge their more purely chemical or biological interests. For the broad mass of workers in the biochemical field—and there are few aspects of biochemistry which do not touch upon and require some knowledge of the properties of proteins—may be deterred by the rigorous mathematical treatment which a book of this nature must embrace. Yet it is important that this section of biochemists should understand, to take one obvious example, the factors governing the solubility of a protein, a knowledge facilitating all preparative and purification techniques in the field of proteins 'proper', hormones, enzymes, viruses, immuno-chemistry and the rest. How far then does the book fulfil the needs of this class of reader? Certainly, Chapters 3 and 12 by Scatchard and by Kirkwood (thermodynamics and simple electrostatic theory; properties of solutions of dipolar ions), and Chapter 25 by Mueller (theory of electrophoretic migration) will not be appreciated and their usefulness must be rather limited. On the other hand, most other chapters are characterized by an unassuming approach and show the adaptation of simple laws to the study of complex problems. Of this, Chapter 4 (dipolar ions and acid-base equilibria) and Chapter 6 (dielectric constants and dipole moments), both by Edsall, are two examples. The authors do indeed create an awareness that they have been sensible of the needs of the less specialized reader, and strike a nice balance between descriptive and mathematical formulation. With a little perseverance, therefore, this class of reader will reap a rich harvest.

We have noted the main emphasis of the book, namely, the dipolar ionic character of proteins. One of the most important sections here is the interaction of proteins and ions, and Chapter 24 reveals that some aspects are not fully understood; particularly the extreme insolubility of some protein cations in presence of mere traces of salt. Again, the interaction of protein with protein must be of great importance in physiological systems, yet few studies have been made. Among other chapters, protein structure is summarily treated, and only a few aspects of denaturation. The treatment of the amino-

acid composition of proteins in one chapter is rather inadequate, and the description of some analytical methods, at a time of expansion into the newer chromatographic and biological methods, is not of permanent value. The supplementary index, tabulating the page reference of various types of data for certain amino-acids, peptides and proteins, is extraordinarily useful.

KENNETH BAILEY.

MANAGEMENT OF A SPECIAL LIBRARY

Manual of Special Library Technique

With Particular Reference to the Technical Special Libraries of Commercial and Government Establishments. By J. E. Wright. Pp. viii+104. (London: Association of Special Libraries and Information Bureaux, 1945.) 8*s*. 6*d*.

THE discussions devoted to the organization and problems of special libraries and information departments have always been among the most popular at the annual conferences of the Association of Special Libraries and Information Bureaux, and the interest which was aroused by the symposium of papers on the organization of technical information services in industry arranged by the Society of Chemical Industry in October 1943 is further evidence that Mr. Wright's book should have a wide appeal. In contrast to Mr. J. L. Thornton's book on special library methods published in 1940, which was largely a survey of university and university college libraries and those of learned societies and institutions, Mr. Wright's book is a manual of practice, and has particular reference to the technical special libraries of commercial and Government establishments. Within its limits it is a thoroughly competent piece of work. The right points are emphasized and although some of its chapters, for example those on indexing and on classification, may be rather too condensed, it should meet a recognized need. While the manual contains little that is new, Mr. Wright has brought together information which a beginner might not easily trace, and such beginners, as the Association has discovered, are by no means rare.

Most libraries maintained by an industrial firm begin as a small collection of books in a manager's office, with some inflow of trade and other periodicals. Chemical and engineering firms and some others may have enough research interest to acquire some bound runs of the periodicals of the learned societies, and sooner or later the expansion of this nucleus requires a separate room. As soon as even only a small separate room is required, someone is needed to handle the periodicals and take care of the collection, and by this time some special abstracting or card-indexing of particular information may have been requested by busy technologists. The part-time amateur or casual attendant thus finds himself or herself blossoming into a full-time works librarian, and however qualified in knowledge of the manufacturing or scientific side of the firm's business, usually lacks, and is ignorant of, any literature of librarianship as a vocation. Mr. Wright's book is a valuable addition to those published remedies for growing pains of which such beginners are often unaware, and the chapters on the inquiry desk and on information service, based on a paper given to the Association's Conference in 1942, should be particularly appreciated.

For a short manual this book is well balanced, but it would have been better not to have brought in so much reference to ephemeral conditions. In what is presumably intended as a standard and permanent manual, matter relating to war hindrances, if included at all, would better have been relegated to an appendix and discarded at the appropriate time from the subsequent and enlarged editions which will doubtless be called for. The section on patent specifications is excellent, but could with advantage be amplified to include information regarding United States, German, Swiss and French Patent Office publications. In regard to questions of library co-operation, however, Mr. Wright might have made the position of the library of an individual firm a little clearer. In practice, firm's libraries may and often do respond generously to requests for assistance, but such requests are considered on their merits; and it is not clear why Mr. Wright suggests that it is not possible to co-operate in one matter while refusing to co-operate in others. The point is that a firm's library, by its constitution and purpose, cannot offer service outside in the way that a library under public auspices, such as a university library or a Government library, might be expected to do, and this circumstance has to be kept carefully in mind in formulating any large schemes of library co-operation.

R. BRIGHTMAN.

MILK HYGIENE

Bacteria in Relation to the Milk Supply

Third Edition. By G. H. Chalmers. Pp. vii+272. (London: Edward Arnold and Co., 1945.) 8*s*. 6*d*. net.

THE scope of this book has now been clearly defined by this third edition. The book in its present form will without doubt find its greatest value in the hands of students of the methods of milk production, processing and distribution, who require some knowledge of elementary bacteriology. As such the book is extremely valuable, since it is the only modern British text on the subject of hygiene applied to milk handling in all its stages. The section on the control of dairy plant is particularly well done, and collects together all the subject-matter otherwise scattered throughout various text-books, research papers and Government pamphlets.

It must be understood, however, that the book is in no way a text-book of bacteriology, and serious students of dairy bacteriology cannot rely on this volume for any great help in their subject apart from the particular aspects of the hygienic control of production and processing methods and plant. From the systematic point of view it is to be regretted that the existing confusion over nomenclature is increased by such terms as *B. coli*, *B. welchii*, *B. subtilis*, *B. tuberculosis* and *B. cyanogenes*, organisms which, by usual custom, represent five separate genera. It is also perhaps a pity that there is, in the technique of the plate count and coliform test, slight deviations in details from those published by the Ministry of Health. Lack of uniformity in such details renders more difficult the reproducibility of tests already difficult to reproduce.

One further small point: the value of this generally recommended book would be greatly enhanced by the addition of more references to work mentioned in the text.

PHYSICAL CONDITIONS OF THE SURFACE OF THE MESOPHYLL CELL WALLS OF THE LEAF

By Prof. FRANCIS J. LEWIS

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MOST of the extensive work carried out during the last half-century on transpiration has been mainly concerned with stomatal behaviour and the amount of water vapour passing out from the stomata during their period of opening. Very little attention seems to have been given to the nature of the outer surface of the mesophyll cell walls through which the water vapour passes, and through which at the same time active gaseous exchange takes place.

It has been stated that the surface of these walls is either moist or covered with a thin film of water from which evaporation into the intercellular cavities of the mesophyll takes place. It seemed of interest to investigate the properties of this surface more critically in the light of these suggestions.

The experimental method first employed consisted in cutting leaf strips parallel to the lateral veins. If such strips are suspended vertically with one edge in contact with water, no entry of water takes place into the capillary system, and the same result may be observed if the whole strip is immersed in water. It makes no difference whether the experiment be carried out in light or darkness, and all attempts to induce the entry of water into the capillary system proved unsuccessful.

Experiments were then performed to determine the possibility of the entry of other liquids under similar conditions. Leaf strips suspended vertically over a number of organic liquids, and with the cut end just in contact showed a ready entry of such liquids into the air space system. For this purpose benzene, chloroform, ether, petroleum ether, acetone, essential oils, olive oil and pure medicinal paraffin have been used.

In all these cases immediate entry occurs, the liquid rushing with great velocity into the capillary system of the mesophyll. In the case of benzene, chloroform, ether and petroleum ether a vertical rise of 2 cm. may be obtained in 60 sec., and the rise goes on at a progressive rate until the inflow reaches the upper edge of the strip.

The entry of essential oils, olive oil and paraffin is somewhat slower; but even with paraffin a vertical rise of 5 mm. can be observed to occur in approximately 5 min., and a more rapid rise with the lighter oils.

Direct microscopic observations of the mesophyll surface in relation to the flow of liquids seemed desirable and were carried out in the following manner. The leaf of *Ficus elastica*, by suitable manipulation, can easily be torn transversely, so that considerable areas of the mesophyll are exposed. The lower epidermis with the lower hypodermis readily splits away from the upper portion of the leaf. If the operation be carried out rapidly, no injury to the cells takes place except the individual cell ends of the spongy parenchyma next to the hypodermis. A strip as large as desired, up to 2 cm. in length and breadth, can then be cut off and placed on a slide under the microscope. In this way the whole depth of the mesophyll can be examined under a magnification of 100 or more, and an excellent view of the space system and the small lateral veins be maintained.

A drop of water placed on this surface remains suspended like a lens on the summits of the mesophyll cells and shows no disposition to spread over their surface into the capillary space system. The drop can be enlarged so that it covers the whole strip, but the intercellular spaces still remain non-infiltrated. When a drop of the organic liquids mentioned earlier is used in the same way, instant entry into the intercellular spaces occurs. All these liquids, except medicinal paraffin, have the disadvantage of being toxic and rapidly killing the cells with which they come into contact. While the phenomena to be described do not vary essentially whatever liquid is used, the microscopic observations here described relate solely to the use of pure medicinal paraffin. The use of this hydrocarbon further had the advantage of its behaviour being easily followed, while the entry of the other liquids is so rapid that it cannot be followed by the eye.

When a drop of paraffin is placed at one end of the leaf-strip with the mesophyll surface exposed, the oil immediately penetrates the capillary system. Two advancing fronts can be observed. From the edge of the drop a stream comes out which cascades down into the air space system, and this is followed by the main wave. The outflow cascading down into the air spaces is followed by the main oil wave at a distance of approximately 1 mm., and the oil thus travels the length of the exposed mesophyll in this fashion. When a drop of water is placed about the middle of the strip and oil added at one end of the strip, the oil travels along in the manner described until it comes to the water, and the initial oil wave trickles into the air space system below the water lens and continues its path on the further side.

From these observations it seems clear that while water will not flow over the surface of the mesophyll cell walls or to fill the air spaces, a number of organic liquids do so, and the phenomena can be followed by the use of a non-toxic hydrocarbon such as pure paraffin.

Experiments with Emulsions

If a small quantity of water be shaken up with a much larger amount of paraffin so that the water droplets are of the order of about 0·001 mm. in diameter, and the paraffin with water droplets be placed at one end of a strip of exposed mesophyll, the oil enters the air space system carrying some water droplets with it. It sometimes happens that a water droplet comes into contact with one of the fine veins. When this happens the water droplet appears to adhere to the surface of the vein, often sends out an arm or narrow outflow on one or two sides, loses its spherical shape, becomes flattened, diminishes in size and finally vanishes, being absorbed into the vein. When such a water droplet comes into contact with a mesophyll cell no change takes place, and, in the absence of a local current of oil sweeping it away, it remains unchanged in position.

When an emulsion of a small quantity of benzene in water is used the behaviour of the mesophyll can be observed microscopically. If leaf-strips be placed in such an emulsion and the containing tube be kept slowly agitated, the ends of the leaf-strips become infiltrated with benzene and the turbidity of the benzene-water almost disappears owing to the absorption of the larger droplets of benzene into the mesophyll air space system. If a similar emulsion be made with paraffin and water and the same conditions be observed, the ends of the leaf-strip become

oil-infiltrated. The finest droplets of oil are not absorbed, but only a slight turbidity of the emulsion remains, due to the presence of microscopic droplets.

When a leaf-strip with the mesophyll exposed is prepared and quickly placed on a slide under the microscope, and covered with a cover-glass, moisture immediately collects on the under surface of the cover-glass. It forms at first a system of microscopic polygonal strands of water, giving a minute shagreen aspect to the surface of the cover-glass when viewed under a magnification of 100. After a few minutes the system tends to coalesce. If now water is run in under the cover-glass, it immediately penetrates between the wet cover-glass surface and the mesophyll surface, but does not flow down into the air spaces of the mesophyll. If a drop of oil is placed in contact with the edge of the leaf it immediately passes into the interspace from end to end of the leaf-strip and is bounded above by the water film still adhering to the cover-glass which, owing to slight inequalities of the surface of the mesophyll, is distant 0·01–0·001 mm.

From these observations it appears clear that while the mesophyll is passing off water vapour rapidly into the air, and this can be condensed on the cover-glass surface in its immediate proximity, the cellulose walls from which the vapour proceeds cannot be wetted, nor does any condensation of water occur on this surface. Under these conditions when oil is presented to the cellulose walls, it immediately flows over them and fills the capillary space.

Infiltration of the Air Space System under Pressure with Dyes

Infiltration under a pressure gradient showed that different dyes have quite dissimilar effects. For example, a solution of Orange G filled the interspace system and coloured the whole infiltrated portion. The same treatment with Methylene Blue resulted in the whole of the dye being taken out of the solution at the point of entry while the clear water proceeds and fills the interspaces. Several preliminary trials of dyes taken at random revealed totally dissimilar effects in different cases, and it was resolved to make an extended series of experiments with a number of biological dyes.

The terms acid and basic dyes, while used frequently in dyeing processes, are sometimes misleading, and from a chemical point of view may be valueless. Every dye contains at least one group of atoms known as a chromophore which is regarded as being responsible for the colouring properties of the compounds in which it occurs. Some chromophores have a basic character and others are acid. On this basis dyes can be classified into acid and basic regardless of the solutions in which they occur. With these facts in mind, all water-soluble dyes available at the time were tested in regard to their behaviour to the surface of the walls of the mesophyll cells by infiltration under a pressure-gradient into the air space system. As a common standard a solution of 1/1,000 gm. mol. was used. The difference in behaviour between the two types of dye can be illustrated by the detailed description of the results given by a basic dye such as Janus Green and an acid dye such as Orange G. When a leaf is infiltrated with Janus Green the whole of the dye-stuff in solution is retained or absorbed on the surface of the mesophyll cells at the point of entry, while the water uncoloured by any dyestuff passes on and fills the interspaces of the mesophyll. The usual method adopted was to cut the leaf in half transversely, connect the cut petiole with a vacuum pump and place the leaf in the dye solution. In this case the whole of the dye-stuff in the solution passing in is adsorbed on the surface of the mesophyll cells within less than a millimetre from the edge of the leaf, while in less than 45 sec. the whole of the rest of the leaf becomes filled with water free from dye. Some objection may be taken to the fact that the solution passes into the space system over a front of cut and injured cells. To avoid this the whole uninjured leaf was submerged in the dye solution, the chamber exhausted. On restoration of atmospheric pressure infiltration takes place from the cut end of the petiole through the air spaces in the cortex. No infiltration takes place through the xylem strand. With this treatment exactly the same phenomena can be observed, for the whole of the dyestuff is adsorbed on the mesophyll walls in a small patch near the base of the leaf while water entirely free from dye fills the interspaces of the lamina. It thus makes no difference whether the dye solution enters the cut edges of a leaf or enters through the cortical interspaces from the petiole; immediate adsorption of the dye takes place in both cases. Microscopic examination shows that the adsorption of the dye is not due to staining of the cell contents but to an actual deposition on the outer surface of the walls. It can further be shown that the dye-stuff enters into a strong combination with the cell wall surface. If the coloured areas of the mesophyll are exposed and placed in water no portion of the adsorbed dye goes into solution; the dye remains permanently held on the surface. Immersion in acetone renders the adsorbed dye soluble and after a short time it may all go into solution and the original green colour of the mesophyll be restored. It is then clear that a dye with a basic chromophore such as Janus Green is strongly adsorbed and held on the outer surface of the cell walls.

If a dye with an acid chromophore such as Orange G be taken, an entirely different set of phenomena occurs. Infiltration results in the dye solution filling the interspaces, and the whole of the infiltrated area takes on the colour of the dye, the outer surface of the walls showing no adsorption of the dye. If now the leaf be allowed to clear itself of the water of the infiltrated solution, which it does in less than one hour in sunlight, the dyestuff is left in irregular patches on the surface of the walls. If the patches are exposed and placed in water the deposited dye immediately goes into solution, showing that it is not held or adsorbed on the surface.

The following dyes with a basic chromogen have been tested: Janus Green, Methylene Blue, Neutral Red, Safranin, Rosanalin, Methyl Violet, Crystal Violet, Methyl Green, Iodine Green, Rhodamine B. These all show the same strong adsorption of the dye by the outer surface of the mesophyll cell walls as has been described for Janus Green. Stains with an acid chromogen such as Orange G, Acid Fuchsin, Methyl Blue, Aniline Blue, Eosin, Erythrosin, all show the same features described in detail for Orange G.

Interesting features are found when the infiltration contains in solution both an acid and a basic dye. In this case the basic dye behaves as described in detail for Janus Green, while the acid dye behaves in a similar fashion to Orange G; so that the leaf is wholly coloured by the acid dye, which enters the interspaces of the mesophyll, while the basic dye is taken out of solution and adsorbed on the surface at the point of entry.

The acidity or the alkalinity of the dye solution makes no difference to the results ; the adsorption or the non-adsorption appears to depend entirely on the acid or on the basic character of the chromogen group of the dye.

Action of Fatty Acids on the Wettability of the Cell Wall Surface

Numerous experiments have been carried out with the view of rendering the wall surface wettable by water.

Water containing cane sugar in extremely low concentration has been infiltrated into the air spaces and the leaf allowed to clear itself in sunlight by transpiration through the stomata. This gave no result as water did not enter the air spaces when one edge was placed in contact with water. The use of glycerine also gave no result.

The use of sodium taurocholate suggested itself as an agent for decomposing and penetrating mono-layers of protein. A leaf strip placed vertically in contact with water containing a minute proportion of sodium taurocholate (between 1/100,000 and 1/200,000) immediately showed a rise into the mesophyll spaces and the infiltration proceeded up the strip in the same manner as pure paraffin, but more slowly. After entering for some distance (10–20 mm.) the infiltration stops when a broad band of yellowish brown appears at the margin of infiltration. No further entry of water occurs beyond the band.

At first, experiments with sodium taurocholate showed a ready entry of the water, in other trials it was slight or did not occur at all. Further investigation showed that the *p*H of the solution was important. Solutions decidedly on the alkaline side were inoperative, while a *p*H of 6 and below renders the action certain.

Microscopic observations with sodium taurocholate were carried out on the mesophyll exposed by tearing in the manner described earlier.

If a glass needle be wetted with water containing a slight concentration and a droplet placed on the surface of the mesophyll, after a short interval the water globule begins to spread over the surface and eventually sinks into the lower interspaces in the same way as pure paraffin.

The above observations were carried out on a great variety of leaves. For experiments in which the lower epidermis had to be detached such leaves as *Hyocyamus muticus*, *Ficus elastica*, *Morus*, *Canna*, *Ricinus*, *Malva*, *Pancratium*, *Caryota* proved very suitable. *Hyocyamus* possesses a leaf in which nearly the whole lower epidermis can be peeled off in one operation, leaving the mesophyll cells quite uninjured below. The age of the leaf also influences the ease with which these manipulations can be carried out.

The preceding observations show : (1) that the outer surface of the mesophyll cells are highly hydrophobic ; (2) that they are quickly covered by a liquid hydrocarbon ; (3) on infiltration with water under a pressure gradient the liquid in the air spaces is quickly cleared when the leaf is placed in strong light, and there is no adhesion to the surface by liquid water ; (4) the surface of the walls shows strong adsorption to certain dyes dissolved in water ; dyes so adsorbed possess a basic chromophore ; dyes having acid chromophores show no adsorption ; (5) the hydrophobic nature of the surface of the cell wall is destroyed by sodium taurocholate, which has a lysic action on the protein mono-layers of blood corpuscles.

RECENT DEVELOPMENTS IN AIR PHOTOGRAPHY

By Wing-Cdr. H. HAMSHAW THOMAS, M.B.E., F.R.S.

THE value of air photography for military intelligence and map revision became recognized early in 1915, and during the War of 1914–18 great progress was made in the design of aircraft cameras. Long series of overlapping pictures were obtained, stereoscopic examination of prints was commenced, and many of the types of information obtainable from suitable photographs were recognized. After that War, the use of this method in survey and map revision was studied[1], and surveys of large areas were made, especially in Canada and the United States. In some places air photographs were employed for scientific studies as I suggested in *Nature* in 1920 [2], and results of importance for geologists, foresters, civil engineers and archæologists have been obtained.

The outbreak of war in 1939 found Great Britain, however, with very inadequate preparations for air photography as one of the chief sources of war intelligence. But during 1940 an organization was brought into being in which many professional men of science were enrolled, and gradually a very strong and efficient service was built up. Later a close co-operation was established with the American Army and Naval Air Services, in which ideas, equipment, materials and methods were interchanged.

The provision of photographs of the areas controlled by the enemy required the use of special aircraft, able to fly deep into enemy country at a height and speed which rendered their interception difficult. This meant the production of special types of our fastest machines, and the training of special pilots to navigate and fly them. The aircraft were generally fitted with two or more cameras, so that the maximum number of useful photographs could be obtained on every sortie. Cameras of the type in service at the outbreak of war were very largely employed, but lens makers were called upon to produce new types of lenses of long focal length for use in them. The general features of these cameras had been designed at the close of the War of 1914–18 ; they have automatic operation with distant control, and a magazine of film for 250 exposures. As the result of constant research and experiment, many important improvements in the design have been introduced. Later a new type, with a magazine holding 500 exposures, was brought into service, and a somewhat similar instrument designed by the Fairchild Co. in the United States was also used.

The cameras were generally mounted in the aircraft with the optical axis vertical, or slightly tilted so that by the simultaneous use of two instruments greater lateral cover could be obtained. For low-level photographs cameras were installed in an oblique position in the fuselage or under the wings ; very valuable work was done with two synchronized cameras facing forwards and giving stereoscopic results. The task of obtaining pictures of specific installations from a low altitude made great demands on the skill and daring of the pilots ; it was generally attended by considerable risks.

The operation of cameras at high altitudes produced some special problems, such as the effects of the intense cold on the moving parts, and the occurrence of condensation on the lenses. Special heating arrange-

ments had to be devised to ensure the efficient operation of the cameras at very low temperatures. At low altitudes difficulties were introduced by the very rapid movement of the aircraft. These were solved by the design of new cameras with a moving film. Specially modified types were also needed to secure at night photographs taken by the light of a powerful magnesium flash, or depicting the incendiary bombs dropped by bomber forces and the fires they started.

Photographic chemists have played an important part by producing sensitized films suitable for the work which had to be done, and by devising methods for processing exposed film so that a negative with a very fine grain could be produced in a minimum period of time. In view of all the operating conditions, panchromatic material proved to be the most useful, but infra-red film was sometimes used, and colour film has been recently employed for special tasks.

The production of air photographs whenever the weather was favourable, in sufficient numbers to give a picture of enemies' resources, activities and defences, and to provide the topographical information required by the planning staff, is only one part of the work of photographic intelligence in war. The other part is the detailed examination of the prints and the production of reports on what has been observed. This is often a lengthy and somewhat laborious process. In addition, some of the material may be employed in map revision, or may be used for the construction of models to show the appearance of an area as seen from sea-level or from a low altitude.

For all these purposes pairs of prints are studied with a stereoscope, which gives the observer some measure of appreciation of the relief of the terrain and of the height of objects. Whenever possible, the latest photographs are carefully compared with pictures of the same area taken at an earlier date. This work requires well-trained observers with a good visual memory; they must be able to appreciate the significance of small details, of shadows cast by objects and of changes which may have occurred after a lapse of time. It is often necessary to measure quickly and accurately the sizes of small features seen on the photographs, and from this to determine their actual size. They must be familiar with the appearance and distinctive features of all objects likely to occur on the ground, for reports will not be of full value unless the things that are noticed can be identified. The task of the photographic intelligence officer is thus one of interpretation, and is essentially morphological in character. A very considerable number of men and women who before the War were engaged in scientific research have used their skill and training in this work. Among them were archæologists, geologists, geographers, botanists and zoologists, with some engineers and surveyors; science teachers, artists and many others with suitable intellectual equipment also did valuable work.

Without attempting any complete account of the information gained, some of the subjects investigated may be mentioned. During 1940, after the fall of Dunkirk, the collection of invasion barges in the Channel ports, the movement of enemy shipping, the building of U-boat bases and the construction of airfields in France and the Low Countries were watched. In that year the first air survey of the Ruhr was made; the systematic study of its industrial installations, of oil plants and of the facilities for storing fuel oils in enemy-occupied countries was commenced. At the same period, the results of British bombing attacks on Europe began to be assessed by reference to photographs of targets taken before and after attacks. This work became a task of great importance as the European war proceeded; it served not only as objective evidence of the results of day and night bombing, but it also provided a measure of the efficiency of different types of bombs and of their effect on structures of different kinds.

Suitable annotated photographs of target areas were needed by bombers using the 'H2S' radar equipment. After the Germans had attacked the U.S.S.R., and their armies in Western Europe assumed a defensive role, regular photographic reconnaissance was needed to follow the building of coastal defences. It became possible to give a full report at any time of the state of the enemy's positions along the coast from Holland to the Spanish frontier. Much of this information was used in the planning of commando raids. Detailed study was also given to the building of radar stations by the Germans after the initial discovery of their first station from photographs taken in November 1940. This work required the most careful examination of thousands of photographs and a minute study of all suspicious objects. When a new station had been located on high-altitude pictures, pilots were often able, with great daring, to obtain oblique views from a low altitude which would show the external details of the installation.

As time passed and plans began to be formulated for landing the Allied armies in North Africa, Italy and Normandy, the demands for military information of every kind became enormous. Not only was it necessary to determine the positions and types of the enemy defences and his strength in armoured fighting vehicles, but also to obtain exact information about the characters and gradients of beaches, the nature of the adjoining terrain, of the woods and thickets, the roads, rivers and bridges, and about many other things which might affect the success of a landing. Photographs and the models made from them played a very important part in the preparations for every great offensive action.

Photographic intelligence also played a noteworthy part in naval operations. It was of great assistance in showing the positions of German naval units throughout the War. The location of the battleship *Bismarck* in a Norwegian fjord in 1941 and the subsequent events will be remembered. After long and careful study it became possible to identify in photographs each of the merchant ships used by the enemy and to follow their movements from port to port. Shipbuilding and submarine construction were kept under regular observation and the knowledge obtained assisted the defence of our merchant navy. The method of calculating the speed of a ship, by the study of the waves seen when it was photographed at sea, is an interesting example of research carried out by interpreters with a physical and mathematical background; it had important operational results.

As the years of war passed, some of the research groups of intelligence officers were confronted by problems of considerable difficulty. They had to report on objects which did not exist before the War, and the real nature of which could only be inferred from their appearance. The description and identifi-

cation of such things required careful observation and scientific reasoning. The radar stations already mentioned were of this class; another example was decoy installations built in Germany with the object of drawing off the attacks of Allied bombers from specific targets. Many of these decoys of different forms were located and described after a long period of study.

A subject which occupied the attention of a small group of specialists was the production of synthetic petrol and other oil. A considerable number of new plants were built after the War had commenced, while the older ones were enlarged or extended. The first problem was to locate the new plants, and after this had been done they had to be studied to discover the processes used and their probable designed capacity. The estimation of the oil resources of the enemy during the later years of the War depended very largely on the reports of this group, which had also to ascertain the effects of bomb damage on production, and to forecast the time which would be taken in the repair of damage. It has been lately learned that the Allied attacks on oil contributed largely to the collapse of the enemy, and these attacks depended to a very large extent on photographic intelligence. The production of synthetic rubber in Germany presented a somewhat similar but still more difficult problem.

It is interesting to notice that photographic reconnaissance showed that a most extensive exploitation of the brown coal deposits of Central Europe had been made for the production of electric power, tar and fuel of different kinds. Very few people in Britain seem to realize the importance of brown coal in the economic life of Germany.

Aircraft construction must be mentioned among the industries which received special study. The appearance of new types was often first announced after the examination of photographs; the development of the jet-propelled Me.262 was recognized in this way.

Of all the tasks carried out by pilots and interpreters of Allied photographic units none was more exacting or more vital than the investigation of the enemy rockets and flying bombs. During the summer of 1943, photographs provided objective evidence of these weapons and showed the places where they were being developed. The successful attack on Peenemunde which followed these discoveries caused a postponement by several months of the launching of the missiles against England. Afterwards, the location of a large number of firing sites in northern France was successfully accomplished, and the accurate bombing of these military installations still further delayed their employment. The enemy then proceeded to construct firing points of a new type which was less obvious from the air, but it was not very long before more than a hundred of these were located. When firing eventually commenced, Allied bombers were able to reduce considerably the projected weight of attack. Attention was also paid to the places where the missiles were manufactured and stored. In the course of the fight against the 'V' weapons, considerably more than a million photographs were taken and examined.

In the Mediterranean area and the Far East, air photography has played an important part to which no reference can yet be made. The production of modern military maps, a most vital service in the warfare of to-day, needs a separate article to show what has been done. Air survey has provided much material for this work; the photographs have been used in different ways, sometimes after the methods worked out by the British Air Survey Committee, sometimes by the rapid methods practised in Canada before the War, sometimes with the help of the Wild Autograph or by the Zeiss Multiplex method.

From all this co-ordinated effort, there should be some legacy capable of useful employment in a world at peace and for scientific work. A vast library of photographs of Western Europe and of other areas now exists in which are numbers of photographs of interest to scientific workers. It is to be hoped that these will be made available for study, and that they will not be destroyed as after the War of 1914–18. Once again we have seen the great value of the air method of determining in great detail the positions of objects on the ground. The use of this method would make possible the study of physical features, of the distribution of vegetation, of the location of antiquities, and many other things which cannot be investigated by ground survey because of the vast labour involved. Attention has already been directed in *Nature* of July 7, p. 2, to the scientific advances which may well result from the continuation of air survey by the R.A.F. in time of peace, and the matter needs careful consideration by the appropriate authorities. The history of air photography in Britain shows how the Fighting Services may suffer if organized units of the R.A.F. are not maintained for this work in the future. But efficiency can only be kept up when there is important work to be done, and Service personnel know that when they carry out good work it will lead to results of permanent value.

The work steadily pursued in Canada between the two Wars should be more widely known. It provides an example of the beneficial results of air survey for civil purposes, while affording experience of the greatest value in case of war. Great areas have been mapped by the Dominion air surveyors, and it may be recalled that so early as 1924 the Forestry Department sent photographs, which were shown at the Empire Exhibition at Wembley, illustrating the practical value to foresters of this work.

Scientific workers have always stood for the value of research even though its immediate practical value cannot be demonstrated, and the same view may be taken of air survey. Only those actively engaged in the detailed geological investigation of the upland areas of Britain know how this work is restricted by the lack of detailed topographical maps. Air photographs would easily remedy this deficiency. In the same way the problems of changes in coastal lands, the study of land utilization as well as town and country planning, could receive immediate help from an organized national photographic reconnaissance unit the results of which were kept in a library similar to the Canadian National Library of Air Photographs (now known as the National Topographical Library, of the Department of Mines and Resources) at Ottawa.

In 1939 few people, either in the Services or in civil life, realized the potentialities of air photography or the part it was destined to play in the great European struggle. The brief account which has been given above should remind us that it may in the same way prove to be of unforeseen value in times of peace.

[1] For references, see Hart, "Air Photography Applied to Surveying" (1940).

[2] Thomas, H. H., *Nature*, **105**, 457 (1920).

SEX EDUCATION: AIMS, POSSIBILITIES AND PLANS*

By CYRIL BIBBY

IT is sometimes forgotten by many educationists to-day how much is owed to the pioneers in the field of sex education. Whatever differences of opinion there may be about the desirability of the specific measures they recommended, it is clear that the great advance in sex education which is taking place to-day could not have occurred if they had not prepared the ground. As a result of their work, views that were novel and unorthodox are now almost commonplace and acceptable even in official circles.

Perhaps the greatest turning point on this path towards official recognition was the transference in 1942 of the major part of the work of the British Social Hygiene Council to the Central Council for Health Education. What this official support has meant to the cause of sex education is perhaps best illustrated by some figures. The numbers of sex education lectures given by these two bodies to certain types of audience during the past five years are as follows:

Audience	1940–41	1941–42	1942–43	1943–44	1944–45
Teachers	7	95	83	86	232
Youth leaders	17	35	33	59	118
Parents	21	39	37	75	117
Young people	257	612	580	1,348	1,416
School children	71	87	101	208	159

The total attendance at these meetings during 1943–44 was 68,712 (the figures for 1944–45 being not yet available) while, if the audiences at meetings and film shows on venereal diseases are included, the total attendance during the year was some 300,000. Quantitatively, then, the present position is fairly satisfactory. The number of people who have received *some sort* of sex education during the last five years is considerable.

It is clear that there has been of recent years a radical and widespread change of public opinion on the question of sex education. The time has passed when it was necessary to state with some vehemence the case against sheer obscurantism. Probably there will remain with us for many years a few frightened adults who will continue to foster the cult of ignorance; but an increasingly large section of the population is allowing the myths of the gooseberry bush and the stork to fade into oblivion. The general public, educational and medical administrators, churches and social organizations, teachers and youth leaders, parents and pupils—all are ready to go ahead. No longer is it necessary to press the claims of sex education in language more vigorous than profound. Now is the need for careful study of the many educational issues involved. Only after such study is it likely that the position in sex education will be at all satisfactory as regards quality.

The first issue for study is that of objective. What are the aims of sex education and what are its possibilities? To serve as a basis for useful action, an objective must be desirable, attainable and sufficient—and this cannot be said of some aims that have been propounded.

There are, for example, those who use 'sex education' as an euphemism for dilation on the horrors of venereal disease, and hope to frighten young people into 'goodness'. But sex education is not mere anti-venereal propaganda; it is preparation to live a joyous, well-balanced and fruitful life. There are others whose aim is to produce 'morality' by threats of fire and brimstone. But the educationist can have no concern with such 'goodness' and such 'morality'. Such aims fail on the test of desirability.

Other aims, perhaps desirable enough in themselves, fail on the score of feasibility. To expect by sex education alone to wipe out prostitution and casual promiscuity, to make all marriages successful and all divorces disappear, to abolish adultery and prevent all fornication, is to be hopelessly unrealistic. Many and deep seated are the sexual ills of society, and education unaided will not eradicate them. Economic and political changes and a new social and spiritual vision are needed too.

Now what of the criterion of sufficiency? A great many people seem to imagine that sex education consists merely of imparting the so-called 'facts of life', although one would have thought that the inadequacy of this conception were sufficiently clear. A study of ancient or contemporary history, or even a superficial knowledge of the lives of one's acquaintances, will rapidly dispel any illusion that there is necessarily a close correlation between the extent of an individual's biological knowledge and the excellence of his actions.

The teaching of the obvious biological facts will make it clear to our children that the human sex organs are essentially similar to those of other mammals, such as the rabbit; and if sex education were to stop there, it would be logical for a child to deduce that the sexual behaviour of a healthy young human should not be very different from that of a healthy young rabbit. But since presumably we do not wish to adopt the rabbit as the model for our sexual behaviour, sex education must at the appropriate stages deal also with those respects in which humans *differ* from the other mammals, and in particular with the consequences of the unique development of our nervous system and of our peculiar sociability.

But still something else is needed. Our children must be inspired with a feeling of the excellence of sex and of its immense potentialities. Our young people, if they are to deny themselves the immediate sensual pleasures with which our bodies can so richly provide us, must see some reason for such a sacrifice. If they are to be asked to wait, they must feel that they have a future, and a future that is worth waiting for. If society is to make demands, it must see to it that its members think sufficiently highly of it to be willing to accede to them. Behaviour is dependent upon ideals and inspiration, as well as upon factual knowledge and intellectual understanding.

It is, however, easy enough to criticize aims expounded or implied by others. Much more difficult is the task of formulating a statement to take their place. I do not feel sufficiently confident to do so at all dogmatically; but at any rate a tentative effort should be made. I would, therefore, define the aims of sex education something along these lines: "That our people should grow up learning the appropriate facts in the best possible way; that their general attitude to sex should be a completely healthy one; that they should draw up for themselves a code of conduct after careful consideration of all the issues involved and should endeavour to behave according to this rationally determined code; and that they

* Substance of an address at the annual general meeting of the Eugenics Society on May 29. The paper will be published in full in the *Eugenics Review*.

should react to the behaviour of others with sympathy, tolerance and charity, but without spineless acquiescence in a code inferior to their own." No doubt this statement of aims could be much improved, but it will serve as a working basis for the time being.

First, what constitutes 'appropriate' knowledge and at what age should it be imparted ? This latter query is clearly one to which there is no simple answer. No one age can be prescribed for sex education, any more than it can for any other aspect of health education or character training. Sex education should surely be a continuous process from early years to later life, and the question should really be re-phrased to read : What aspects of sex education are particularly appropriate to different ages ? This is obviously difficult to answer in general terms, for no one human is exactly like another ; but if we call to our aid that mythical creature the 'average' person, a reply may be attempted.

I would suggest that by about the age of two or three years, children should be learning the polite terminology for the sex organs, just as they learn the words 'arm', 'leg', and 'head'. By the time they go to school at about five, they should in most cases know that the baby grows inside the mother and is born *via* an opening between her legs ; and should understand something of the similarities between birth in humans and in the domestic mammals. During the next two or three years the child should learn that the father contributes the sperm cell which fertilizes the mother's egg, and that the penis is placed in the vagina during mating.

These apparently dogmatic statements about the order in which information should be imparted are not made without reason. The suggested order is that indicated by analysis of the questions typically asked by children of various ages. Questions about birth and pregnancy tend to be asked first of all. It is usually only later that the child inquires about the role of the father, and thus elicits explanations of fertilization and copulation. My belief is that, in general, the right time for enlightenment is when the child seeks it—not when some adult thinks that an appropriate age has been reached.

There are some things, however, in which the adult must act as pacemaker, because the adult knows what sort of ground lies ahead and the child does not. Some time from about the age of twelve onwards a girl will begin her menses, and she needs to be prepared in advance by a simple biological explanation at the age of about eleven. Boys also should have an idea of the significance of menstruation, so that they do not build up on a basis of ignorance an atmosphere of mystery about their sister's periods. But more important for boys is a preparation for the changes that will occur in themselves during adolescence, and in particular for the onset of seminal emissions which, accompanied as they often are by erotic dreams, cause adolescent boys a good deal of needless worry. Minds worried and terrified by the outrageous allegations which still circulate about the alleged ill-effects of masturbation need also to be set at rest—or, better still, so fortified by the truth that the worries and fears never materialize.

So far no mention has been made of any other than the reproductive aspect of sex, and there is, I believe, good reason for this. It is clear from their whole attitude that most children of less than about twelve years (or even older) think of sex as a purely reproductive matter, and have no conception of its amatory aspect. During the three or four succeeding years, however, the endocrine changes of adolescence begin to produce deeper sexual feelings ; an understanding of the love aspect of sex begins to dawn and, with it, an interest in the morals and social conventions of sexual behaviour. This, therefore, I suggest is the period when a point should be made of explaining something more of the influence of the endocrine secretions on the body and the emotions. This, too, is probably the best time for discussing questions such as courtship and marriage, 'necking and petting', promiscuity and prostitution ; and for imparting the elementary facts about the venereal diseases.

Towards the end of adolescence and in early adult life, general sex education merges into specific marriage preparation and guidance—a topic too large to consider in any detail now. It may be suggested, however, that apart from a knowledge of the actual technique of intercourse, sex education during the courtship stage should emphasize the importance of each partner understanding well the emotional peculiarities of the other and exercising delicacy and restraint in whatever degree of love-making may be mutually agreed upon. Couples contemplating marriage should be encouraged to learn something of each other's physical and mental health ; to understand the economic implications of marriage and parenthood ; to reach agreement on how their future home is to be run ; and they should be informed of the sources to which they can turn for further information and guidance.

Sex education, however, should not end with marriage. Apart from any continuing guidance in the technique of intercourse, I believe that all married couples should have some training in child care and parentcraft and—of particular relevance here—should be given some understanding of the normal sexual development of children and of how to cope with the problems arising from it. Here, however, the sex education of one generation merges into that of the next ; and perhaps we had better leave the matter for the time being.

The next problem is that of the encouragement of a healthy attitude to sex, and this is a difficult matter—partly because there is by no means unanimity about what in fact constitutes a healthy attitude. I can do no more, therefore, than register my own personal *credo*.

It seems clear that on impressions gained and attitudes formed in the first five years of life depend to a considerable extent the emotional balance and happiness of the adult. Let us, therefore, examine some of the factors influencing these impressions and attitudes. Because of the close physical proximity and nervous connexion between the voiding and the genital organs, attitudes developed with reference to the former are likely to be transferred to the latter. Any feeling of distaste for the process or the products of voiding may, therefore, have a decidedly unfortunate influence on later feelings about sex. Thus it is patently important not to encourage such feelings ; but on the contrary to convey the impression that voiding, like eating, is a perfectly normal and proper process.

Then there is the question of the so-called 'infantile masturbation'. It is unfortunately the case that many parents, mistaking the exploratory path of innocence for the broad highway of incipient vice, either tell the child not to be 'nasty' or 'rude', or by some action show their disapproval. What is the poor infant to think, that it may safely pull its

nose and may twiddle its toes with impunity; but if it does the same in a region half-way between, it incurs displeasure? Clearly there is nothing better calculated to encourage the feeling from the earliest days, that there is something quite isolated from the rest of life, something unclean, about the sexual organs, and hence at a later date by association, about the sexual functions. This too, therefore, must be avoided.

Now, what of the question of nudity? It is a commonplace that attitudes to sex are often associated with similar attitudes towards nudity, so if a child from the first learns to regard nudity as in no way an indecent phenomenon, it is reasonable to hope that it will be helped in the development of a healthy attitude to sex. Naturally, however, children must, to save both themselves and others from embarrassment, learn as they grow up that there are occasions and places, including most public occasions and public places, in which nudity is frowned upon.

A great opportunity for encouraging a proper attitude to sex occurs when another child is expected in the family. By careful preparation on the part of the parents, a sense of pleasurable anticipation may be aroused in the children and crowned with a feeling of family solidarity when the baby arrives, and that surely is the goal to aim at.

During these early years, moreover, there are certain attitudes not specifically sexual in nature which are, nevertheless, of fundamental importance in laying the foundations for a successful family life in later years. I have in mind the development of habitual friendliness to the other members of the family, of affection and consideration for others, of willingness to share possessions and to co-operate amicably in activities with playmates. I have in mind also the growth of interest in, and of a sense of wonder at, the workings of Nature, the growth of an æsthetic sense, of a desire for personal health and cleanliness, of admiration for vigour and smartness, of distaste for furtiveness and dishonesty. Sex education, indeed, interpenetrates indissolubly with general character training.

With the onset of adolescence other more specifically sexual attitudes become important. One should endeavour to arouse a sense of pride in approaching maturity. It is important also that each sex should develop an attitude of sympathetic consideration to the other, regarding friendships as perfectly natural and quite desirable, but as needing the exercise of discretion and restraint. This is the period too, I suggest, when one should particularly endeavour to encourage an attitude of distaste for obscenity and pornography—without, however, going to the other extreme of prudery or priggishness. There are those, I know, who believe that sex is so sacred that it should never be the object of humour. For my part, I *do* feel that certain aspects of sex and sex behaviour are sometimes rather ludicrous, that sex *may* sometimes quite properly be the occasion of humour; and I would therefore emphasize the importance of avoiding the sin of hypocrisy. The distinction to make is surely that between hearty, unashamed laughter and nasty, shamefaced sniggering; between something which is funny and incidentally sexual and something which is merely filthy in nature.

By the time adult life is reached, basic attitudes are already largely determined. It is important, however, if the idea of sex education is to be widened, as I believe it should be, into a conception of education for family life, that we should devote attention to encouraging those contemplating marriage to be willing to discuss reasonably and in a friendly spirit, such matters as the economic running of the home, the division of domestic duties, family planning and so on; and that we should endeavour to ensure that married persons should be considerate in all things towards the spouse, should not regard the wedding ceremony as terminating the period of courtship; should have a proper attitude to the upbringing of their offspring. But once again we have made the circle, and have reached to the next generation.

(*To be continued.*)

OBITUARIES

Mr. W. Sydney Smith, C.B., O.B.E.

William Sydney Smith was a native of Nottingham. He was born in 1866, the eldest son of Samuel Smith, of the firm of Sydney Smith and Sons, engineers. Educated at Nottingham High School, where he excelled in class and in sports, at the age of sixteen he was apprenticed to a Nottingham engineering firm. During his apprenticeship, while working from 6 a.m. to 5.30 p.m., he attended evening classes, an early indication of his grit and determination. He first intended to take up teaching, but winning in 1889 a Whitworth Exhibition of £100, he decided to follow the family tradition of engineering, and taking his B.Sc. (London) degree, in 1890, he joined his father in his engineering business for a short time. He then went to an electrical engineering firm at Westminster, and on, for a while, to Willans and Robinson at Thames Ditton, returning to his father's firm in 1893.

On the death of his father in 1895, Sydney Smith sat for a Home Office examination and was appointed one of H.M. inspectors of factories, going to Manchester in 1896 and from there in 1905 to Derby. While in Manchester he compiled a 'blue book' on hoists and lifts. In 1908 he was appointed H.M. inspector of dangerous trades at the Home Office.

Early in 1918 the late Sir Henry Fowler, who had known Sydney Smith at Derby and had a high opinion of his personal qualities and his engineering ability, recommended him as his successor as chief superintendent of the Royal Aircraft Establishment at Farnborough, Hants, and he served there until his retirement in 1928.

Though having little aeronautical experience, Sydney Smith quickly grasped the essentials of the work of the Establishment, and he keenly encouraged all steps to improve its effectiveness as the main centre of aeronautical research, and to make its resources, and the results of its work, readily available to the aircraft industry. The period of his work at the Royal Aircraft Establishment was not an easy one; after the change from a war economy to that of peace, the further retrenchment in Government expenditure necessitated the discharge of a large number of the employees. He was a great friend of the staff and workpeople, to whom he was endeared by his obvious integrity, his strict fairness to all and his sympathy and consideration for their welfare; and it was very painful to him to have to discharge men at a time when employment was not easy to obtain.

His work at the Royal Aircraft Establishment was recognized by the award of the O.B.E. in 1918 and C.B. in 1922.

Sydney Smith had a great habit of early rising, and

[None of the vacancies in these columns relates to a Man between the ages of 18 and 50 inclusive or a Woman between the ages of 18 and 40 inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1945, or the vacancy is for employment excepted from the provisions of that Order.]

HOME OFFICE FORENSIC SCIENCE LABORATORY

Applications are invited for the posts of Biologist and Physicist at the North Eastern Forensic Science Laboratory at Wakefield. Only well qualified candidates of British birth and parentage should apply. The Biologist should be an Honours Graduate in Botany, with subsidiary qualifications in Zoology and Bacteriology. The Physicist should be an Honours Graduate, preferably with qualifications in Physical Chemistry. In each case commencing salary would be on the range of £275 to £650 per annum plus Civil Service War Bonus (at present £60 per annum), according to age and qualifications, but only in a most exceptional case above £400. Only a temporary appointment can be offered at the present time, but candidates born on or after August 2, 1915, will be eligible to compete in the post-war reconstruction competitions with a view to being established. It is not possible to offer prospects of establishment to candidates born before that date unless the circumstances are very exceptional. Applications (with copies of three recent testimonials) should be submitted on or before November 6, 1945, to the Establishment Officer, (Room 321), Home Office, Whitehall, S.W.1, from whom further particulars may be obtained if required.

LONDON COUNTY COUNCIL

Applications are invited for appointment to two positions of full-time JUNIOR ASSISTANT PHYSICIST (temporary war-time appointment) in the Council's hospitals service. The duties will be mainly in connection with X-ray and radium work at Hammersmith Hospital, Ducane Road, W.12, and Lambeth Hospital, Brook Drive, S.E.11, but the persons appointed will be required to undertake any other duties which may be allotted to them from time to time. Salary £350 a year rising by annual increments of £25 to £400 a year (together with cost of living addition £60 a year for men or £48 a year for women). There are no emoluments.

Application forms giving full particulars, obtainable (stamped addressed foolscap envelope necessary) from Medical Officer of Health (S.D.6), London County Council, County Hall, S.E.1, are returnable by October 19, 1945.

UNIVERSITY OF MELBOURNE

SENIOR LECTURESHIP IN GENERAL SCIENCE AND SCIENTIFIC METHOD

Applications are invited from persons with training in Philosophy, Logic and one or more branches of Science and with experience in research, for appointment to the newly established position of Senior Lectureship in General Science and Scientific Method. Duties will include the giving to Arts students of a special course to introduce them to the history, method and discoveries of science with illustrations from both the biological and physical fields, and the organization of a course in scientific method for science and medical students in the early years of training. Salary range, £550–£750 per annum (commencing rate according to qualifications and experience) with cost of living adjustment (at present an increase of £48 per annum) and subject to Provident Fund contribution. Further particulars may be obtained from The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1. Closing date for receipt of applications (in Melbourne), November 15, 1945.

UNIVERSITY COLLEGE OF SOUTH WALES AND MONMOUTHSHIRE

COLEG PRIFATHROFAOL DEHEUDIR CYMRY A MYNWY

Applications are invited for an appointment as Technical Laboratory Assistant in the Chemistry Department.

Candidates should possess experience in chemical laboratory work, including chemical analysis, glass-blowing, care and repair of scientific apparatus.

Candidates should be between the ages of 21 and 35 and be free to take up the appointment before November 1. Salary, commencing £275 to £350, according to qualifications and experience.

Applications, with testimonials, should be addressed to The Registrar, University College, Cathays Park, Cardiff, and be sent before October 16, 1945.

Wanted Urgently. Watson's Kima Microscopes or similar types. Full particulars to Headmistress, St. Dominic's High School, Stoke-on-Trent.

LIVERPOOL EDUCATION COMMITTEE

CITY OF LIVERPOOL TECHNICAL COLLEGE, BYRON STREET, LIVERPOOL, 3.

Principal : H. R. BUTLER, M.Sc., F.R.I.C., F.C.S.

Applications are invited for appointment as full-time LECTURER IN ORGANIC CHEMISTRY in the above College. Candidates should possess Honours Graduate qualifications. Salary will be in accordance with the Burnham Technical Scale. Further particulars of salary and form of application may be obtained on receipt of a stamped addressed envelope from the Director of Education, 14 Sir Thomas Street, Liverpool, to whom completed forms should be returned not later than October 20, 1945.

W. H. BAINES, Town Clerk,
Clerk to the Local Education Authority.

WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

The Governing Body invites applications for the post of SENIOR LECTURER IN CIVIL ENGINEERING. Duties commence on January 1, 1946. Candidates should hold a good honours degree in Civil Engineering and have practical experience in Structural Design and in teaching. Qualifications in Hydraulics and/or Surveying will be an additional recommendation. The exact status and remuneration of this post are under reconsideration, but it will in any case carry with it a salary not less than £50 above the Burnham Technical Scale.

Further particulars and application form will be sent by the undersigned on receipt of a stamped addressed foolscap envelope. Last date for the receipt of applications, Thursday, October 18, 1945.

J. F. S. ROSS,
Principal and Clerk to the Governing Body

NUFFIELD HEALTH & SICKNESS RECORDS BUREAU

(GLASGOW)

The Committee of the above Bureau invite applications for the post of RECORDS OFFICER to be responsible to the Committee for the supervision of collection and analysis of information concerning morbidity in the West of Scotland. Some experience of statistical methods, including punch-card systems and machinery, is necessary. The salary offered is £600 per annum. Applications, with the names of three referees, by October 27, 1945, to Mr. R. Morrison Smith, C.A., F.H.A., 135 Buchanan Street, Glasgow, C.1.

UNIVERSITY OF WESTERN AUSTRALIA

Applications are invited for the position of Hackett Professor of Agriculture. Salary £1,000 (Australian) per annum plus £40 at present for cost of living.

Applications in duplicate should reach the Agent-General for Western Australia, London, not later than Friday, November 30, 1945. Copies of conditions are obtainable from the Agent-General for Western Australia, Savoy House, 115 Strand, London, W.C.2.

G. A. CURRIE,
Vice-Chancellor.

BRIGHTON TECHNICAL COLLEGE

Principal : Gordon E. Watts, M.A., Ph.D., F.R.I.C.

Applications are invited for an appointment as LECTURER in MECHANICAL ENGINEERING in the above College. Salary according to Burnham Technical Scale with full allowances for approved research, industrial and teaching experience.

Further particulars and forms of application may be obtained from the undersigned. The completed forms should be returned, with copies of at least two recent testimonials, to the Principal of the College not later than October 20.

F. HERBERT TOYNE,
54 Old Steine, Education Officer.
Brighton, 1.

UNIVERSITY OF CAMBRIDGE SCHOOL OF AGRICULTURE

ASSISTANT in AGRICULTURAL ENTOMOLOGY

There are two vacancies in the Advisory Entomology Department. 1. In the grade Temporary Senior Scientific Assistant (salary £300–£425 p.a. plus war bonus). 2. In the grade Temporary Junior Scientific Assistant (salary £240–£375 p.a. plus war bonus). Applications, with names of two referees, to F. R. Petherbridge, School of Agriculture, Cambridge.

Microscope (Cooke). Complete modern outfit including special Research Lamp. Box P.143, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

UNIVERSITY OF BRISTOL

Applications are invited for the post of TECHNICAL ASSISTANT in the Department of Chemistry. Duties will consist of assistance in research work and the daily maintenance of laboratories.

Applicants should have some specialist experience in either organic or general chemistry, and must be prepared to take up duty not later than January 1, 1946. The salary will be a minimum of £5 per week according to age and experience.

Applications, with copies of three testimonials, should be sent to The Registrar, The University, Bristol, 8, not later than October 31, 1945.

Inorganic Chemist (Qualified) to supervise chemical control of Middlesex factory manufacturing cast plaster panels. Able to determine value of gypsum deposits and would have responsibility of opening up and controlling laboratory for research into uses of gypsum. Possibilities of travel abroad. Must be man of initiative. Salary £500 to £1,000 a year according to qualifications and experience. Write, quoting F.4964.XA, to Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, for application form which must be returned completed by October 31.

Two Officers are required for the Intelligence Section of the Mineral Resources Department, Imperial Institute. The work relates to the occurrence, mining, preparation and marketing of ores and minerals. Candidates must possess a University degree (at least 2nd Class Hons.) or equivalent and be trained in Economic Geology. Practical experience an asset. Salary £275 p.a. with annual increments of £18 plus war bonus (at present £60 p.a.). Appointment temporary with a view to permanent pensionable employment. Further information from Establishment Officer, Imperial Institute, London, S.W.7.

Dundee Technical College. An Assistant Lecturer is required in the Mathematics Department. Candidates should possess honours degree in mathematics. The existing salary scale, which is under review, is £300—£15—£400, with addition of war bonus of £60, and placing according to experience. Applications, with copies of not more than three recent testimonials, should be lodged not later than October 22, 1945, with the Clerk and Treasurer, Technical College, Bell Street, Dundee, from whom forms and particulars may be had.

Well-known London Company (Sched. under E.W.O.) requires services of lady with experience in abstracting technical literature or presentation of statistics preferably in chemical or allied industry. Knowledge of tech. German essential. Applicant should also have knowledge of shorthand and typewriting. Write, giving full particulars of qualifications, experience, age and salary required, to Box 415, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Male or female librarian with Science Degree or equivalent with experience in scientific and technical abstracting required for industrial research organization. Applicants should have a sound knowledge of German. A knowledge of other languages would be an advantage. Salary will be dependent upon qualifications and experience but in no case will be less than £350 per annum plus war bonus. Box 419, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Experienced Laboratory Technician required for serological and haematological routine. Preference given to members of the Institute of Medical Laboratory Technology. Salary in accordance with B Grade, Hosa Research Laboratories, Sunbury-on-Thames.

Trained Technician required immediately in Physiology Department. Commencing salary in Grade B of the B.H.A. Scale according to age and qualifications, etc. (not less than £300 p.a.). Applications to Vice-Dean, St. Bartholomew's Hospital, at Queens' College, Cambridge.

Temporary Demonstrators required for Session 1945–46 in Physics, Biology and in Chemistry. Salary £400 p.a. with prospect of permanent engagement. Applications to Vice-Dean, St. Bartholomew's Hospital, at Queens' College, Cambridge.

For Sale. Watson Microscope. Objectives, 2/3rds, 1/6th and 1/12th Leitz oil immersion. Two eyepieces. Mechanical stage, sub-stage condenser. Very good condition, can be seen. Offers. Box P.144, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

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usually spent an hour or two before breakfast working in his garden, which was his chief relaxation. He was an ardent supporter of improvement in educational facilities both for the trade lads within the Establishment and in the provision of a junior technical school and evening classes and a secondary school in the district.

His garden and his local activities (among other things he was a member and vice-chairman of the Surrey N.W. Area Assessment Committee) gave him satisfying occupation during his retirement, until his strength gradually failed and he died at his home, "The Pines", Camberley, on July 15, 1945.

He married in 1907, Hilda Mary, the daughter of William Charles Tuke, of Manchester, who, with three daughters, survives him.

We regret to announce the following deaths :

Miss Lucy Ashcroft, formerly lecturer in mathematics in the University of Reading, on September 30.

Prof. A. E. Edgecombe, associate professor of botany in Northwestern University, Evanston, Illinois, known for his work in mycology, on March 30, aged forty-eight.

Peter Esben-Petersen, a Danish authority on the systematics of neuropterous insects, on April 2, 1942.

Prof. E. Shearer, formerly professor of agriculture and rural economy in the University of Edinburgh and sometime director-general of the Ministry of Agriculture, Egypt, on September 14.

Prof. E. J. Williams, F.R.S., professor of physics in the University College of Wales, Aberystwyth, on September 29, aged forty-two.

NEWS and VIEWS

Prof. Norman Feather, F.R.S.

Dr. Norman Feather takes up his appointment as professor of natural philosophy in the University of Edinburgh this session. Dr. Feather has held the appointment of lecturer in physics in the University of Cambridge since 1936 ; he was elected to a research fellowship of Trinity College in 1929, and to a staff fellowship in 1936. After taking the Natural Sciences Tripos in Cambridge, Dr. Feather took up research work under Lord Rutherford in 1927 and worked first on the long-range α-particles from radium. He spent a year at Johns Hopkins University in Baltimore, and there studied the relations between β-particle energies and absorption coefficients, deducing therefrom a much used empirical relation. Returning to Cambridge in 1930, he resumed work with the Wilson cloud chamber, and in 1932 was brought in by Dr. J. (now Sir James) Chadwick to obtain cloud chamber confirmation of his discovery of the neutron. Within a few weeks, Dr. Feather was able to obtain tracks resulting from neutron collisions and, in particular, was able to demonstrate the disintegration of nitrogen by neutrons. This was the first evidence of disintegrations produced by neutrons.

In 1935 Dr. Feather joined Prof. Chadwick, who had in the meantime been appointed to the chair of physics in the University of Liverpool, and for two years helped to build up the physics research facilities there. During this period, Prof. Chadwick and he studied the photo-disintegration of deuterium. He returned to Cambridge as lecturer in physics and staff fellow of Trinity College. He then took up the study of nuclear energy-levels by the coincidence methods of counting which have since borne good fruit. Dr. Feather is the author of a biography of Lord Rutherford and a treatise on radioactivity. In the early days of the War, along with the rest of the Cavendish Laboratory staff, he headed a party manning a south-east coast radar station. He returned from there to shoulder a major share of the teaching and administrative duties of the Cavendish Laboratory and, early in 1940, under the sponsorship of the M.A.U.D. Committee of the Ministry of Aircraft Production, took up work with Bretscher on the measurement of nuclear cross-sections required to establish the feasibility and size of an atomic bomb. He has since been a member of the British technical committee which has directed the work of the British group concerned with atomic energy.

Anatomy at University College, London
Appointment of Mr. J. Z. Young, F.R.S.

The appointment of Mr. J. Z. Young, demonstrator in zoology in the University of Oxford, to the chair of anatomy at University College, London, provides an interesting departure from the normal practice in Great Britain in filling chairs of anatomy. Tradition in this Department at University College, deriving largely from Elliot Smith's wide range of activities, favours a broad conception of the field of anatomy which is thus likely to be continued. Prof. Young's work before the War on the nervous system of many species and his fruitful collaboration with clinical colleagues on the Nerve Injuries Committee of the Medical Research Council during the War suggests, further, that the especial emphasis on neurological anatomy associated with the work of Elliot Smith and Woollard at University College, London, is to be maintained. Experience gleaned in unusual fields should enable Prof. Young to bring fresh and arresting ideas to the current reconsideration of preclinical training, and new developments in the teaching of anatomy may confidently be anticipated.

Prof. R. P. Linstead, F.R.S.

Prof. R. P. Linstead, whose appointment as director of the Chemical Research Laboratory, Teddington, has just been announced, was educated at the City of London School and at the Imperial College of Science and Technology, where he had a brilliant career. He graduated in 1924 and entered J. F. Thorpe's flourishing school of organic chemistry, working with G. A. R. Kon on three-carbon tautomerism. After obtaining the degree of Ph.D. in 1926, he succeeded Kon as private assistant to Thorpe, a post which enabled him to devote all his energies to research. During this period he worked out a method for the estimation of isomeric unsaturated compounds in mixtures, which enabled considerable progress to be made in the study of unsaturation and of tautomerism of unsaturated compounds. He obtained the degree of D.Sc. in 1930. Linstead spent a year away from academic work with the Anglo-Iranian Oil Co., then returned to the Imperial College as a member of the staff and remained there until 1938, when he accepted the Firth chair of chemistry at the University of Sheffield. He moved to Harvard in the following year, but was soon afterwards

seconded for service with the Ministry of Supply, where he acted as deputy director of scientific research.

Prof. Linstead's scientific work is characterized by remarkable thoroughness and breadth of view; he is clearly not interested in quick returns and likes to tackle problems of fundamental significance. His best-known contributions include studies of unsaturated acids, carbocyclic fused-ring compounds and the discovery of a very interesting new class of synthetic pigments, the phthalocyanines; his recent investigation on the stereochemistry of catalytic hydrogenation is a particularly finished piece of work. Prof. Linstead, who is forty-three, was elected a fellow of the Royal Society in 1940 and is an honorary M.A. of Harvard University.

Wellcome Museum of Medical Science: Appointments

Wing-Commander C. J. Hackett has been appointed director of the Wellcome Museum of Medical Science in succession to Dr. S. H. Daukes, who has been responsible for the development of this Museum during the last twenty-six years. Dr. Hackett, who was a research fellow in tropical medicine of the Medical Research Council and who has done important work on yaws and other tropical diseases, will take up his new appointment as soon as he has been released from the Royal Air Force.

Dr. E. Ashworth Underwood has been appointed director of the Wellcome Historical Medical Museum and the Wellcome Historical Medical Library, and will take up his new duties as soon as he can be released from his present post of medical officer of health and chief school medical officer of the County Borough of West Ham. Dr. Underwood has held his present post for the past eight years. Before that he was medical officer of health of the Metropolitan Borough of Shoreditch, deputy medical officer of health of the city of Leeds, and lecturer in public health in the University of Leeds. In this field he has written widely on tuberculosis, on epidemiology and allied subjects. Dr. Underwood is well known for his activities in the sphere of the history of medicine. During the past five years he has been honorary secretary of the History of Medicine Section of the Royal Society of Medicine. He has contributed to the *Proceedings* of that Society, and to other journals, studies on the history of certain infectious diseases, on the medical importance of Lavoisier and the French chemists, on the earlier anatomists and on other subjects. He has for some time been collaborating with Prof. Charles Singer in work on Vesalius.

National Research Council (Canada)

Three new members have been appointed to the National Research Council (Canada) and two other members have been reappointed. The new members are: Mr. Percy Bengough, president, Trades and Labour Congress of Canada, Ottawa; Dr. Paul Gagnon, director, Department of Chemical Engineering, Laval University, Quebec; and Prof. David A. Keys, Macdonald professor of physics and chairman of the Physical Sciences Group of the Faculty of Arts and Science, McGill University, Montreal. The two members reappointed are Prof. J. A. Gray, Chown science research professor, Queen's University, Kingston, Ontario, and Mr. Arthur Surveyer, consulting engineer, Montreal, Quebec.

Scientific Co-operation with Czechoslovakia

Sir Alfred Egerton, one of the secretaries of the Royal Society of London, has left for a visit to Prague to convey the greetings of the Royal Society on behalf of the men of science of Great Britain to their colleagues in Czechoslovakia. He will be the guest of the rector of the Charles University in Prague and will discuss with him and his colleagues what aid British science can give to the rehabilitation of science and scientific education in their country. It is hoped that this visit may do much to enable the people of Czechoslovakia to re-establish firm scientific contacts with men of science throughout the world. Sir Alfred Egerton is taking with him, for the Masaryk University at Brno and the Royal Bohemian Society of Sciences at Prague, scientific publications of the Royal Society issued during the war years.

Czech Botanists During the War

Botanical research, like that in other branches of science, almost ceased in Central Europe when the Germans marched in. With their laboratories closed, Czech botanists retreated to their gardens and homes, where they had the leisure in which to examine the results of previous researches, conducted before such work was interrupted. Prof. Bohumil Němec, already the author of several standard Czech botanical works, wrote a comprehensive treatise on "Plant Life", in which he used more than seven hundred original illustrations. In addition, he published a more popular work, "The Green Kingdom", and also articles dealing with the mechanism of plant growth, movement and reproduction for biological and scientific journals, which seem to have increased in importance as the nation's position became more desperate. Dr. S. Prát continued to publish sections of his "Rostlinopis", a kind of botanical encyclopædia inspired, apparently, by the work a hundred years ago of those two pioneers of botany in Bohemia, the brothers J. S. and K. B. Presl, who used the same title for their "Botany", which they did not live to complete.

In mycology, Dr. J. Peklo published several long papers (including a seventy-page monograph) on the genetics of certain fungi and the problem of 'relative sexuality' among lower plants. As these contributions to botany are written in Czech they will not receive much attention until detailed abstracts are available in English. Not all Czech botanists were fortunate enough to remain unmolested. Prof. Němec's son was obliged to hide in the forests of Slovakia, and the exposure has impaired his health. Dr. Augustus Bayer, professor of botany in the Masaryk University of Brno, was executed by the Germans in 1942. He was a specialist on the development and anatomy of wood tissues. Dr. Bayer, who was sixty years of age, had also been engaged upon problems in forestry and agriculture, and indeed had gained an international reputation as an expert in applied botany and dendrology.

Jubilee of the Newcomen Society

The next meeting of the Newcomen Society, to be held on November 14, will mark the completion of twenty-five years activity of the Society. The officers of the Society in 1920 included A. Titley as president, three vice-presidents, ten members of council and H. W. Dickinson as honorary secretary and treasurer; of these fifteen members, seven have served on the Council during the whole twenty-five years, Dr.

Dickinson serving as sole or joint honorary secretary for the whole period except for the two years of his presidency 1932–34, when A. Stowers took office. The growth of the Society can be traced in successive annual reports published in the *Transactions*. The first volume of *Transactions*—that published in 1922—occupied 83 pages, and contained six papers and a list of 120 members; volume 20, 1939–40 (the last before the War), exceeded 180 pages and contained twenty papers, while the annual report gave the membership as 1,512. Since then the membership has risen to more than 5,000, principally due to the activities of the American members. Besides the papers, the *Transactions* have contained a valuable analytical bibliography of the history of engineering and applied science. The Newcomen Society owes much to Dr. Dickinson for his long service as secretary, and also for his editorship of nearly every volume of the *Transactions*. It has, therefore, been decided to invite subscriptions to a Dr. Dickinson Presentation Fund, the proceeds from which will be given to Dr. Dickinson in the form of a cheque or be expended on objects chosen by him. The upper limit for subscriptions is fixed at £2 2*s*. Members wishing to subscribe are asked to send their subscriptions, not later than October 10, to the assistant secretary, Miss G. Bingham, O.B.E., 43 King's Road, Chelsea, S.W.3, made payable to the "Dr. Dickinson Presentation Fund". Dr. Dickinson will be entertained to dinner after the annual general meeting on November 14, when the presentation will be made.

University and Research Libraries

THE University and Research Section of the Library Association held its first week-end conference since 1938 on September 21–24 at Wadham College, Oxford. The Conference was well attended, and visits were paid to many of the Oxford college and other libraries. The general meeting of the Section held on September 22 and 23 was concerned chiefly with the discussion, amendment and final approval of the Committee's proposals for the post-war development of university and research libraries. As soon as they are approved by the Library Association Council, they will be issued to the general public. Reference has already been made in *Nature* (Dec. 11, 1943, p. 687; February 19, 1944, p. 203) to these proposals which are intended to ensure an adequate supply of books and other materials for the prosecution of research in Britain. They deal with the place of university and research libraries in a national system, the national and local organization for research, administration and staffing, and plead for the fullest co-ordination of all library facilities. But this cannot be achieved until the national library resources have been comprehensively and qualitatively surveyed, a long overdue piece of bibliographical research. The programme of such a survey has been prepared by a committee of the Section's and it is hoped that funds will eventually be forthcoming for the project.

M. Henri Lemaître, a vice-president of the Library Association and formerly librarian of the Bibliothèque Nationale, was unable to attend through illness to deliver his promised address. Fortunately, a copy had arrived, and was translated and read to the session. M. Lemaître outlined the story of French libraries and librarians during the German occupation, a record of destruction and racial discrimination. During 1940–45, more than two million books were lost through the ravages of war, many of them forming the irreplaceable local collections in which France abounded. Many thousands of books, including complete libraries, were seized by the Germans. Yet French librarians stood firm against all threats, and continued to serve their readers to the best of their ability. In their private lives and in their professional occupation they were in the van of the struggle against the Nazis, and many suffered imprisonment and death for their devotion. Despite Nazi opposition they maintained a supply of books to French prisoners of war. They continued to supply books on the various proscribed lists to trustworthy readers; and when liberation came, they were ready with their plans for rehabilitation with the creation of new book centres for the French people on the lines of the English county library system.

Grants for Dental Teaching and Research

THE Nuffield Foundation has agreed to make grants for the promotion of dental teaching and research in Great Britain. The assistance provided by the Foundation is to be in three parts. First, grants totalling £9,000 a year for ten years are to be made to the Sutherland Dental School, University of Durham; University of Leeds Dental School; the Turner Dental School, University of Manchester; and Guy's Hospital Dental School, for the development of research work on preventive dentistry. Secondly, Nuffield dental fellowships will be established to improve the supply of dental research workers and teachers. Lastly, a few scholarships to enable dental students of outstanding ability to receive a more thorough scientific training will be awarded. Fellowships will be open to three groups of candidates: those with dental qualifications, university graduates in medicine, and thirdly those holding a university science degree; the annual value will be between £400 and £800. Scholarships, providing tuition fees and a subsistence allowance not exceeding £200 a year, are intended for candidates who, in the opinion of their dental school, would profit by receiving, during their course of training, additional instruction in anatomy and physiology. Forms of application for fellowships and studentships may be obtained from the Secretary of the Nuffield Foundation, 12–13 Mecklenburgh Square, London, W.C.1.

Announcements

MR. ARCHIBALD N. BLACK has been appointed Donald Pollock reader in engineering science in the University of Oxford.

DR. J. E. HURST, technical director of Bradley and Foster, Ltd., Bradleys Concrete, Ltd., of Darlaston, and director of research of the Staveley-Bradley, Foster Research Laboratory Institute at Sheepbridge, is to be Sheriff of the City and County of Lichfield. Dr. Hurst is president of the Staffordshire Iron and Steel Institute, and is known for his work on the heat treatment of cast-iron and the development of cast-iron suitable for nitrogen hardening.

THE Stephen Paget Memorial Lecture of the Research Defence Society is being resumed this year and will be given by Sir William Savage on the occasion of the annual general meeting of the Society, the title being "Public Health and its Debt to Experimental Medical Research". The meeting will be held at Manson House, Royal Society of Tropical Medicine and Hygiene, London, on October 12.

LETTERS TO THE EDITORS

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

Anti-*Hr* Sera

THIS communication is sent in order to acknowledge an error which has misled Race, McFarlane, Cappell[1] and Fisher[2] in their communications in *Nature* of May 5, 1945, entitled "Anti-*Hr* serum of Levine". At the same time, I take the occasion to make a few additional comments on some of the problems in this new field of research, so important for the clinician as well as the theoretical investigator.

In their discussion on the relationship of the anti-*Hr* and their *St* serum, the British workers conclude that these sera are not identical. On purely hypothetical considerations, Fisher had previously assumed the existence of at least three different varieties of anti-*Hr* sera, named by him, γ, δ and η. Until recently, the only anti-*Hr* sera described corresponded to the variety γ, which gives about 80 per cent positive reactions among white individuals. A serum of the type η characterized by an incidence of 96 per cent reactions was recently studied by Mourant[3].

Race and Fisher now believe that the one of the anti-*Hr* sera of Levine corresponds to the hypothetical antibody δ of Fisher. The only evidence in support of their contention is derived from the following statement made, but not further substantiated, in a paper by Waller and Levine[4]: ". . . in tests with a potent anti-*Hr* serum all the Rh_1Rh_2 bloods gave negative reactions . . .". Unfortunately, this statement does not correctly describe my actual findings, which were hitherto not published but were mentioned incidentally in the paper by Waller and Levine entitled "On the *Rh* and Other Blood Factors in Japanese".

In order to clarify the situation, the results of tests on the blood of 335 white and 135 coloured individuals with potent anti-Rh_0, anti-Rh', anti-Rh'', and anti-*Hr* are summarized below. The error mentioned occurred in the brief reference to these studies carried out during April–July, 1944.

Number tested	White (335)		Coloured (135)	
Type	Incidence	*Hr* positive (%)	Incidence	*Hr* positive (%)
Rh_1Rh_2	14·63	100	4·44	100
Rh_2	16·72	100	16·30	100
Rh_1	49·85	61·7	23·70	96·3
Rh_0	2·69	100	45·93	100
$Rh'Rh''$	0·00		0·00	
Rh''	1·19	100	0·74	100
Rh'	0·87	100	1·48	100
Rh negative	14·03	100	7·41	100
All types		80·9		99·3

Accordingly, the only statement which could be made is that all bloods of the type Rh_1Rh_2 tested are *Hr* positive. I freely admit an error which, although serious, must nevertheless be classified under the category of the clerical variety. It would never have been possible if the data given above had been published in tabular form.

Incidentally, the anti-Rh'' serum employed was derived from an Rh_1 patient immunized by repeated transfusions (titre about 1 : 40). In contrast to Wiener's anti-Rh'' serum, no other agglutinins were present. The anti-*Hr* serum briefly referred to elsewhere[5] had a titre of 1 : 100.

In accordance with Levine's definition of anti-*Hr* specificity, all bloods negative with anti-Rh' (*Rh* negative and Rh_2) give strong reactions with anti-*Hr* sera, while the remaining bloods Rh_1 and Rh' are either negative or give weak reactions[5,6,7]. When the first anti-*Hr* serum, of weak activity, was described in 1941, large quantities of potent human anti-Rh_0 and anti-Rh' sera were already available and distributed by me to several medical centres in the United States. (The first statistical study with these two sera were made by Levine and co-workers in the months of April to June, 1941. At the written request of Dr. Wiener, the incidence of the four subtypes and their reactions with anti-*Hr* serum were made available for the third edition of Dr. Wiener's book[8].) Anti-Rh'' sera were independently described two years later by Race *et al.*[9] and Wiener[10]. As shown by Race, anti-*Hr* agglutinins may now be more rigidly defined also in their relationship to anti-Rh'' serum. Thus, all bloods Rh_1Rh_2, $Rh'Rh''$, and Rh'' react with anti-*Hr* sera of the γ variety.

In the series indicated in the accompanying table, individuals negative for *Hr* were observed in only one type, Rh_1, and these, genetically Rh_1Rh_1, comprise 38·3 per cent of type Rh_1 of the white series. *Hr* negative individuals can be found also in the much smaller group of Rh'.

The incidence of *Hr* positive reactions in the entire white and coloured group were 80·9 and 99·3 per cent respectively. These figures compare well with Wiener's findings of 72 per cent and 98 per cent respectively[11]. As suspected by the latter, his anti-*Hr* serum was not sufficiently active and undoubtedly gave too many negative reactions.

The confusion with regard to the specificity of anti-*Hr* sera is due in part to the practical difficulty in collaboration on the part of British and American workers during the war years. Another factor was my failure to publish more fully on the properties of the potent anti-*Hr* serum referred to briefly in my several papers. A mere statement in the literature that my more potent anti-*Hr* serum gave about 80 per cent positive reactions would have enabled Race and Fisher to detect the clerical error quoted above.

Accordingly, there is no doubt that the *St* and *Hr* sera contain identical antibodies, corresponding to the variety γ of Fisher. This holds true for four sera in the collection of Race, at least two of the three sera observed by Levine, the *Hr* serum of Wiener, Davidsohn and Potter[11], and an extremely potent serum of Vogel. The discovery of η serum by Mourant seems to confirm Fisher's views, but a serum corresponding to the specificity of δ characterized by failure to react with Rh_1Rh_2 is still to be described.

The correlation of the studies by the American and British workers in this complex field is rendered difficult also because of several different terminologies. Another complicating factor is the uncertain supply and the lack of potent reagents essential for genetic investigations based on family and racial studies. This is particularly true for anti-Rh'' and anti-*Hr* sera (γ and η) especially with regard to the existence of several phenotypes of remarkably low incidence[12].

So far as the varying terminologies are concerned, it will undoubtedly become necessary for an international committee of geneticists and serologists to recommend a uniform terminology. Since isoimmunization by the factor *Rh* and its variants is important clinically, one can scarcely expect the

clinician to commit to memory, at this stage, several different systems of terminology.

From the point of view of prevention of transfusion accidents and the diagnosis and treatment of erythroblastosis fœtalis, the clinician should concern himself exclusively with the anti-Rh_0 serum, the only one available to hospitals in the United States, and presumably also in Great Britain[13]. I have shown[5] that 92 per cent of all cases of isoimmunization by the *Rh* factor can be detected with this diagnostic reagent. Until a final genetic theory and uniform terminology are agreed upon, it is preferable for the clinician to think in terms of a simple genetic theory based on the behaviour of the standard diagnostic anti-Rh_0 serum which contains but a single antibody. For the exceptional 8 per cent *Rh* positive individuals immunized by variants of the *Rh-Hr* system or other blood factors, the clinician must consult the serological specialist, who may not have on hand potent anti-*Rh″* or anti-*Hr* sera.

PHILIP LEVINE.

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[1] Race, McFarlane and Cappell, *Nature*, **155**, 542 (1945).
[2] Fisher, *Nature*, **155**, 543 (1945).
[3] Mourant, *Nature*, **155**, 542 (1945).
[4] Waller and Levine, *Science*, **100**, 453 (1944).
[5] Levine, *J. Pediatrics*, **23**, 656 (1943).
[6] Levine, Burnham, Katzin and Vogel, *Amer. J. Obst. and Gyn.*, **49**, 925 (1941).
[7] Levine, in the "Yearbook of Pathology and Immunology", 509 (1941).
[8] Levine, cited by Wiener, "Blood Groups and Transfusion", 253–254, 3rd Edit. (C. C. Thomas).
[9] Race, Taylor, Boorman and Dodd, *Nature*, **152**, 563 (1943).
[10] Wiener, *Science*, **54**, 316 (1943).
[11] Wiener, Davidsohn and Potter, *J. Exp. Med.*, **81**, 63 (1945).
[12] Levine, *Science*, **102**, 1 (1945).
[13] Levine, *Amer. J. Obst. and Gyn.*, **49**, 810 (1945).

Effect of Tissue Extracts in controlling *Staphylococcus aureus* Infections

FOR a number of years our laboratories have been conducting investigations on natural cellular substances, some of which are stimulatory and some inhibitory to growth of tissues and micro-organisms[1,2,3,4]. In connexion with the work on bacteria, we recently reported a substance isolated from both human and ox spleens which, *in vitro*, was germicidal in concentration as low as 1 part in 2,000 for *Streptococcus hæmolyticus*[5]. The present investigations, conducted on *Staphylococcus aureus*, were undertaken as an extension of this work with spleen extract and also include observations on various other ox tissue extracts, primarily brain, heart and kidney.

With extracts of the aforementioned ox organs prepared in a manner similar to that mentioned in a previous report[5], a series of *in vitro* and *in vivo* experiments were conducted on 48-hour cultures of *S. aureus* incubated at 37·5° C. The *in vitro* experiments, incorporating 0·5 and 1·0 per cent of the extracts by weight in the media, indicated that after an initial three-day period of depressed growth, the organism was definitely stimulated, so that at the end of the sixth day colony size and number of the experimentals had increased 2·5 to five times that of the controls. Coincident with this increase in growth, there occurred a decided change in the morphology of the organism, the colony growth being converted from an original orange or yellow *S* variety to a white *R* configuration. Further study also indicated that these organisms varied from the controls in their biochemical characteristics (see table). Except for small percentages of difference in the amount of growth stimulation, these results were the same with all four of the tissue extracts tested.

Tests	Yellow *S* Control organism	White *R* Experimental organism
Fermentation of mannitol	+	−
Liquefaction of gelatin	+	+ (slight)
Chromogenesis	+ (yellow)	− (grey-white)
Hæmolysis	+	−
Coagulase reaction	+	−

Despite the fact that under the influence of the extracts the growth of *S. aureus* had been stimulated, it was felt that the change in biochemical characteristics of the organism following its conversion from the yellow *S* form to the white *R* might have been accompanied by a change in virulence and was therefore of sufficient importance to merit *in vivo* testing. These tests were divided into three separate experimental groups and conducted only with brain extract, since, *in vitro*, this extract had produced the most rapid conversion to the white *R* form. White mice were used in all the experiments, 20 being employed for each experimental group, 10 serving as controls and 10 as experimentals.

First experimental group. In this experiment, conducted for the purpose of determining whether *S. aureus* grown *in vitro* under the influence of brain extract retained its altered characteristics *in vivo*, control mice were infected subcutaneously with 1 c.c. of freshly prepared saline cultures of the yellow *S* organism, while experimentals were infected with a similar amount of the white *R* form. No tissue extract was injected into any of the animals. Three days after infection, control animals developed a gradually ascending paralysis, which resulted in 70 per cent mortality by the fourth day. The remaining 30 per cent developed large abdominal abscesses and sloughs which persisted for three weeks. On the other hand, there was no mortality among the experimental animals. These animals did not develop paralysis, and only 20 per cent developed abdominal lesions of a very minor character which disappeared by the seventh day. Cultures from the lesions in the two groups of animals revealed organisms corresponding to those injected, both as to colour and biochemical characteristics, thus indicating that the white *R* form retains its altered characteristics *in vivo* and as such is less virulent than the yellow *S* form.

Second experimental group. This experiment was conducted as a test of the prophylactic action of brain extract against *S. aureus* infections. Forty-eight hours prior to the subcutaneous inoculation of all animals with 1 c.c. of suspension of yellow *S* organisms, the experimental group was injected subcutaneously with 50 mgm. of brain extract, and thereafter at 24-hour intervals throughout the experiment. Three days after inoculation with staphylococci, all control animals had developed large abdominal abscesses which resulted in 50 per cent mortality. Those animals that lived required three weeks for complete healing. Of the experimental animals, 50 per cent developed no abscesses whatever. The remaining 50 per cent developed very small lesions which were healed in ten days. Total dosage of brain extract for each animal was 500 mgm.

Third experimental group. This experiment was conducted as a test of the therapeutic action of brain extract on *S. aureus* infections. All animals were infected in the manner described for the prophylactic

experiment. When the animals developed abdominal lesions on the third day, they were divided into control and experimental groups, and the latter were given daily injections of 50 mgm. of brain extract. As early as two days after the injection of the brain extract, definite improvement was noted in the experimental animals, and by the fourteenth day of the experiment or the eleventh day of treatment all animals were completely healed. There was no mortality. The abscesses in the control group, however, continued to progress and resulted in a final mortality of 60 per cent and a delay in healing of the remaining 40 per cent of three weeks.

Conclusions. A factor has been extracted from ox brain, spleen, heart and kidney tissue, which *in vitro* is capable of converting yellow *S* forms of *S. aureus* to white *R*, the latter having biochemical characteristics quite different from the former. Moreover, this organism retains its altered morphological and biochemical characteristics *in vivo* and is definitely less virulent than the yellow *S* form. Prophylactic and therapeutic tests with the brain extract show that it is effective in preventing and treating *S. aureus* infections, the efficacy of the treatment probably resulting from a decrease in virulence of the organism produced as a result of alteration in its morphological and biochemical characteristics.

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Eva Maria Lynch, S.S.J.

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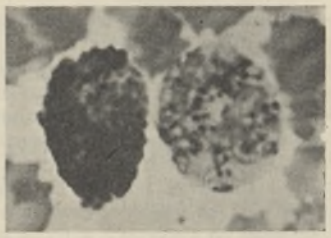
Nov. 8, 1944.

[1] Sperti, Loofbourow and Dwyer, *Studies Inst. Divi Thomae*, **1**, 163 (1937).
[2] Fardon and Sullivan, *Studies Inst. Divi Thomae*, **2**, 39 (1938-39).
[3] Cook, Kreke, Giersch and Schroeder, *Science*, **93**, 616 (1941).
[4] Schroeder and Hollencamp, *Studies Inst. Divi Thomae*, **3**, 193 (1941).
[5] Nutini and Kreke, *J. Bact.*, **44**, 661 (1942).

Differentiation between Eosinophils and Pseudo-eosinophils of Rabbits' Blood by means of a Peroxidase Reaction

The difficulty of distinguishing between eosinophil and pseudo-eosinophil leucocytes in rabbits' blood stained with the usual blood stains is well known. Ehrlich's triglycerin mixture, in which the eosinophil granules are shown up specifically in yellow, gives irregular results and, in general, rather unsatisfactory smears. Recently, I described a new technique for the peroxidase reaction on leucocytes in human blood films employing 2,6-dichlorphenol-indophenol[1]. This technique applied to films of rabbits' blood allows the observer easily to single out the eosinophil leucocytes, even under relatively low power (for example, × 200).

The most suitable procedure is to treat for 5–10 min. fresh, air-dried, formol-alcohol fixed blood films with a mixture of 0·05 per cent aqueous solution of 2,6-dichlorphenol-indophenol (4 pt.) and 0·5 per cent solution of neutral red (1 pt.), to every 5 c.c. of which four drops of hydrogen peroxide (4 vol. per cent) had been added prior to use. After a short wash, the film is blotted dry and oil is directly applied. Under these conditions the cytoplasm of the eosinophil leucocytes is densely packed with heavily stained large spherical granules (up to 1·5 μ in diameter); almost every granule shows a dark purplish-black periphery and



Two granular leucocytes of rabbits' blood; eosinophil on the left. × 1600.

a somewhat lighter interior, the colour of which ranges between mauve and a dirty greyish blue, while the pseudo-eosinophil granular leucocytes show much smaller (about 0·5 μ) and scattered dark purplish granules, some of which are more ovoid or rod-shaped than spherical; the granules vary in size, and some, if big enough, also appear as dark rings with a tiny light centre. The contrast between the two types of cells is particularly striking after a short reaction time when only a limited number of granules in each pseudo-eosinophil is stained. If the time is prolonged to 20 min. or more, many more granules in each pseudo-eosinophil become positive. This observation is opposed to the view that the enzyme is situated actually on or in the granules.

Measurements of cell diameters made with these preparations show the eosinophils to vary from 10 to 12 μ, and the other granular leucocytes from 7 to 10·5 μ. In differential counts the eosinophils are found to represent 1 per cent or less of the white blood corpuscles, which figure agrees well with Klieneberger's data[2]. The relative number of basophils has to be determined by means of one of the usual blood stains.

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Department of Physiology,
Medical School,
Birmingham, 15.
June 19.

[1] Jacoby, F., *J. Physiol.*, **103**, 25 P (1944).
[2] Klieneberger, C., "Die Blutmorphologie der Laboratoriumstiere" (Leipzig, 1927).

Cosmic Radiation Observed at the Col du Lautaret, Hautes-Alpes

Les deux clichés reproduits ici ont été pris dans l'été 1943 au col du Lautaret (2,060 m.) au cours d'une mission organisée par M. Leprince-Ringuet. La détente de la chambre de Wilson était commandée par trois compteurs dispersés sur une aire d'une dizaine de m.²; deux de ces compteurs étaient couverts de 4 ou de 8 cm. de plomb. Les gerbes des figs. 1 et 2 sont donc secondaires de grandes gerbes d'Auger particulièrement riches en rayonnement pénétrant.

La gerbe de la fig. 1 est issue de 14 mm. de laiton. Elle est essentiellement constituée de cinq paires serrées régulièrement disposées et faisant entre elles un angle d'environ 1/10 de radian. Les premières deux paires sont visibles sur les images latérales, les trois autres malheureusement pas.

La gerbe comprend une particule lourde (meson ou proton) arrêtée dans l'écran de 15 mm. de plomb. Les deux trajectoires de la première paire paraissent donner un secondaire : la première traverse ou donne un secondaire peu dévié (5°); la deuxième donne un

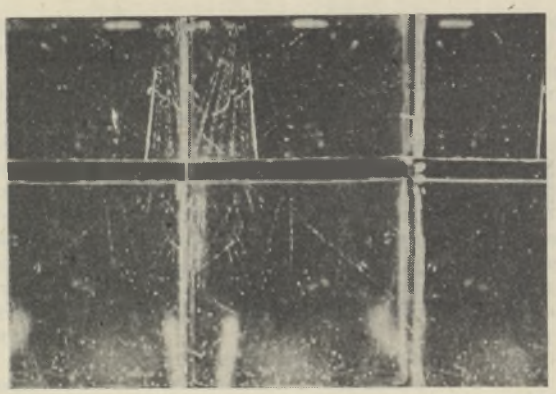

FIG. 1.

secondaire très divergent ou subit une très forte diffusion. Les deuxième et troisième paires sont bloquées. La quatrième paire comprend sans doute en réalité trois trajectoires. L'une d'entre elles est gerbigène et probablement une autre traverse. La cinquième paire donne naissance dans le gaz à un secondaire de grande énergie.

La gerbe de la fig. 2 est créée dans l'écran de 15 mm. de plomb. Elle comprend trois paires faisant un angle de 5° entre elles. Les deux paires latérales sont décomposables à l'observation stéreoscopique. La trajectoire centrale d'ionisation identique ne peut être celle d'une particule lourde lente, un électron de choc de plus de 10 cm. de parcours ne peut avoir été éjecté que par une particule de plus grand v/c que 0·7 et d'ionisation inférieure à 1·5 fois le minimum. Cette trajectoire médiane résulte donc de la superposition de deux trajectoires rapides.

Il existe dans cette série de clichés deux autres gerbes de paires moins typiques et plus discutables.

La diffusion élastique multiple est d'après Euler, Molière, Landau, Bethe, Williams, l'effet prépondérant dans les gerbes cascades. Elle ne peut donner lieu à ces figures régulières et planes. Ces gerbes sont des gerbes de type Heisenberg où plusieurs particules sont créées en un seul acte. Elles paraissent polarisées et semblent impliquer une interaction de spin. La présence d'une particule lourde et probablement d'une ou deux particules pénétrantes semble d'ailleurs suggérer que le champ perturbateur est un champ du type nucléaire comme le prévoit Heisenberg. Elles paraissent associées aux gerbes d'Auger.

Lorsque de telles gerbes se produisent à une profondeur notable dans les écrans, leur régularité géométrique disparaît forcément par absorption, déviation et multiplication des trajectoires.

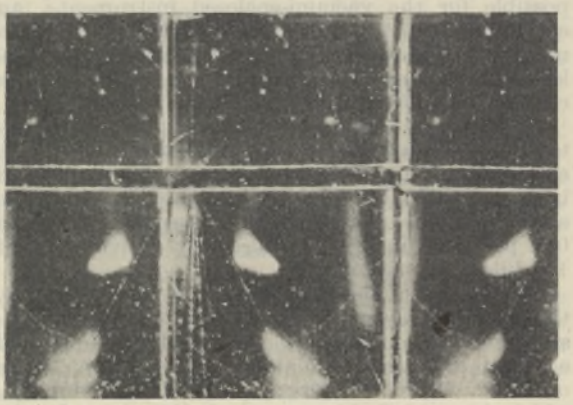

FIG. 2.

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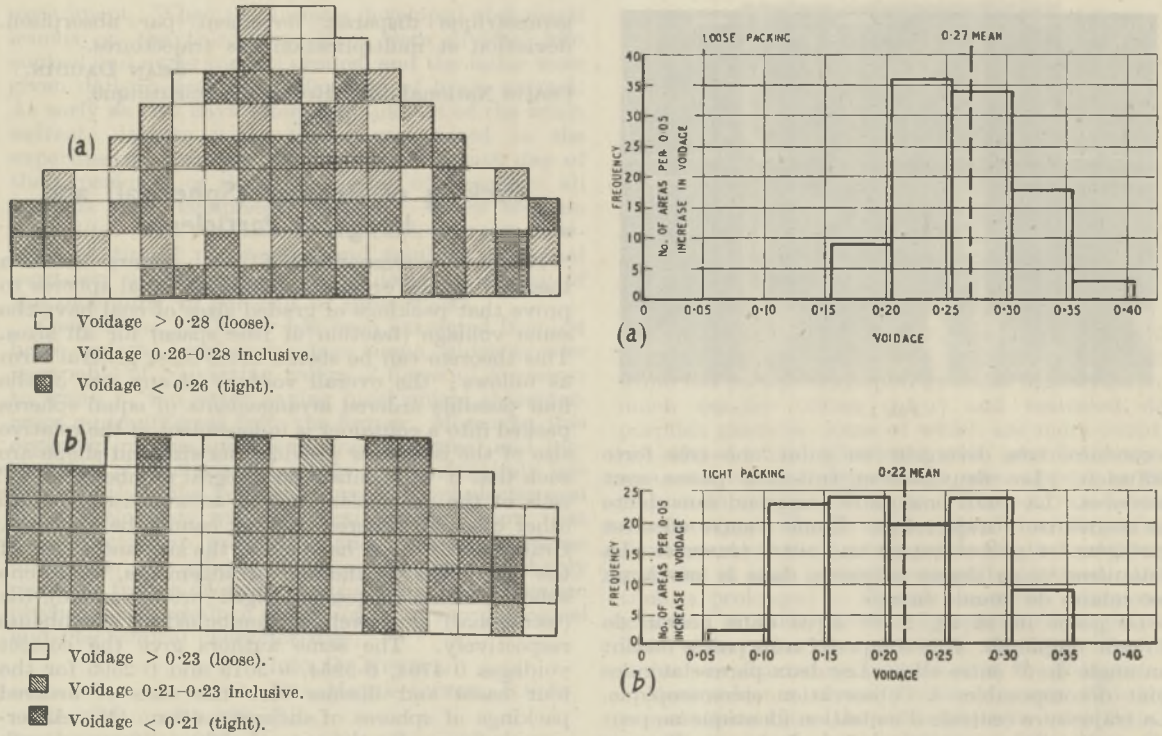
Packing of Regular (Spherical) and Irregular Particles

RECENT correspondence[1,2] in *Nature* cites a theorem on the ordered packing of equal spheres to prove that packings of graded sizes of coal have the same voidage (fraction of free space) for all sizes. This theorem can be stated in its most general form as follows: the overall voidage of any one of the four possible ordered arrangements of equal spheres packed into a container is independent of the relative size of the container provided its size and shape are such that it will contain an integral number of 'unit' cells of the particular ordered arrangement; in all other cases an ordered packing cannot be obtained. Graton and Fraser[3] have given the size and shape of the 'unit' cells for the four arrangements, where one sphere touches six (cubic), eight (orthorhombic), ten (tetragonal) and twelve (rhombohedral) neighbours respectively. The same authors give the correct voidages 0·4764, 0·3954, 0·3019 and 0·2595 for the four cases and discuss also the case of ordered packings of spheres of different sizes. (Mr. Ackermann's figures for the case of eight contacts on each sphere appear to be incorrect.)

This theorem does not apply to the packing of coal for two reasons. First, equal spheres poured into a box take up a disordered arrangement[4], with a voidage between 0·45 and 0·37. Secondly, irregularly shaped particles pack in an entirely different manner. Although the packing is still disordered, the frequency distribution of numbers of contacts are different, particularly for the looser packings. (Compare Smith, Foote and Busang's tests[4] on lead shot, and Bennett and Brown's tests[5] on starch particles.)

It is possible that the observed constant voidage of irregular materials of different sizes is due to two opposing effects. Spiers[6] quotes voidages for packings of graded coal lumps ranging from 0·47 to 0·54 as the size decreases from 1 in. × ½ in. to ⅛ in. × $\frac{1}{16}$ in. We have found the opposite effect in a small container (10 in. cube); here the voidage decreases from 0·47 to 0·43 for coal sizes from 1 in. × ½ in. to ¼ in. × ⅛ in. Thus an apparent independence of size might be found in practice with certain materials and sizes of containers. Generally, the voidage increases as the relative size of container to particle decreases.

In conclusion we should like to direct attention to Osborne Reynolds' principle of dilatancy[7], which has been overlooked by almost all workers in the field of packing of granular materials. We have shown recently that the principle of dilatancy accounts not only for the non-uniformity in the transmission of forces through granular beds observed and discussed by Jenkin[8], but also for gross non-uniformities in the distribution of local voidage which we have found[9] to be inherent in packed materials (see figures). In practical applications, in fuel beds and coal treatment processes, for example, the non-uniformity of the packing is likely to be of greater significance than any average property such as the overall voidage. For this reason at least, apart from the reasons mentioned above, studies of the geometry of



DISTRIBUTION OF LOCAL VOIDAGE IN LOOSE AND TIGHT TWO-DIMENSIONAL PACKINGS.

Left: Map showing spatial distribution.
(*a*) Average voidage, 0·27.
(*b*) Average voidage, 0·22.

Right: Frequency distribution of local voidage.
(*a*) Average voidage, 0·27.
(*b*) Average voidage, 0·22.

ordered arrangements of spherical particles are of little assistance.

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13 Grosvenor Gardens,
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[8] Jenkin, C. F., *Proc. Roy. Soc.*, A, **131**, 53 (1931).
[9] Brown, R. L., and Hawksley, P. G. W., *Coal Research*, 113 (March, 1945).

Measurement of High Voltages

ABSOLUTE measurements of high voltages, up to about 300 kilovolts, have been carried out by various workers using instruments of the attracted disk type, as originally devised by Lord Kelvin, in which the electrostatic deflecting force on the disk is balanced by mechanical means. When such instruments are operated in air, large spacings are necessary for the higher voltages, and difficulties arise in the production of a uniform field without the use of excessively large electrode diameters. This has been overcome to some extent by one group of workers[1], who have enclosed the cylindrical space between the electrodes with a series of guard-rings. In another arrangement[2], the apparatus is operated in compressed gas, with a consequent reduction in the spacing between the electrodes for a given voltage.

It has occurred to us that there are considerable advantages to be obtained by the enclosure in vacuum of the attracted disk electrometer, and of other forms of electrostatic voltmeters. The working voltage gradient for instruments operating in air is limited to a value below about 10 kV. per cm., whereas, in vacuum, a voltage gradient of more than 100 kV. per cm. can be used. For a given voltage, therefore, the spacing between the electrodes in vacuum can be reduced to less than one tenth of that in air, so that the production of a uniform field between the electrodes can be simplified and a more compact form of instrument can be made. As the attractive force between the electrodes varies as the square of the voltage gradient, a greater mechanical precision is possible for the vacuum-enclosed instrument; an attractive force of 4·5 gm. per cm.^{2} of electrode area may be obtained in vacuum for a gradient of 100 kilovolts per cm.^{2} as compared with 0·045 gm. per cm.^{2} at 10 kilovolts per cm.^{2} in air.

An attracted disk electrometer enclosed in a continuously evacuated system is now being constructed, and will be used for the absolute measurement of both A.C. and D.C. high voltages. Little difficulty is anticipated in obtaining an accuracy of within 0·3 per cent in the measurement of voltages of 100 kilovolts or more.

On account of the large deflecting force available, the instrument can be made of more robust construction than one operating in air, and an improved accuracy and greater reliability of indication can be obtained. There is an absence of convection currents, which is one of the causes of difficulties in the

operation of the air type of instrument. Also there is freedom from interference by dust and humidity.

Similar advantages to those claimed above for the attracted-disk electrometer are obtained in direct-reading electrostatic voltmeters when these are enclosed in vacuum. Several of these instruments are being developed, for various voltage ranges, extending from several kilovolts to hundreds of kilovolts. One such instrument has already given satisfactory operation in the measurement of voltages between 50 and 100 kilovolts. Although continuous evacuation is used in the present designs, it is intended later to seal the mechanism in a glass-metal envelope.

Further information concerning these developments will be published in due course.

We express our appreciation to Sir Arthur P. M. Fleming, director of research and education, Metropolitan-Vickers Electrical Co., Ltd., for permission to publish this note.

J. M. Meek.
F. W. Waterton.
Metropolitan-Vickers Electrical Co., Ltd.,
Trafford Park, Manchester, 17.
June 20.

[1] Brookes, H. B., Defandorf, F. M., and Silsbee, F. B., *J. Research*, Nat. Bur. Stand., **20**, 253 (1938).
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Anodic Deposit of Protactinium

Previously described experiments[1] have shown that under certain conditions of electrolysis of sulphuric or hydrofluoric solutions of protactinium, this element can be deposited on the cathode, at least in extremely thin layers. I have now observed, in sulphuric solutions, an anodic deposit on a lead oxide (PbO_2) support. Normal solutions of sulphuric acid containing about 10^{-5} gm. of protactinium in presence of 1 or 2 mgm. of zirconium sulphate were used. With a cathode of platinum, an anode of platinum covered with lead oxide (PbO_2) and a current of 5–20 mA./cm.^{2}, the yield is 30–60 per cent after two or three hours, with moderate stirring. Under these conditions the deposit on the cathode is insignificant. An anodic deposit can also be observed on gold anodes, but these electrodes are severely attacked. I have never observed an anodic deposit on pure platinum electrodes. The yield is reduced if sulphuric acid is replaced by nitric acid.

The influence of the nature of the anode is not due to a difference in oxygen overvoltage. Measurements of the potential of the three types of electrodes against a calomel electrode were carried out and have shown, for a given current density, no significant difference; if anything, electrodes covered with lead oxide show a smaller positive potential than the platinum and gold ones. It is known, however, that PbO_2 anodes favour electrolytical oxidations; for example, the formation of chromic and periodic acid.

As to the nature of the deposit, it is still uncertain. Usually, metallic peroxides formed at the anode correspond to a state of valency of the metal superior to the normal. The valency of protactinium in sulphuric solutions being already 5, what can be the valency of the anodic peroxide?

The investigation is being continued in order to clear up this question, as well as the mechanism of the deposition.

M. Haïssinsky.

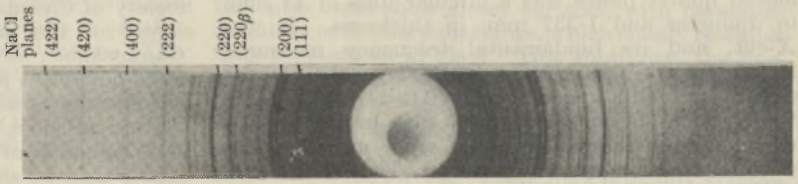
Institut du Radium, Paris. June 20.

[1] Emmanuel, H., and Haïssinsky, M., *C. R. Acad. Sci.*, **206**, 1102 (1938); Bouissière, M., *J. Phys.*, **2**, 72 (1941).

X-Ray Study of the Solution of Alkali Halides in Borax and B_2O_3 Glass Systems

A number of salts including alkali halides dissolve readily in glass. It has been suggested by S. K. Majumdar and R. M. Palit[1] that an X-ray investigation of the nature of these salts in the dissolved state inside the glass medium would be interesting. Such a study is naturally expected to give information regarding whether these salts form ionic, molecular or colloidal solutions, combine chemically with the glass medium, or induce any crystallinity in the glass itself. An investigation in these directions is being carried out in this laboratory.

Powder photographs of various alkali halides dissolved in glassy B_2O_3 and borax were taken at different concentrations and compared with powder photographs of the crystals of these substances. In the case of sodium chloride dissolved in borax, all the lines of sodium chloride and some lines which belonged neither to it nor to any of the known crystalline sodium borates appeared, as shown in the accompanying reproduction. The positions and relative intensities of the sodium chloride lines were identical with those of the pure salt. The sharpness of these lines indicates that *crystallites* of sodium chloride enter into glass. The average size of the particles in these colloidal solutions is under investigation. The only effect of using different concentrations of sodium chloride in borax was that the intensities of the sodium chloride lines increase with concentration. In the case of sodium chloride dissolved in B_2O_3 glass, the results were similar except that the new unidentified lines appeared only in weak solutions. For potassium chloride dissolved in borax and B_2O_3, the results were again similar; while in the case of rubidium chloride only the lines of pure rubidium chloride were obtained.



Thus we find that the alkali halides form colloidal solution in glass; the particle sizes are sufficiently large as to give sharp reflexions. Determination of the average size of these crystallites by measuring the half-intensity widths of these lines is in progress. Attempts are also being made to trace the origin of the extra lines that have been observed in the cases of dissolved sodium chloride and potassium chloride.

Two of us (S. K. M. and B. K. B.) are grateful to the Board of Scientific and Industrial Research of the Government of India for financial help.

S. K. Majumdar.
B. K. Banerjee.
K. Banerjee.
Indian Association for the Cultivation of Science,
210 Bowbazar Street, Calcutta. May 24.

[1] Majumdar, S. K., and Palit, R. M., *J. Ind. Chem. Soc.*, **19**, 461 (1942).

Harmonics in the Piezo-Electric Oscillation of a Quartz Crystal

S. Parthasarathy, A. Pande and M. Pancholy[1] have recently given evidence of oscillation of the quartz crystal not only at odd harmonics but also at even and half-odd harmonics. In the third column of Table 1 in their communication, there are fourteen values of the ratio of the frequency to the fundamental which they got from a single quartz plate: 0·499, 1·00, 1·465, 1·96, 2·69, 3·00, 3·50, 4·00, 4·40, 5·00, 5·35, 6·23, 7·04, and 8·00.

In the course of an experiment on supersonic waves propagated in liquid, we have also noticed the harmonics produced by the piezo-electric oscillation of a quartz crystal on the background of a continuous range of frequencies of oscillation. The electric circuit we used was an ordinary Hartley type with an output of about 6 watts only. Eleven quartz plates, of different shapes, circular, rectangular and square, were used. They were cut and ground in this Institute, except one which was given to us in exchange by the American Air Force in Kunming. They were either AT-cut or X-cut, and no thickness variation on each plate more than 0·005 mm. was observed.

The quartz plate was clamped on a holder immersed in distilled water. A hot-cathode sodium discharge lamp of 40 watts was used as light source. The diffraction pattern was observed with a reading telescope of focal length 247 mm. The frequency of oscillation was measured with a G. E. wave-meter of precision type.

As soon as the electric circuit began to oscillate, the diffraction pattern appeared; as the frequency of the electric circuit increased by turning the condenser in the tank circuit, the spacing between the diffraction lines was gradually and continuously widened. The diffraction pattern usually gave one or two orders. However, at certain particular frequencies, the milliammeter in the plate circuit recorded a sudden jump; at the same time the diffraction pattern went up to a higher order and its intensity abruptly increased. For example, one of eleven quartz plates was a circular disk of 18 mm. in diameter and 1·337 mm. in thickness. It was X-cut, and its fundamental frequency measured 2,080 kc. It was then submitted to the electric circuit for oscillation. From 2,000 to 14,000 kc. there were twelve frequencies where the jumps on the milliammeter occurred and the order and intensity of the diffraction pattern increased. The exact values of the ratio of the frequency to the fundamental were found to be 1·00, 1·72, 1·94, 2·04, 2·16, 2·65, 3·00, 3·13, 4·00, 4·45, 5·00, 6·20. They were believed to be closely, if not exactly, the odd, even and half-odd harmonics which Parthasarathy and his collaborators found. Throughout the whole range of oscillation, the diffraction patterns never failed to appear, although at certain places they were barely visible even with the help of a telescope.

It will be remembered that the Hartley circuit has a strong feed-back, so the crystal is forced to vibrate. It seems that the quartz crystal can be forced to vibrate over a wide range of frequency as soon as its impedance has been overcome, and that it particularly shows the resonance of vibration at the frequencies of $\frac{p+1}{2}f$, where f is the fundamental frequency of the quartz crystal and p is an integer. The odd harmonics oscillate much more strongly than the even, as is indicated by the intensity and number of orders of the diffraction pattern. If we put the crystal in a Pierce circuit which has a weak feed-back and is generally regarded as less active in oscillation, the crystal only oscillates at its fundamental frequency and odd harmonics. It may be added that in the forced vibration, the harmonic vibrations do not come out very exactly, and they may change their resonance frequencies when a different mode of excitation, as in different conditions of clamping the crystal, is used.

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May 1.

[1] Parthasarathy, S., Pande, A., and Pancholy, M., *J. Sci. and Indust. Res.*, **2**, No. 5, 295 (1944).

Hexachlorocyclohexane as an Insecticide

My attention has been directed to the possibility that Dr. L. B. Bourne's letter[1] may be read as implying that Dr. E. L. Taylor's reference[2] to hexachlorocyclohexane, supplied by Imperial Chemical Industries, as a "new" insecticide was unjustified in the light of recent information that this material has been available as an insecticide in France for some years.

I am asked to emphasize that it was in the spring of 1943 that I.C.I. made the important and unexpected discovery that the remarkable insecticidal properties of hexachlorocyclohexane are almost entirely associated with only one of the four isomers (gamma) which had first been isolated thirty-one years earlier. The Company, however, was not permitted by the Government to disclose this or the extent to which hexachlorocyclohexane had been manufactured and used as an insecticide in Britain until 1945, when an announcement was made in the Hurter Memorial Lecture (not yet published) to the Society of Chemical Industry on March 8. This discovery of the outstanding insecticidal activity of 'Gammexane', as the gamma isomer has been called, made possible a planned development of hexachlorocyclohexane as an insecticide.

Thus sufficient material was produced to meet the 1943 demands of agriculture for a dust to replace derris, then in short supply, for the control of flea beetle. The material proved so successful, not only in the control of many agricultural and horticultural pests, but also in trials against locusts and industrial pests such as cockroaches, crickets, bed bugs, flies, etc., that production was increased in the following two years and the material was made available for these widely varied applications. Up to the time when the Government permitted the disclosure of the nature of the active constituent of the material, hexachlorocyclohexane equivalent to several thousand tons of insecticidal dust had been produced in Britain.

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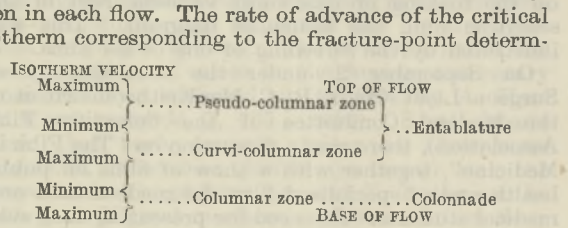
[1] *Nature*, **156**, 85 (1945).
[2] *Nature*, **155**, 393 (1945).

THE GIANT'S CAUSEWAY

"SURE, an' if ould Finn did not build it, how did it come to be there, at all ?" Although the world-famous Causeway—justly claimed by Molyneux in 1694 to be "as Remarkable a Natural Curiosity . . . as may be met with in Europe"—has long offered a challenge to geologists, there has hitherto been no satisfactory account of its petrology, structure and geological setting. This singular neglect of a classic area stimulated S. I. Tomkeieff to make a thorough investigation of the basalt lavas of the Causeway and its environment, and just before the War he communicated his results to the Association de Volcanologie in a masterly paper[1] which was printed in Naples in 1940. Fortunately, this eagerly awaited publication has survived, and copies are now available in Britain.

In Antrim a lower series of lavas (olivine-basalts) is normally separated from an upper series (columnar tholeiitic basalts) by a major interbasaltic (lateritic) zone. The sequence is magnificently displayed in the cliffs adjoining the Causeway. The Causeway itself is a terrace carved by the sea from the lowest of the tholeiitic flows, the base of which, to be seen only at very low tide, has been found by Mr. Tomkeieff resting directly on fresh olivine-basalt belonging to the lower series. On each side of the Causeway, however, the columns rest on the interbasaltic zone at a height of about 70 ft. above sea-level. The basalt flow of the Causeway is therefore regarded as having filled a river valley excavated through the interbasaltic zone into the underlying olivine-basalts. The divergent arrangement of the columns, at right angles to the valley sides, fully accords with this simple interpretation of the apparently anomalous position of the flow where it forms the Causeway.

In vertical section, columnar lavas of the Causeway type have a conspicuous two-fold arrangement for which a new terminology is proposed. The lower zone of vertical polygonal columns is referred to as the 'colonnade', while the upper zone of less regular jointing is distinguished as the 'entablature'. The latter is subdivided in turn into a lower 'curvi-columnar' zone (thin, curving columns, often radiating from marginal points) and an upper *pseudo-columnar* zone (thick, short polygonal blocks) which is usually surmounted by a thin slaggy and vesicular zone. The different joint systems responsible for these structural zones are most ingeniously explained by Mr. Tomkeieff as consequences of the varying velocity of propagation of isotherms during the cooling history of a flow. From the calculated distribution of temperature in a cooling sheet, curves are drawn indicating the temperature reached at different levels at the ends of successive and equal time intervals, and from these curves others are derived showing the velocity of the inward progress of the isotherms. The velocity-of-propagation curves show three maxima (one at each margin and one in the middle) with two minima between. The latter divide the sheet into three parts which are correlated with the three sets of structures seen in each flow. The rate of advance of the critical isotherm corresponding to the fracture-point determines the nature of the jointing, while the amount of the accumulated stress determines its magnitude. The free surface and the high initial velocity of the isotherms at the top controls the widely spaced, crude jointing of the pseudo-columnar zone, while the absence of a free surface at the base and the smaller initial velocity of the isotherms gives rise to the more closely spaced joints of the colonnade. Between the two minima, each of which corresponds to a pause in the fracture process, an unfractured zone remains sandwiched for a time. Eventually the final rapid increase of isotherm velocity, and therefore of stress accumulation, promotes an increased tensile strength (on analogy with the behaviour of glass rods), and so leads to overstraining which culminates in the violent fracturing represented by the tangle of wavy joints characteristic of the curvi-columnar zone.



After the formation of the columnar fissures, escape of gases from the cooling lava would be greatly facilitated, and as expanding gases are a most efficient cooling agent, the temperature of the margins of the columns would rapidly fall. Contraction of the outer part of a column would throw it into compression, while tension would gradually develop in the inner part. A cross-rupture would originate at the point of maximum tension somewhere inside the column and would spread rapidly round and then inwards and outwards, giving rise to a curved joint representing the first stage in the formation of a transverse 'ball-and-socket' joint. Minute variations in the delicate interplay of the principal stresses would determine whether a given joint curved upwards or downwards. Occasionally a fracture originating some way from the centre would fail to reach the centre, so bringing about the formation of a central knob, a feature that has long defied explanation. The outward progress of the curved fracture would normally stop along the circular line of no stress, to be completed by later fracturing as a horizontal lip. Sometimes, however, the original fracture would overshoot this limit and spread evenly to the margin. Both the central knobs and, generally, the outer lips have a granular fracture of later origin than the glossy fracture of the initial, curved joints.

It is pointed out that freshly opened joints in the tholeiitic lavas show glossy surfaces, with parabolic, radiating or feathery markings, which closely resemble fracture surfaces in glass. This similarity, the fine-grained and uniform texture of the rock, and the presence of interstitial palagonite and glass, all suggest that the fissuring took place while the lava was still in a semi-glassy or even glassy state. On the other hand, the olivine-basalts were probably crystallized completely before fissuring. Their joint-planes have a granular surface and the rock is of much coarser grain and lacks a glassy mesostasis.

Former petrographic descriptions of the Causeway basalt and its associates have been no more than brief notes. Mr. Tomkeieff now gives us a detailed account, including the mineralogy, modal composition and granularity of the flows above and below the major interbasaltic zone, together with new chemical analyses of the colonnade and entablature of the second of the upper flows. A good analysis of the Causeway basalt itself has been available since 1936 [2]. Other topics dealt with include the origin and mode of eruption of the lavas. The suggestion that the Antrim lavas belong to a multiple-vent type of shield-complex is favoured, in agreement with the recent conclusion of the Geological Survey that the lavas of the British Tertiary province were not neces-

sarily erupted, as previously thought, through dyke-fissures.

Finally, it should be recorded that the history of 250 years investigation is most entertainingly summarized and fully documented. By his outstanding success in grappling with a group of problems that has tantalized many generations of "Inquisitive Naturalists", Mr. Tomkeieff has far outdistanced his predecessors. He is to be congratulated on a contribution which, for the first time in the history of the Causeway, may be hailed as thoroughly worthy of its impressive subject. ARTHUR HOLMES.

[1] Tomkeieff, S. I., *Bull. Volcanologique*, ii, 6, 89 (1940).
[2] Holmes, A., *Proc. Roy. Irish Acad.*, 43 B, 91 (1936).

THE FILM IN SCIENCE

A CONFERENCE on "The Film in Science", organized by the Scientific Film Association, was opened at the Technical College, Huddersfield, on August 31, after a civic reception by the Mayor, Alderman Sidney Kaye; over 100 were present.

Mr. Geoffrey Bell (deputizing for Mr. Arthur Elton, president of the Association, who was in Denmark) said that the conference gave an opportunity for many different users of scientific films to state their needs and problems. That the Conference was held in the provinces implemented the Association's aim to be fully representative of Britain rather than metropolitan in character. The Scientific Film Association could bring to a focus the growing scientific culture partly represented by scientific film societies all over Britain—and also shown, significantly, by the chance that the B.B.C. on the following Sunday was broadcasting its first review of scientific films. He added that the pressure of events has now made it clear that a widespread understanding of what science stands for, long recognized as desirable, is a matter of the most vital necessity; and films can help to bring about this understanding.

Miss Dorothy Grayson (educational representative of the British Film Institute), speaking on "The Science Film in Education", said that one of the duties of science is to protect people from making blind assumptions. Films should fall into three categories: those which deal with the established sciences; those presenting the facts as known, with some attempt to derive conclusions from them; and those which give education in doctrines and values. "We always pretend," said Miss Grayson, "that schooling contains no element of propaganda, but we should be wiser if we faced the realization that it does. We try to pretend that we as teachers deal only with the facts, and that our own personalities and convictions never seep through. This is not true. The children do get their values very largely from environment, but these also come from the deliberate purposive education given in schools. Instruction and practice in critical deduction is very necessary." In school the film is especially valuable as a tool of exposition. The screen can bring into juxtaposition events separated in time and space, it benefits research inquiry by adjusting time- and sight-scales, and it makes history a living thing. The films also present the teachers' factual material in ampler form and leave them free to concentrate on interpretation. There should be abolition of customs duties on all educational films which merit international circulation, and a subsidy for the development of such work is also badly needed.

On the morning of September 1, Mr. W. F. Andrews (head of the Department of Chemistry, Physics and Biology, Doncaster Technical College), speaking on "Scientific Film Needs in Technical Training", said that from many years of experience he realized the need for three types of film covering the requirements of primary, secondary and advanced technical training. Mr. H. Richmond (head of the Mining Department, Doncaster Technical College) described the "Film Strip in Technical Training", emphasizing its value for revision purposes. He showed a strip which has been used as an introductory aid for acclimatizing mining trainees to pit work. Both speakers stressed the need for an immediate supply of such visual material, the value of which was demonstrated during the War in technical training for the Services.

In the afternoon, the use of the "Film as an Instrument of Scientific Research" was described and demonstrated by Mr. Derek Stewart (Kodak Research Laboratories). After a short historical account of the technical development of cinematography, he dwelt at some length on the various ways in which the modern camera has been perfected for specialized purposes. High speed enables as many as 3,000 exposures per second to be taken. Reductions in apparent speed of up to 200 to 1 are therefore obtainable when projecting such pictures at the normal rate. This technique has made valuable contributions to the analysis of motion of rapidly moving machinery and to the study of the mechanism of explosions. At the other end of the scale, time-lapse photography, used to such fine purpose by the late Percy Smith, has served to speed up the apparent rate of motion of slow-moving processes. Biological growths, for example, taking many months in real life, can thereby be presented visually and as a homogeneous whole in the space of a few minutes.

In the evening, Mr. Basil Wright (producer at the Crown Film Unit) talked on "Film Production". He emphasized that the new art of the film is only possible through the co-operation of many workers skilled in different spheres. Even if the exceptional man did all his own scripting, directing and cutting, he would be almost certain to have his processing done commercially. In the professional field, this means that film-making demands highly developed team-work. One aspect of this is the relationship between director and producer, best explained perhaps by saying that the producer has to see the wood while the director looks for the trees. In subsequent discussion, the need for instruction in film-making was emphasized. Medical men and scientific men would thereby be enabled to produce film records valuable as a means of exchanging ideas and imparting information. The existence at the University College, Exeter, of the first Visual Education Centre in Britain is a significant step towards academic recognition.

There followed a reading, in his absence, of a paper by Mr. Frank Goodliffe (director of Science Films) on the making of that most valuable part of the scientific film, the animated diagram. This was illustrated by the screening of one of his films.

On September 2, under the chairmanship of Surgeon Lieut.-Cmdr. R. C. MacKeith (chairman of the Medical Committee of the Scientific Film Association), there was a discussion on "The Film in Medicine", together with a show of films on public health and of specialized films for medical men and medical students. The need for presenting each sub-

ject from many different angles and in the light of opposing schools of thought was stressed by a delegate from South Wales, supported by many others. After seeing the film "Defeat Tuberculosis", he said that, admirable though it was in showing the cure of the disease under ideal clinical conditions, it might nevertheless lull the public, to whom it was designed to be shown, into a false sense of security. Apart from allaying the fear of 'T.B.' in the public mind, it should also have emphasized the urgent necessity for providing the ideal facilities to all who may be in need of them.

The value of the film in teaching medicine, and in particular, surgery, was demonstrated by a professionally made film on "Transplantation of Cornea Autokeratoplasty", as well as by an amateur production by three medical men from the Westminster Hospital on an "Introduction to Acute Inflammation".

Dr. W. T. Astbury (director of the Textile Physics Laboratory, University of Leeds) gave a lecture on "X-Ray Adventures among the Proteins and other Molecular Giants" on September 2. In this talk, garnished with a pleasant humour and illustrated by slides and 'working' models of proteins and fibre molecules, Dr. Astbury emphasized his conviction that the mere imparting of knowledge is not enough. Films should be made which show the quest for ultimate knowledge to be a dramatic and exciting adventure.

During the Conference, delegates inspected an exhibition of projectors and other visual aid equipment; spare projectors were kept busy running amateur-made films, and film strips. The scientific film review, broadcast in the Sunday evening "Science Magazine", interested many. Discussions followed all the lectures, and the Conference ended with a long programme of scientific films.

The Scientific Film Association will publish a full account of the proceedings as soon as possible.

TYROGLYPHID MITES AND HUMAN DISEASE

STUDENTS of applied zoology are familiar with the damage caused by Tyroglyphid mites to stored products valuable to man. The part they may play in the causation of disease is less well known.

Sir Philip Manson-Bahr and W. J. Muggleton (*Lancet*, 81, Jan. 20, 1945) direct attention to the possible significance of mites and their eggs in human fæces. Invasion of the human alimentary, urinary and respiratory tracts by tyroglyphid—and sometimes also by tarsonemid—mites has been reported by M. Khalil (*Proc. Roy. Soc., Med.*, 14, Sect. Trop. Dis., 24; 1921), who found the eggs of *Aleurobius farinæ* in 8 per cent of 130 Cornish miners; by J. Mackenzie (*J. Roy. Army Med. Corps*, 39, 339; 1922), who found *A. farinæ* and *Tarsonemus* in recruits suffering from nocturnal enuresis and in one suffering from hæmaturia; and by others who found various mites in human sputum. The evidence about the possible effects of mites in the human alimentary canal has been reviewed up to 1929 by A. Hase (*Z. Parasitenkunde*, 1, 765; 1929). Some experts think that such common mites as *Glyciphagus domesticus*, *Aleurobius farinæ* (in meal) and the cheese mites *Tyroglyphus siro* and *T. longior* can be pathogenic if great numbers are eaten; others deny this. The dermatitis suffered by people who handle mite-infested foodstuffs (Grocer's itch, copra itch) is, however, well known (see *Lancet*, 351, Sept. 9, 1944). Manson-Bahr has seen dead mites in human fæces from time to time, and during the past year has been finding them with increasing frequency. Recently, eggs showing development from the morula stage to the newly hatched nymph have been found in the fæces of two patients. The mites could not be identified with certainty, but were probably *Tyroglyphus siro*. One of the patients had had recurrent diarrhœa and had come from the Isle of Man, where he had eaten much over-ripe cheese. Search for similar mites in the rationed cheese now being sold in Britain has failed. Manson-Bahr and Muggleton conclude that, so far as can be ascertained at present, the presence of mite eggs in human fæces has no pathological significance.

The possible effects of mites upon the respiratory tract are the subject of a paper by E. Soysa and M. D. S. Jayawardena (*Brit. Med. J.*, 1, Jan. 6, 1945) on pulmonary acariasis. During 1943–44 these authors observed a remarkably heavy incidence of bronchial asthma among patients in a hospital of the South-East Asia Command. From January 1942 until June 1944 bronchial asthma was responsible for 48 per cent of all respiratory cases and for 21 per cent of cases invalided out of the Army through this hospital. Some patients showed a high eosinophilia, which in asthma may be, according to Osler, as high as 53 per cent. But the patients rarely gave a family history of asthma or of other allergic symptoms; their eosinophilia was not due to intestinal parasites; drugs commonly given to relieve asthma gave only temporary relief to these patients, and their eosinophilia persisted. Major T. R. Jansen referred the authors to a civilian patient who had asthma with high eosinophilia, and mites were found in his sputum; he made a remarkable recovery after administration of pentavalent arsenic. Referring to the work in Ceylon of H. F. Carter, G. Wedd and V. St. E. D'Abrera (*Ind. Med. Gaz.*, 79, 163; 1944), who recovered species of *Tyroglyphus*, *Tarsonemus*, *Carpoglyphus*, *Glyciphagus* and *Cheyletus*, all common in stored products, dust, debris, etc., from 17 out of 28 patients, and found that arsenical treatment reduced both the numbers of the mites and the eosinophilia, Soysa and Jayawardena record their own observations.

The whole problem and its relevant literature is discussed by Soysa and Jayawardena, who found, as others have done, that treatment with arsenical preparations (they used 'carbasone' or 'stovarsol') was satisfactory. While the existing evidence does leave some doubt whether mites can alone cause all the asthma-like symptoms described, the problem requires further investigation. The differential diagnosis between this asthma-like condition and tuberculosis and other obscure and transient respiratory conditions with asthma-like symptoms and eosinophilia (for example, Loeffler's syndrome) may be especially difficult.

That monkeys of the genus *Macacus* suffer from pulmonary lesions in which mites are found is shown by L. J. Davis (*Brit. Med. J.*, 482, April 7, 1945), who quotes F. D. Weidman (*J. Parasit.*, 2, 37; 1915) on the acarids which he found in the lungs of *Macacus rhesus*. Davis found in the lung lesions of a species of *Macacus* (the species is not stated) mites which probably belonged to the genus *Pneumonyssus*, and he suggests that these mites may be

normal ectoparasites of these monkeys, so that monkeys could readily inhale these mites. Experimental infestation of monkeys with them might, he suggests, help us to understand the problem of infestation of the human lung with mites. Davis says that the lesions in the monkey's lung resembled, to the naked eye, the lesions of early tuberculosis. This recalls the similar resemblance to tuberculous lesions of the lesions of organs other than the lung, for example, those of the mesenteric glands, caused by larvæ of the degenerate Arachnid *Linguatula*. But there is much histological evidence that lesions caused by parasitic nematodes (for example, various Filarioid species) may also resemble those due to tuberculosis. It is clear that the solution of this whole problem will require all the skill of the clinician, the pathologist and the biologist.

G. LAPAGE.

FORTHCOMING EVENTS

Tuesday, October 9

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—W. V. Grigson: "The Aboriginal in the Future India".

INSTITUTION OF CHEMICAL ENGINEERS and CHEMICAL ENGINEERING GROUP (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. E. R. A. Merewether: "Industrial Health—Progress, Contrasts and Fallacies".

ILLUMINATING ENGINEERING SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 6 p.m.—H. C. Weston: Presidential Address.

SHEFFIELD METALLURGICAL ASSOCIATION and SHEFFIELD BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN (Sheffield Metallurgical Club, 198 West Street, Sheffield, 1), at 7.0 p.m.—H. O. Howson: "The Formation of Banded Structures in Horizontal Centrifugal Castings".

Wednesday, October 10

ROYAL SOCIETY OF MEDICINE, SECTION OF COMPARATIVE MEDICINE (at 1 Wimpole Street, London, W.1), at 2.15 p.m.—W. A. Pool: "A Plea for the Eradication of Tuberculosis in Cattle in Great Britain" (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. A. H. Mumford: Inaugural Address as Chairman.

SOCIETY OF CHEMICAL INDUSTRY (joint meeting of the NEWCASTLE SECTION with the ROYAL INSTITUTE OF CHEMISTRY) (in the Chemistry Lecture Theatre, Newcastle-upon-Tyne), at 7 p.m.—Dr. H. Baines: "The Choice of Photographic Materials for Scientific Purposes".

INSTITUTE OF WELDING, NORTH LONDON BRANCH (at the South-West Essex Technical College, Walthamstow, London, E.17), at 8 p.m.—"X-Rays and their Use in Weld Testing"; Dr. R. J. Barnes: Part 1, "Plant and Equipment"; Dr. S. Torrence: Part 2, "Use and Applications".

Thursday, October 11

ROYAL COLLEGE OF SURGEONS (at Lincoln's Inn Fields, London, W.C.2), at 5 p.m.—Sir Howard Florey, F.R.S.: "The Use of Micro-organisms for Therapeutic Purposes" (Lister Memorial Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, INSTALLATIONS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. Forbes Jackson: Inaugural Address as Chairman.

SOCIETY OF CHEMICAL INDUSTRY, ROAD AND BUILDING MATERIALS GROUP and LONDON SECTION (at Gas Industry House, 1 Grosvenor Place, London, S.W.1), at 6 p.m.—Prof. E. K. Rideal, F.R.S.: "Some Physico-chemical Problems in Construction".

ASSOCIATION OF SCIENTIFIC WORKERS, LONDON AREA (in the Caxton Hall, Westminster, London, S.W.1), at 7.0 p.m.—Report on Visit of British Men of Science: Prof. D. M. S. Watson, F.R.S., Dr. W. A. Wooster, and others.

ROYAL INSTITUTE OF CHEMISTRY, LONDON AND SOUTH-EASTERN COUNTIES SECTION (at the Public Library, William Street, Slough), at 7.0 p.m.—Dr. J. M. Walter: "Recent Advances in Plastics".

Friday, October 12

RESEARCH DEFENCE SOCIETY (at Manson House, Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 3.15 p.m.—Sir William Savage: "Public Health and its Debt to Experimental Medical Research" (Stephen Paget Memorial Lecture).

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Prof. Bengt Edlén: "The Origin of the Emission Lines in the Coronal Spectrum" (George Darwin Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—W. G. A. Perring: "The Mechanism of the German Rocket Bomb, V.2" (Lantern Lecture).

INSTITUTE OF WELDING, BIRMINGHAM BRANCH (at the James Watt Memorial Institute, Great Charles Street, Birmingham), at 6.30 p.m.—Dr. E. G. West: "Developments in the Welding of Aluminium Alloys".

SOCIETY OF CHEMICAL INDUSTRY, SOUTH WALES SECTION (at the Royal Institution, Swansea), at 6.30 p.m.—Mr. F. Gill: "New Physical Methods in Examining Petroleum Products".

BRITISH ASSOCIATION OF CHEMISTS, ST. HELENS SECTION (at the Y.M.C.A. Buildings, St. Helens), at 7.30 p.m.—Mr. H. Pritchard: "Chromatography".

Thursday, October 11—Thursday, October 25

ELECTRICAL ASSOCIATION FOR WOMEN. Twenty-first Birthday Celebrations, at Dorland Hall, Lower Regent Street, London, S.W.1.

October 11, at 11 a.m.—Opening by Duchess of Kent.

October 12, at 2.30 p.m.—Sir Robert Watson-Watt, C.B., F.R.S.: "Women and Wireless." Dr. Kathleen Lonsdale, F.R.S.: "A Woman Physicist Looks Back". Sir Harry Railing: "After the Scientist, the Engineer".

October 12 and 13. Annual Conference of the Women's Engineering Society. Miss M. M. Partridge: "The Next Twenty-one Years" (Presidential Address).

APPOINTMENTS VACANT

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

SCIENTIFIC OFFICER FOR POTATO INVESTIGATIONS at the National Institute for Agricultural Botany, Huntingdon Road, Cambridge—The Secretary (Oct. 10).

A LECTURER and an ASSISTANT LECTURER IN ZOOLOGY in the University of Birmingham—The Secretary (Oct. 13).

EDUCATIONAL ADMINISTRATIVE OFFICERS (male and female) to deal with universities, adult education, technical colleges, youth activities, and other aspects of the control of German education in the British Zone of Occupation—Appointments Department, Ministry of Labour and National Service, Sardinia Street, London, W.C.2, quoting Ref. No. O.S.1113 (Oct. 15).

TEACHER OF MECHANICAL ENGINEERING SUBJECTS, and a TEACHER OF PHYSICS, at the Acton Technical College, High Street, Acton, London, W.3—The Principal (Oct. 15).

LECTURER IN INORGANIC CHEMISTRY in University College, Nottingham—The Registrar (Oct. 20).

LECTURER IN ORGANIC CHEMISTRY at the City of Liverpool Technical College—The Clerk to the Local Education Authority (Oct. 20).

LECTURER IN GENERAL ENGINEERING SUBJECTS, and a LECTURER IN ENGINEERING MATHEMATICS, in the Merchant Venturers' Technical College, Bristol—The Principal (Oct. 20).

CHIEF SUPERINTENDING ENGINEER (Ref. No. C.2840.XA), ASSISTANT CHIEF ENGINEER (Ref. No. C. 2841.XA), MECHANICAL ENGINEER (Ref. No. C.2842.XA), for a paper mill in India—The Ministry of Labour and National Service (Appointments Department), Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2 (Oct. 22).

LECTURER IN PHILOSOPHY in the University of Birmingham—The Secretary (Oct. 27).

HARBOUR ENGINEER for harbour construction and maintenance, for the Sudan Railways—The Ministry of Labour and National Service, Appointments Department, Technical and Scientific Register, Room 670, York House, Kingsway, London, W.C.2, quoting E.1962.A (Oct. 31).

DIRECTOR OF THE BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION, 15 Savoy Street, London, W.C.2—The Chairman (Nov. 16).

READER IN PUBLIC HEALTH in the University of London at the London School of Hygiene and Tropical Medicine—The Academic Registrar, University of London, Richmond, Surrey (Jan. 29, 1946).

CHAIR OF NATURAL PHILOSOPHY in the University of Aberdeen—The Secretary (Feb. 15, 1946).

CHAIR OF EXPERIMENTAL PHYSICS AND THEORETICAL MECHANICS at Istanbul University—The British Council (Appointments Department), 3 Hanover Street, London, W.1.

CHAIR OF MECHANICAL ENGINEERING, CHAIR OF ENGINEERING TECHNOLOGY, CHAIR OF ELECTRICAL ENGINEERING, CHAIR OF MARINE ENGINEERING, CHAIR OF MARINE ELECTRICAL ENGINEERING, and a CHAIR OF TELEGRAPHY AND TELEPHONY, in the Technical University, Istanbul—The British Council (Appointments Department), 3 Hanover Street, London, W.1.

CHAIR OF PHYSICS, and CHAIR OF CHEMISTRY, in Ankara University—The British Council (Appointments Department), 3 Hanover Street, London, W.1.

LABORATORY STEWARD to take charge of animal house at a cancer research laboratory—The Director of Research, Glasgow Royal Cancer Hospital, 132 Hill Street, Glasgow, C.3.

LECTURER IN PSYCHOLOGY at the Furzedown Training College, Welham Road, London, S.W.17—The Principal.

A LECTURER IN CHEMISTRY, and a LECTURER IN BIOLOGY, at the Polytechnic, Regent Street, London, W.1—The Director of Education.

LECTURER IN SOCIOLOGY at Bishop Otter College, Chichester—The Principal.

TEACHER (man or woman) OF BIOLOGY at the Wolverhampton and Staffordshire Technical College—The Clerk to the Governors, Education Offices, North Street, Wolverhampton.

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