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NATURE

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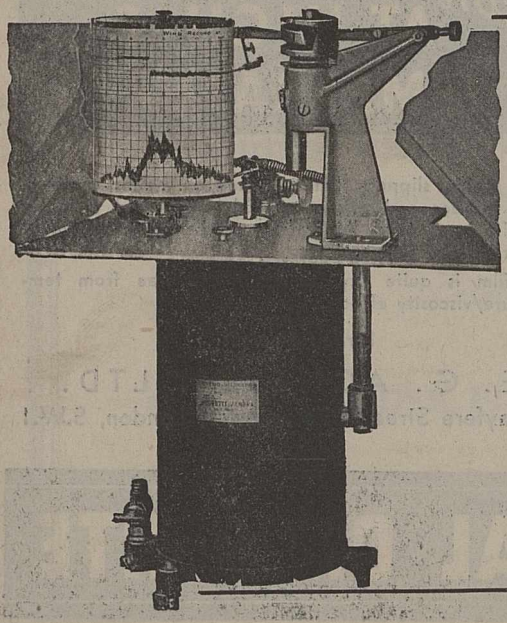

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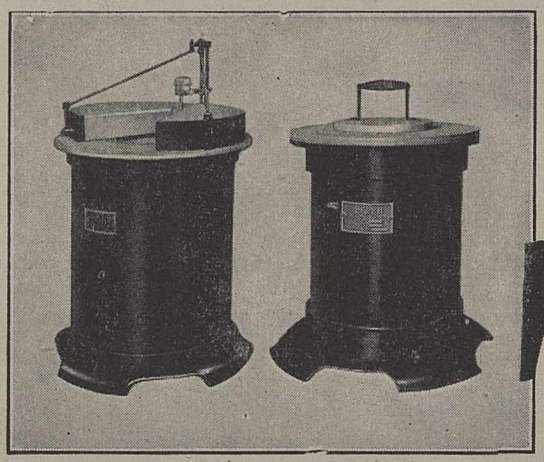

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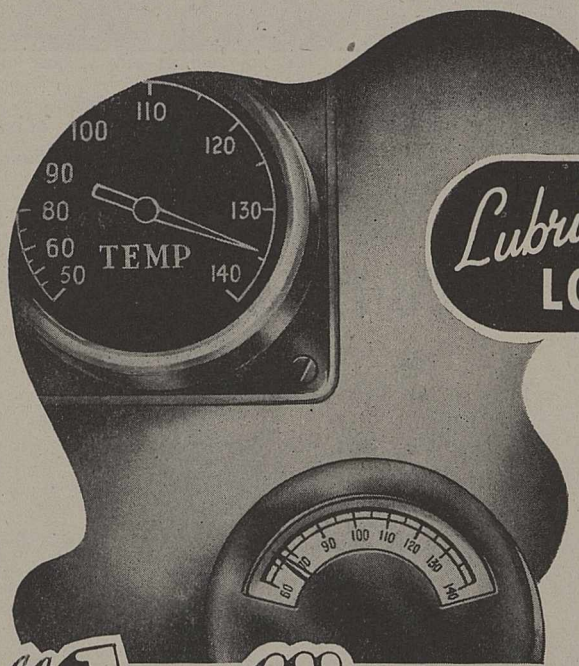

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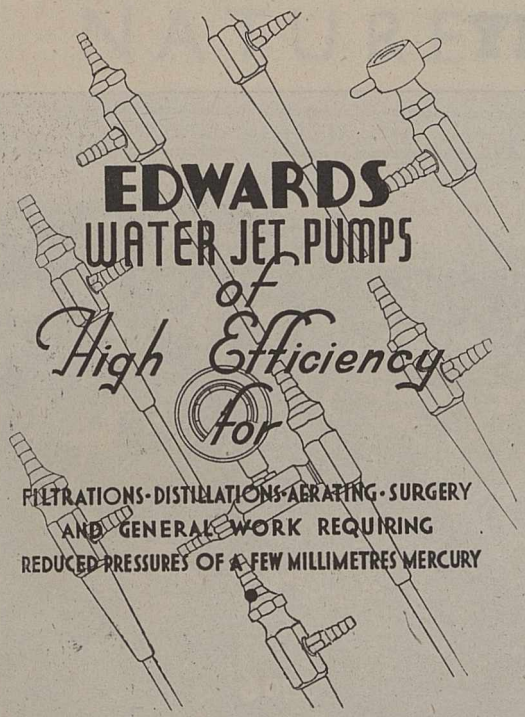

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LIBRARY RESOURCES OF GREAT BRITAIN

AN important chapter in the McColvin report on the Public Library System of Great Britain dealing with co-operation, specialization and national projects emphasized the urgent need for a thorough and realistic survey of the whole field of special and non-public libraries. Such a survey, Mr. McColvin urged, would disclose a wealth of material which is not fully recognized and utilized, and would stimulate co-operation both between non-public libraries themselves and between non-public and public libraries. It is a necessary preliminary to a sound organization and development of the specialized resources of the nation.

This view was endorsed at subsequent discussions on the rehabilitation of European special library and information services during the Conference last September of the Association of Special Libraries and Information Bureaux, and the importance of such a survey has since been urged by Mr. G. Woledge, librarian of Queen's University, Belfast (see NATURE, Dec. 11, p. 687). A good deal of attention is being given to this question by the University and Research Section of the Library Association, which is considering the publication of a report on the post-war development of university and research libraries as a complement to the McColvin Report. The rehabilitation position, coupled with the problem which may well confront all libraries in completing after the War their broken and interrupted series of scientific and technical periodicals, will certainly enforce some attempt to plan systematically the distribution of available resources. Moreover, without some measure of co-operation, any efficient distribution of the book resources of Great Britain in view of present publishing difficulties is well-nigh impossible.

The basis for any such efforts must clearly be a survey of existing collections in all forms of special libraries, within and without the public library system of Great Britain, the functions they serve and their relation to the general needs of the country. The first step before any such inquiry can well be initiated is clearly to determine its scope, and on this point discussion of the proposal can most profitably at present settle. In such discussion, however, it is necessary to have a clear idea of the nature and extent of existing university and research libraries, their resources and the services they render, the form of present library co-operation, and the needs of the users of such libraries and the services they are entitled to expect.

In regard to the last, Mr. Woledge has already indicated some essential points. In an adequate system, both special libraries and special collections in general libraries will be required ; also reference collections and collections for loan. The geographical accessibility of reference collections must be considered, and the provision of the shelf access which is more easily supplied in a separately organized special library or department than in a section of a general library. Again, in addition to shelf-arrangements

which facilitate 'browsing', the collection and arrangement of ancillary material such as cuttings, off-prints, photographs, with all that is implied therein in the way of expert and specialized staff, must receive attention. Whether regarded from the point of view of an information system, the stimulation of creative thought or general education, the system must provide for the needs of the general reader as well as the specialist and research worker.

It is not, of course, suggested that the university and research libraries of Great Britain are not already, in themselves and through the system of voluntary co-operation developed in the last twenty-five years, already making most valuable contributions in such ways in supplying the material required for the advancement of knowledge. The problem is to determine whether the present extremely heterogeneous units, differing widely in age and size, could be knit to the general advantage into some more formal or informal structure. That need not affect the independent status of the individual libraries, to which some will attribute much of their present sense of responsibility, or the voluntary character of the existing system of co-operation. Under present conditions the individual libraries can scarcely continue to render the most efficient service to their own special clientele, and expend to the best advantage their available resources, unless regard is had to their position in the national system and the help which they might receive from, and give to, other libraries.

The university libraries are the properties of the bodies they exist to serve, and the interests of those bodies have naturally a first claim on their services. Almost without exception, however, they have recognized that part of the service which a university owes to its community is to make available, within the limits of its means and to those qualified to make use of them, such of its resources as are not available elsewhere and are not needed for its daily work. They have been glad to welcome outside readers and to lend their books to other libraries, and the contribution thus made to the advancement of knowledge is by no means insignificant.

The so-called 'special' libraries are also the property of various kinds of corporate bodies—local and national learned, scientific and professional societies, government departments, research associations, industrial and commercial firms, newspapers, etc. Although such libraries need feel even less obligation than the university libraries to the general public, their resources have been increasingly made available, if not generally, at least to other libraries whether special or public. Frequently they are the only source of supply of much specialized literature, and their co-operation in the national organization for inter-library lending through the National Central Library has been far more important than any statistics could show.

Besides these, there is a further group of government libraries the primary obligations of which are to the public in general; it should be unnecessary to say anything here about the importance of the British Museum as a reference library, or of the Science Library as a source of scientific periodicals for loan. The great municipal reference libraries, although in most ways associated more closely with the work of the public lending libraries than with that of other research libraries, are none the less an important part of the country's resources for research, and besides all these groups there is the National Central Library, the organizing work of which has facilitated the full utilization of their resources.

No organization which leaves any of these groups out of account can claim to make anything like full use of Great Britain's library resources. A national scheme must provide for their voluntary participation on a national as well as on a local and regional basis. Given such co-operation, there should be no inherent difficulty in the allocation of public funds to provide for the strengthening or maintenance of any particular special collection which might be desirable in the public interest as a result of the proposed survey.

Without minimizing the importance of adequate staffing and housing of libraries, both special and general collections, or of efficient administration, the most urgent need is that of a survey of actual book resources as a basis for framing policy. An administrative survey is undoubtedly needed, but whether it should, as Mr. McColvin appears to imply, be combined with the urgently needed survey of the contents of libraries, may be questioned. Both are large projects, but they demand different qualifications in those responsible for carrying out the survey. Administrative reform, it is true, might sometimes be required before a special library could co-operate effectively, but that can scarcely apply to the appraisement of its holdings in the survey.

Much material for the survey of book resources in Great Britain is no doubt already in the possession of the National Central Library and of the Association of Special Libraries and Information Bureaux. The co-operation of both these bodies may be expected, but most of the present material will require re-examination. It is not enough in framing a policy merely to know of the existence of a special collection; information as to how far it is complete, how fully it is kept up to date, how far books are available for loan and in non-lending collections, and how adequately it is organized, is essential. The survey should bring out the weaknesses as well as the strength of the book resources of Great Britain.

There are other questions as to the extent of the survey which require determination. One is the inclusion or exclusion of local collections, most of which form part of the public library service and are often in very small libraries. It may well be decided to leave manuscripts and theses to a subsequent survey. Questions with regard to periodicals will probably arise, and the survey can be no more than a first step in the co-operative selection of periodicals, though it should assist the allocation of 'runs' where insufficient copies are available.

On the basis of such a survey, it should be possible to frame a policy which could be based on agreed principles, and to decide which collections could be most profitably developed in general and on what

lines. It would enable libraries to plan the development of their special collections, and though much more will remain to be done, such a survey is almost an essential preliminary to the co-operative purchase of periodicals.

The first objective in such a policy must clearly be the establishment of one full collection in a single library, such as is provided for many subjects by the British Museum and other great general libraries. No system of inter-library lending can take the place, for certain types of research, of a library where any reasonable demand can be satisfied at short notice. It is best that such a library should not lend its books, or at least do so sparingly, but Mr. F. C. Francis's paper on the British Museum as a special library, read at the autumn conference of the Association of Special Libraries and Information Bureaux, gives some idea of the problems that must be faced in attaining even this objective. We cannot assess the value and completeness of special libraries for this purpose without regard to the amount of material contained in more general works or series.

On the other hand, it is not so essential that the second objective, a full collection of books available for inter-library loan, should be in one library. Further development of the co-operation in this field which has been so marked in the last twenty years may be expected, chiefly on the lines of further specialization related to individual and to general needs, in the medium-sized general libraries, mainly reference libraries and university libraries. It may well prove that the greatest need for financial assistance is in this field.

The third objective should be a full collection, which may or may not be identical with one of the collections already mentioned, allowing access to the shelves and suitably arranged for that purpose. The importance of open-shelf libraries properly arranged so as to provide for and even encourage 'browsing' is often overlooked. The value of such 'browsing' in stimulating thought during research has been repeatedly demonstrated, and the special libraries and information departments might consider whether the re-arrangement of their material so as to permit free access to public material at least on the part of their own staff would not be worth while. Apart from that internal advantage, it might facilitate fuller participation in inter-library lending, though as Mr. McColvin has emphasized in his report, one of the objectives of a carefully planned policy should be to provide books where they are most wanted and thus reduce inter-library loans to a minimum.

The mere size of the great general libraries of Great Britain tends to preclude the supervision and shelf-arrangement necessary for open access collections of this type, and this function may fall to the special libraries or information departments. Again, every subject needs the provision of books in each of these three ways, though the relative importance will vary from subject to subject. For some subjects, more than one full non-lending collection may be required; overlapping or duplication must be considered in no narrow spirit. Questions of local as opposed to national book provision would rightly be disregarded by the survey, which none the less must examine the desirability of ensuring that certain large classes of literature, which cannot, and should not, be repeated in all libraries, exist in duplicate or triplicate for inter-library loan.

If any such survey is to be initiated in time for its results to be available when the replanning of libraries and replenishment of stocks become possible, it is imperative that it should be set on foot without undue delay. As a first step, the question of the scope of the inquiry and survey requires immediate consideration, and in this the views not only of librarians but also of users of libraries are alike important. The goodwill of all concerned in furthering the co-operation, which has been such a feature of the inter-war period, and in building up a network of special libraries and special collections in general libraries so as to cover the whole field of knowledge, or in the co-operative collection so far as possible of particular items such as periodicals, will be essential. Nor should its importance be overlooked by scientific institutions, to whom the housing of their existing libraries, as Sir Henry Dale indicated in his presidential address to the Royal Society, is already a matter of concern, and it should be assured of the warm support of all those who recognize that plans for the expansion of the universities must include generous provision for the libraries, both books and buildings.

AN INTERNATIONAL LANGUAGE

(1) Basic English and Its Uses

By I. A. Richards. Pp. 127. (London: Kegan Paul and Co. Ltd., 1943.) 3*s.* 6*d.* net.

(2) Basic for Science

By C. K. Ogden. (Psyche Miniatures, General Series No. 95.) Pp. ix+314. (London: Kegan Paul and Co. Ltd., 1942.) 3*s.* 6*d.* net.

LAST September, when Mr. Winston Churchill received an honorary degree from the oldest of American universities, he spoke of the common task awaiting our two peoples in the service of mankind. Himself the son of an English father and an American mother, and a supreme master of our common tongue, he did not see why we should not try to spread the use of our language even more widely over the globe. He went on:

"Some months ago I persuaded the British Cabinet to set up a Committee of Ministers to study and report on Basic English. Here you have a plan. There are others, but here you have a carefully wrought plan for an international language capable of very wide transactions of practical business and of interchange of ideas. . . . What was my delight when, the other evening, quite unexpectedly, I heard the President of the United States suddenly speak of the merits of Basic English . . . Harvard has done more than any other American university to promote the extension of Basic English. The first work on Basic English was written by two Englishmen, Ivor Richards, now of Harvard, and Ogden, of Cambridge University, England, working in association."

The latest works by Ivor Richards and C. K

Ogden treat of the uses of Basic English for the advancement of science. This is indeed the main theme of Mr. Ogden's book, which is written in Basic. Dr. Richards' volume has a wider scope. Like Mr. Churchill in his Harvard speech, Dr. Richards is chiefly concerned with the world's need of some means of international communication for the transaction of practical business, the interchange of ideas, and the spread of normal English. He argues with much force that national aggression is the outcome of spiritual separation, because sentiments of exclusive loyalty to the group, or of disloyalty to the planet, plunge us into wars; that the need for a common language will be greater than ever when the post-war world is linked up by the aeroplanes of to-morrow, by world-wide controls of many kinds—sanitary, economic, commercial—and by a universal demand for information and news; and that a world inevitably made one by its physical communications will destroy itself unless it can be united also through intellectual and moral communications.

If, then, in addition to its national tongues and its local vernaculars, the post-war world is going to need some common means of international communication, what is it to be? Dr. Richards gives his reasons for believing that no artificial language will meet the case and concludes that, "If there is to be a common language it must be a simplified, but not denatured, form of one of the world's existing major languages". Dr. Richards examines the question which of these languages is best suited to the task. He decides in favour of English, not merely because it is most widely used already, but also because there are good reasons for its prevalence. For example, despite the handicap of its appalling spelling, it can be made easier than any other language for learners in general.

The work on Basic English begun by Ogden and Richards in Cambridge during the 1920's and continued in many countries—particularly in the United States with the help of the Rockefeller Foundation—has aimed at discovering how English may best be learnt through a limited vocabulary in such a way that, if the process is interrupted at an early stage, the work already done may provide an auxiliary means of international communication of very wide use, and so that, if the learning is continued beyond that stage, there will be nothing to unlearn.

This "Basic English is English made simple by limiting the number of its words to 850 and by cutting down the rules for using them to the smallest necessary for the clear statement of ideas. And this is done without change in the normal order and behaviour of these words in everyday English. This is the first point to make clear. Basic English, though it has only 850 words, is still normal English. It is limited in its words and its rules, but it keeps to the regular forms of English. And though it is designed to give the learner as little trouble as possible, it is no more strange to the eyes of my readers than these lines", by Dr. Richards, "which are in fact in Basic English".

Much of Dr. Richards' book is concerned with the teaching of English to foreigners, particularly in China, with Basic as the first stage of the process. While insisting that Basic is no adequate substitute for a mastery of literary English, he holds that a sound knowledge of it is a better and more attainable goal than a more impressive programme that, in fact, leaves many a student without any serviceable command of the language. He adds that anyone whose native language is English will find that a few hours' study and practice are enough to enable him to travel, shop, visit and do the daily routine of business in Basic.

Dr. Richards found that, in China, the main incentive to learn English is interest in what is most distinctive about the West, its science. Much of the language of science is already international. Basic seeks to fill the gaps. A beginning has been made with a "Basic Science Library, a programme of science in Basic designed for the general reader, the learner of English, and the teaching of science in schools".

Mr. Ogden's little volume, "Basic for Science", gives many examples of the uses of Basic for popular exposition—including a fascinating extract from J. B. S. Haldane's writings on the sizes of animals—as well as for abstracts of original research. It is to be hoped that it may soon become the general practice for research abstracts to be written in Basic so that they may be more widely read all over the world. Meanwhile, Mr. Ogden's book provides scientific workers with an invaluable model for writing their papers and presenting their results in Basic English.

MAXWELL GARNETT.

HISTORICAL ANALYSIS OF ARCHÆOLOGICAL METHOD

The Three Ages

An Essay on Archæological Method. By Dr. Glyn E. Daniel. Pp. 60. (Cambridge: At the University Press, 1943.) 3*s*. 6*d*. net.

THIS concise, learned but lucid memoir deserves study not only by all archæologists, but especially by other men of science who have occasion to refer to archæological results but normally consult those large text-books that use the three-age system in the old misleading manner. It is really a critical historical analysis of archæological method, written by a representative of the brilliant younger generation of prehistorians now on active service. The author brings out ten important points.

(1) A workable system of classification being the indispensable condition for reducing any branch of empirical knowledge to a science, the adoption about 1818 by C. J. Thomsen of Copenhagen of the division into Stone, Bronze and Iron Ages marks the beginning of scientific archæology. (2) Thomsen adopted this system for the arrangement of museum specimens collected in a single geographical province, Denmark, and (3) on the strength of empirical observation, not of *a priori* theories. (4) Since its publication in 1836 it has been found, again empirically, applicable to material from other regions, but *only in Europe, the Near East, and Asia*. (5) With the accumulation of material it became possible and necessary to subdivide the Ages; the Stone Age has been split into Palæolithic and Neolithic since 1865, and these and the remaining Ages have since been subdivided in their turn. To these smaller subdivisions early investigators, following geological precedents (for example, Cambrian), gave names derived from type sites; de Mortillet's terms—Chellean, Acheulian, etc.—and Tischler's—Hallstatt and La Tène—are still occasionally used for such subdivisions of the Palæolithic and Iron Ages respectively, with confusing consequences. For (6) even within, say, the Stone Age of so small an

area as France or Denmark we have now to recognize a plurality of distinct but parallel and contemporary 'cultures' here defined as "significant and persistent associated assemblages of artefacts".

(7) The progress of prehistory has been retarded by the accident that the same names or the same sort of names (for example, Aurignacian, Hallstatt) have been given to assemblages of both types. In reality, the concept of 'culture' introduced a basis of classification quite distinct from the serial or chronological one underlying Thomsen's scheme; for the association of artefacts is due not only as in the latter to contemporary use, but rather to sociological, economic and in a word historical factors. (8) The three-age scheme was put forward as representing, and stratigraphically proved to represent, a chronological succession of technological stages in Denmark's prehistory. Less modest and less intelligent disciples took Thomsen's Ages as equivalent to periods of absolute time like the eras of geology. It has cost a lot of trouble to get rid of this erroneous deduction.

(9) To correct such abuses Daniel proposes some very reasonable and hopeful changes in classificatory terminology: (*a*) Names from type sites (Acheulian, La Tène) or even derived from type objects (like "Separate Grave"—his other examples, Chatelperronian and Gravettian, are in fact derived from French sites) should be reserved for the cultural classification (point 6). (*b*) Position in the serial classification, relative or absolute chronology, should be denoted by numbers or letters; in a footnote the author instances the use of numbered 'periods' in my "Prehistoric Communities of the British Isles", published since the memoir was written. He very properly condemns the practice of two of his most brilliant contemporaries who use terms like 'Neolithic A' and 'Iron Age B' to denote cultures without exclusively serial connotation. His complaint that Clark uses "Mesolithic I" where he should write "Holocene I" is, however less legitimate, since "Holocene I" should be applicable to the whole world, while Clark's division purports to apply only to Northern Europe. Prehistory is likely to be burdened for a long time with purely local sequences that must be distinguished by some qualifying adjective quite free from any suggestion of œcumenical significance.

(10) As a consequence, Thomsen's scheme can now be abandoned. It provided an indispensable scaffolding, but now distorts the structure. To be scientifically valid, a classification must use features that are not only well defined and easily recognized, but also significant and symptomatic of wider relations. The author sympathetically reviews recent attempts to give stadial significance to the Ages by equating them with decisive stages in the economic development of societies. The equations of the Palæolithic and Mesolithic Ages on one hand, and the Neolithic on the other, with the food-gathering and food-producing economies respectively of Elliot Smith would, he admits, achieve this result; but some food-gatherers, around the east Baltic for example, used a formally Neolithic equipment of polished axes, pottery, etc. My own attempts to give a comparable economic significance to the Bronze and Iron Ages are rejected. The urban revolution leading to civilization does not, of course, coincide with either of these Ages. But elsewhere I hope to have opportunity to set forth the concrete evidence that induces me still to maintain that the regular use of cast copper or bronze, and afterwards the substitution therefor of cheaper iron, had such far-reaching technological, economic and sociological consequences that they must rank as defining really distinctive stages in the development of even barbarian societies. Daniel himself suggests that a more significant division would be to bracket the Neolithic and Early to Middle Bronze Ages together as an "Eochalcic Age", and to let a "Full Metal Age" begin with the Late Bronze Age and extend over the whole prehistoric Iron Age. This scheme has the advantage of giving due prominence to the remarkable but still unexplained cheapening of bronze that distinguishes the Late Bronze Age and its results; for neither this fact nor its implications had previously been given adequate recognition. But I shall show elsewhere that its technological and social repercussions were not of comparable magnitude to those following the development of iron working. Incidentally, the term "Full Metal Age" has already been reserved to designate an earlier technological stage that in some regions—in the Wessex culture, for example—is of considerable significance. Nevertheless, I believe that for the presentation and exhibition of archæological results, a scheme on the lines outlined under (9) by Daniel will prove more fruitful than any rationalization of Thomsen's trinity.

V. GORDON CHILDE.

SOME TRENDS OF AMERICAN THOUGHT

The Early History of Science and Learning in America

Proceedings of the American Philosophical Society, Vol. 87, No. 1. Pp. iii+120. (Philadelphia, 1943.)

Twentieth Century Philosophy

Living Schools of Thought. Edited by Dr. Dagobert D. Runes. Pp. 571. (New York: Philosophical Library, Inc., 1943.) 5 dollars.

Bibliography of Research Studies in Education, 1939–40

(Federal Security Agency, U.S. Office of Education.) (Washington, D.C.: Superintendent of Documents.) 50 cents.

A Challenge to Scholarship

By W. Mansfield Clark. (University of Pennsylvania Bicentennial Conference.) (University of Pennsylvania Press.)

THE first item in the above list recalls the interesting fortunes of the word 'philosophy'—originally the love of wisdom, and the search for causes of all things in heaven and earth. In course of time a distinction was made between natural and moral philosophy, but the old meaning still survives, for example, in the degree of doctor of philosophy. The Royal Society of London, founded in 1660, essentially scientific in its outlook, has ever been famous for its *Philosophical Transactions*, which are records of scientific investigations. The American Philosophical Society was founded at Philadelphia by Benjamin Franklin in 1743. It had little or nothing to do with philosophy as we now understand the term. Its interests lay in new discoveries in what we now call the sciences, in "all philosophic [that is, scientific] experiments that let light into the nature of things, tend to increase the power of man over

matter, and multiply the conveniences and pleasures of life". It was the parent of the American Association for the Advancement of Science, founded in 1840. Since the organization of the latter, the American Philosophical Society has become a local scientific association for Philadelphia. But though a local association, it is broad in its outlook, as its latest *Proceedings* show. Not only does it deal with the part played by the Society in the world of science, and in the development of American education, but also with American contributions to historiography, linguistics, economics, anthropology, archæology and architecture. These *Proceedings* are a most interesting record of a few of America's past achievements in science.

As its title indicates, "Twentieth Century Philosophy" is essentially a book of the day. It is a symposium containing twenty-two chapters, either directly contributed by eminent thinkers and scholars, or otherwise representing their positions. One does not wonder that the editor has found it difficult to bring together under one cover thinkers of such divergent principles and temper, and that, having let each of them state his case, he leaves it to the reader to draw his own conclusions. Among the contributors we note the names of J. H. Tufts, Whitehead, Russell, Dewey and Santayana, and among the chapters of special interest to the man of science we note those on the philosophy of science, logical empiricism, the stories of American realism and pragmatism, philosophic naturalism, and the dialectical materialism emanating from the U.S.S.R. The whole forms a useful compendium of living, and warmly contending, schools of thought. If it is the business of each thinking man, whether American or not, to make his own philosophy, his own general outlook upon the universe, this book will help him in his quest, and may help him to understand and tolerate systems which he rejects.

We turn to a topic of wider appeal to readers of this journal—that of the encouragement of research. The liberal provision made for research in the United States is well known in Britain, and indeed Britain has had the advantage of sharing in that liberality. The way they do such things in the United States is exemplified by the extensive bibliography of research studies in education 1939–40, recently issued by the U.S. Office of Education. The book contains 4,012 entries of theses and studies reported by 133 places of education, mostly universities and teachers' colleges, and a few technical institutes. An analysis shows 674 doctors' dissertations, 3,183 masters' theses, and 155 studies reported as faculty research.

In an important sense the figures are revealing. We may assume that the studies reported by faculty members are real contributions to knowledge, and that as a rule, though in a less degree, the same may be said of the doctors' dissertations. There remain the masters' theses, written for the master's degree, and constituting no less than three fourths of the impressive total. Their object is to ensure that a person who has shone sufficiently in his 'recitations' at school, and has attended the appointed lectures at college, shall give evidence of ability to do a piece of independent work. Usually it consists of a few score pages of typescript on a local theme, such as a survey of education in a certain county of the State, or "the effect of the use of separate answer-sheets on reading test results", or "a study of family life in its relation to education in the second grade" of a certain school. There is no question as to the value of these theses for the writers' own education. Only in an elementary sense, however, can they be called contributions to new knowledge. They exemplify a principle now recognized as vital in all progressive schools, both in the United States and in Britain. It is worth recording that in Victorian England the way was led by eminent teachers of science, such as L. C. Miall of Leeds and Lloyd Morgan of Bristol, who emphasized the difference between finding out and being told, and thereby led teachers to realize that pupils from an early age may be led into the paths of simple research.

To return to the question of research in the higher sense. There is no need to emphasize its value, for it is recognized as the life-blood of science. There is, however, a correlative truth which is apt to be lost sight of, and which was forcibly brought out in an address entitled "A Challenge to Scholarship" delivered at the bicentennial conference of the University of Pennsylvania by Dr. Mansfield Clark, professor of physiological chemistry in the Medical School of Johns Hopkins University. He shows how American teachers imported from Europe not only the scientific ideal of research, but along with it the philosophic ideal of an organized system of thought. Undoubtedly, he says, we have added much of our own that is good, but "what needs examination is the tendency in scientific circles to enthuse over research alone". He recalls that in 1896 Merz, in his "History of European Thought in the 19th Century", gave warning of the decay of the ideal of *Wissenschaft*, "a decay that someone put tersely when he remarked that the German scholars had got into the habit of going down deeper, staying down longer, and coming up muddier, than any other". In the United States, says Dr. Clark, the danger that threatens education in the sciences is in "the crumbling of the ideal that a goodly part of scholarship is the studious maintenance of balance between the advancement of knowledge and its consolidation". One realizes his meaning when he adds incidentally that "the last decennial index to *Chemical Abstracts* contains about two million entries!"

In conclusion, it is interesting to observe how the ideal of research has fared in another great country which has temporarily fallen on evil days. At a conference held in May last by the Association of University Professors of Allied Countries in Great Britain ("The Function of a University in a Modern Community." Pp. 57. (Oxford: Basil Blackwell. 1*s*.)), Prof. Paul Vaucher noted among the distinctive features of French universities the importance attached to a high standard of general culture—an ideal which dominated university organization. During the last forty years, however, profound changes have taken place, as the organization "was not well suited to promote scientific research or to provide for students a proper training in research". Hence the development of laboratories in the faculties of science and medicine, and of seminars in the faculty of arts. "Individual scholars, disregarding the critics who often accused them of being under German influence, started creating centres for collective research and for common training in research."

So we are reminded that, whether in the United States or Britain or France or Germany, the scholar and the scientific worker as such are simple seekers after the truth, the whole truth, and nothing but the truth.

T. RAYMONT.

SCOPE AND LIMITATIONS OF INFRA-RED MEASUREMENTS IN CHEMISTRY*

By DR. H. W. THOMPSON
University of Oxford

FOR some years infra-red spectroscopy has been a valuable research tool in pure chemistry, particularly in problems of molecular structure and the deduction of molecular data. Its value in industrial work, both for routine and research measurements, is now becoming fully appreciated, and its usefulness in general organic chemistry may soon at least equal that of ultra-violet spectroscopy. It is therefore opportune to consider its uses and limitations.

The infra-red may be said to extend between wave-lengths of about 1 μ and 10^4 μ. This corresponds to a range of frequencies 3×10^{14} to 3×10^{10} per second, or 10^4 to 1 wave numbers. A small region from the visible up to 1·2 μ can be studied photographically, using conventional spectrographs with glass prisms or finely ruled diffraction gratings. Between 1 μ and 25 μ, prism spectrometers are most often used, in which the prism is made of quartz, fluorite, rock salt or potassium halides. Since large natural crystals of these materials are growing scarce, their production recently in large blocks by cooling the molten salts is important. Diffraction gratings have to be used at wave-lengths beyond 25 μ, although they are also used at shorter wave-lengths if higher resolving power is required. In order to obtain a greater concentration of energy and avoid its dissipation among many spectral orders, these 'echelette' gratings are ruled with specially shaped grooves so that reflexion occurs at favoured angles. The infra-red radiation is usually detected by means of thermo-electric devices. Striking advances have recently been made by the development of very sensitive vacuum thermo-couples and voltage amplifiers, thus leading to an increase in both sensitivity and stability of the galvanometric systems, and to the construction of automatically recording spectrometers. In this way, infra-red technique has ceased to be a delicate research method and has become more easily applicable by non-specialists.

Infra-red emission spectra are rarely intense enough for measurement, and we are nearly always concerned with the absorption spectra. In this spectral range, the quanta of energy absorbed cause the molecules to rotate and vibrate. In order to absorb rotational quanta, a molecule must have a permanent dipole moment. Vibrational quanta are absorbed if the particular vibration involves a changing molecular dipole moment. Thus, although homonuclear molecules like hydrogen or nitrogen do not absorb vibrational quanta, methane can do so, since it can perform an unsymmetrical nuclear vibration which produces an electric moment.

Rotational quanta are nearly always small, and the pure rotational spectra therefore lie at very long wave-lengths, between about 10^2 μ and 10^4 μ, or 1–100 wave numbers. Little is so far known about them, mainly owing to technical difficulties in studying this region, but also because of their complexity with all except diatomic molecules. In the latter case, the spacing between rotational lines leads to the molecular moment of inertia and hence to the bond-length.

Vibrational quanta are larger, the fundamentals varying from about 100 cm.$^{-1}$ to 4,000 cm.$^{-1}$. The fundamentals, lower harmonics, and combinations are therefore absorbed between about 100 μ and 1 μ. Changes in rotational energy usually accompany the absorption of vibrational quanta, and with gases or vapours this gives rise to a fine structure of the vibration bands, the precise details of which are of great significance. With liquids and solutions, the intermolecular influences lead to the disappearance of this rotational structure.

A rigid non-linear molecule has $(3n-6)$ normal vibrations, and a linear molecule $(3n-5)$. With simple symmetrical molecules like carbon dioxide, water or ethylene, it is possible to specify in a general way the geometrical form of these vibrations. They can sometimes be described as 'breathing', 'rocking', 'bending' or 'twisting' motions, and it is also sometimes convenient to differentiate between valency vibrations and deformational modes according as the motions of nuclei are along or perpendicular to the valency bonds. If a molecule has some degree of symmetry, its vibrations can also be characterized with reference to each element of symmetry, and by the way in which the electric moment changes with reference to these symmetry axes. Thus, the 'breathing' vibration of carbon dioxide is symmetrical with respect to the centre of symmetry—the carbon atom; and the other stretching vibration is antisymmetrical. In the latter case, the change of electric moment occurs in a direction parallel to the molecular axis, which is an axis of symmetry; in the deformational mode of carbon dioxide, however, the change in moment is perpendicular to the molecular axis. When the molecule has several planes, or other elements of symmetry, a given vibration may be symmetrical or antisymmetrical with respect to each. In the same way the total change in electric moment in different vibrations will vary in magnitude and in direction with respect to the symmetry elements. Some vibrations, for example, the totally symmetrical modes of ethylene, will involve no change in electric moment, and will not be absorbed as fundamentals in the infra-red. In other cases, the intensities of absorption will vary as the position-rate of change of electric moment during the vibration. For these reasons, intensities, taken alone, are no rigid guide in the allocation of observed frequencies to the fundamental modes. Many semi-empirical rules have to be applied, such as the persistence of some magnitudes through a related series of compounds, the fact that motions of lighter nuclei will usually have higher frequencies than those of heavier ones, and the comparison of spectra of isotopic molecules, particularly those containing hydrogen and deuterium.

For certain purposes, a correct assignment of the fundamental frequencies is essential. The Raman spectrum provides valuable additional data. Here, vibrations are active if they involve a changing molecular polarizability. It therefore happens that frequencies which are not found in the infra-red spectrum may appear in the Raman spectrum, and vice versa. Raman frequencies also differ in their degree of polarization, which may enable us to allocate them more precisely to different types of vibration. Some oscillations, such as the twisting mode of ethylene, are inactive in both Raman and infra-red spectrum. These can sometimes be determined from fluorescence data, or from a comparison

* Substance of the Tilden Lecture, delivered before the Chemical Society on January 20.

of the measured specific heat with that calculated statistically using all the known frequencies.

The other important guide in assigning the vibration frequencies is the analysis of the rotational structure of the infra-red absorption bands. If the molecule has some symmetry, this rotational structure differs according to the direction in which the electric moment changes with reference to the axes of symmetry. The differences are often so characteristic that inspection may serve to allocate the vibration to a particular symmetry class. Detailed analysis of the spacings between the rotational lines may simultaneously lead to the moments of inertia and hence to knowledge about the molecular structure, and much information about simple molecules obtained in this way is more accurate than by any other method.

Such rotational analyses are limited, however, to molecules which are (*a*) volatile enough to be studied as vapours, (*b*) small enough to have low moments of inertia and resolvable structure, and (*c*) have some symmetry. These restrictions are severe, and most molecules with which the chemist has to deal are excluded. Even if (*b*) and (*c*) do not apply, however, useful information can often be obtained. Thus, if there is some symmetry but the moments of inertia are large, the envelope of the rotational structure, or band contour, can be measured. This contour, like the rotational structure itself, varies characteristically with the direction in which the electric moment changes during the vibration with reference to the axis of symmetry. By measurement of the spacing between sub-maxima in the band contour, moments of inertia can be roughly determined or an assumed molecular structure confirmed. If the molecule is asymmetrical, the rotational fine structure of bands is very complex, and although this class of molecules includes such simple structures as water, hydrogen sulphide, ethylene, and formaldehyde, few satisfactory analyses have so far been achieved. Here again, some progress can be made by measuring the band contours. These differ according as the direction of change of electric moment is parallel to the least, middle or greatest axis of inertia. In practice, hybrid contours are to be expected, since the change of electric moment will have components along more than one of these axes; but in many cases the contours are surprisingly simple, and not only help in assigning the frequencies but also serve to confirm assumed molecular structures.

It must be emphasized that even when all three principal moments of inertia of a molecule are known, the whole structure often cannot be deduced, since there are more than three bond-lengths and angles. One or more of the latter must then be assumed in order to determine the others. When data are available for a series of related molecules such as the methyl halides, self-consistency in the whole group may be a useful guide. In other cases, comparison of isotopic molecules is valuable, particularly those containing hydrogen and deuterium.

Another serious difficulty in analysing rotational structures and contours results from perturbation of energy-levels due to interaction of vibration with rotation, which tends to be specific. On the other hand, incompletely resolved or partially unexplained rotational structures often serve to decide between alternative molecular configurations. In this way hydrogen peroxide has been shown to be non-planar, and formic acid to have a *cis* rather than *trans* structure.

When molecules are involatile, or large, only the vibration frequencies may be determinable. If all the frequencies are known, the specific heats can be calculated, using the results of statistical mechanics which relate them to the partition function. Discrepancies in some cases between the calculated and measured values have been correlated with the phenomenon of restricted rotation about bonds in organic molecules. Estimation of the potential energy barriers restricting such internal rotation in series of molecules have now been made and throw some light on the nature of the forces between non-bonded atoms in molecules. If in addition to the vibration frequencies, the moments of inertia are also known, the free energy and entropy can be calculated; and provided other thermochemical data are available, so that changes in zero-point energy can be calculated, equilibrium constants can be calculated for reactions where they cannot easily be measured.

If molecules are regarded as a system of mass points between which harmonic forces operate, it is possible to derive equations relating the vibration frequencies with the nuclear masses and force constants for stretching of bonds and bending of angles. Comparison of the force constant of the same linkage in different compounds will give a direct indication of the multiple or hybrid character of bonds. Interesting results have been obtained in this way for some relatively simple molecules. Progress is limited, however, not only by the severity of the computations required, but also by the more fundamental problem of selecting a valid function to express the variation of potential energy with nuclear configuration. Different types of force field have been assumed, and although no general rules can yet be laid down, the most satisfactory seems to be that which assumes in addition to valency forces certain interaction terms. Future progress must be guided by considering series of related molecules, and thus discovering which types of interaction are important.

As explained already, particular vibration frequencies will be permitted to appear either in the Raman spectrum or in the infra-red spectrum, in both, or in neither, according to the symmetry point group to which the molecule belongs. A comparison of the spectra may therefore fix the symmetry class, and hence decide between possible alternative molecular structures. Benzene and cyclohexane have been studied in this way. In the former case, the question is to decide whether the molecule has a centre of symmetry, which a resonance hybrid should show, but which the Kekulé structure does not have. In the latter case we have to decide between a planar, boat-shaped, or chair-shaped structure. Results are so far rather unconvincing, mainly because the Raman measurements are normally made with the liquids, where molecular distortions lead to a breakdown of the selection rules.

Although any molecular vibration in reality involves the whole molecule, some linkages retain individuality and give rise to characteristic absorption frequencies. Such linkages can therefore be detected or estimated in molecules. The absence of the characteristic O–H group absorption in some hydroxy compounds has proved the existence of the hydrogen bond and revealed unexpected cases of inter- and intra-molecular association. The individuality of linkages tends to disappear when the nuclei are roughly equal in mass or the force constants roughly equal in value. In spite of this, some nuclear skeletons,

such as the nitro or tertiary butyl groups, retain characteristic sets of frequencies in different compounds. Deformational motions are also sometimes characteristic. For example, the symmetrical deformational frequency of the CH_3-group can be used to indicate its presence in polythene; and different types of olefine can be distinguished by differences in some of their deformational vibrations. The latter results can be used to study the cracking of hydrocarbons or the method of polymerization of unsaturated compounds. Thus, when 1.3 butadiene condenses to form buna rubber, the extent of 1.2 or 1.4 addition can be estimated. In polymeric chemistry a variety of problems can be tackled successfully, such as the arrangements within a long chain, or the structure of interpolymers.

Since no two molecules, except a pair of optical isomers, have the same nuclear configuration, the fact that any molecular vibration involves the entire molecule implies that no two molecules will have a completely identical set of vibration frequencies. The infra-red spectrum will therefore be a fingerprint of the molecule. On this basis, many mixtures, sometimes of great complexity and not susceptible to other methods, can be analysed. The method is particularly suitable for isomeric mixtures. Even stereoisomers show different spectra. Analyses of this kind are rapid and require a very small amount of material. Certain technical difficulties still exist, but are rapidly being overcome, and the method has wide applicability in organic chemistry. Accurate measurements on absorption intensities may also lead to more detailed knowledge about the nature of chemical bonds.

THE ANTIQUITY OF MAN IN AUSTRALIA

By PROF. F. WOOD JONES, F.R.S.
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A LARGE part of a recent Memoir of the National Museum, Melbourne (No. 13, 1943), is devoted to the question of the authentic antiquity of certain human artefacts and skeletal remains that have been recorded from various parts of Australia over a long series of years. The available evidence in relation to each find is carefully analysed, and a judicial summing up leads, in most cases, to a verdict of 'not proven'.

This new survey has been undertaken by the director of the Museum, Mr. D. J. Mahony, as a consequence of the recent discovery of mineralized human remains near Keilor at the junction of Dry Creek and the Maribyrnong River in the neighbourhood of Melbourne. The skull was unearthed from undisturbed strata 18 ft. below the surface. The district in which the find was made shows the presence of three distinct river terraces. The terrace from which the skull was excavated is the highest of the series and is 45 ft. above the adjacent river bed, the other terraces being respectively at the 36-ft. and 27-ft. levels. Mahony's conclusion from a geological survey of the area is that the terraces "represent the eustatic rise of sea level during the Riss-Würm interglacial phase" and that "the skull and the terrace are evidently contemporaneous". The correlation of the European Riss-Würm period with happenings in southern Australia and Tasmania is made in the assurance that "most glaciologists consider that glacial and interglacial phases were contemporaneous in both hemispheres".

The circumstances of the finding of the skull *in situ* in the undisturbed face of a sand-pit seem to be well authenticated. The skull itself is mineralized and bears every evidence of being contemporary with the stratum from which it was removed. We may therefore claim that the Keilor skull is the first Australian human fragment the geological antiquity of which is definitely guaranteed by the circumstances of its finding and that, in the opinion of competent Australian geologists, it dates from the Riss-Würm interglacial phase of the Pleistocene period. We may consider its geological story as settled, subject only to possible minor differences of opinion among experts concerning the precise age of the deposit in which the skull was found.

The study of the human remains is, however, far from being completed. In the introductory paper by Mr. Mahony, it is said that "Two mineralised human skulls and some other bones were found". The actual finder of the skull mentioned "one fossilised limb bone and several other fragments" as being with the skull. He adds that "since then five pieces of another skull were found at the same level and about 6 feet distant from the first skull". Only one skull (lacking the mandible) is in the possession of the National Museum, and it is the only specimen dealt with in this publication.

The account of the skull is written by Dr. J. Wunderly and that of the palate and maxillary teeth by Dr. W. Adam. Neither of these accounts can be considered as being definitive descriptions of the characters of the skeletal remains, and it might have been well to limit the account of the skull to a simple statement of its characters and to have refrained from any suggestions as to racial affinities until the rest of the skeletal remains were available for examination. Dr. Wunderly's conclusions concerning the skull are that "it combines Australoid and Tasmanoid characteristics in about equal proportions". Further, he states that "the Australoid and Tasmanoid anatomical characters are consistent with the theory that the Australians had a bi-racial origin, and also with the supplementary theory that Australia was originally peopled by Negritos. The presence of characteristics of the two racial types is more important than their proportional relationship". I find it difficult to understand the meaning of this last statement. Presumably it means that the Australian race as we know it is compounded of two primary races. But if Dr. Wunderly means that these two primary races were what we now know as Australians (Dravidian or Pre-Dravidian Cymotrichi) and Tasmanians (Oceanic Ulotrichi) is not clear, for the peopling of Australia by Negritos (presumably Tasmanians) he relegates to a "supplementary theory". Should he, in fact, mean that the Australian race is compounded of a Pleistocene Australian-Tasmanian mixture, he must be prepared to admit that the Tasmanian race is equally a mixture of the same two elements. For if that is not admitted, explanation is needed as to how, when Australian and Negrito (Tasmanian) had formed a mixed race in continental Australia in Pleistocene times, the Tasmanians, with all their racial characters intact, were present in Tasmania on the arrival of the white man. Only two possible explanations seem to present themselves. The first is that it so happened that the Ulotrichous Negritos who passed from Australia to Tasmania chanced, in

some extraordinary way, to have avoided this racial admixture with Australians during their occupation of Australia. The second, that the influx of Negritos into Australia was an event altogether separate from their advent into Tasmania: that there were two independent Negrito migrations, one into the mainland that merged its blood with that of the Australians, the other into Tasmania direct and not via continental Australia and so preserving their full Negrito characters. It cannot be claimed that either of these hypotheses tends to clarify the question of the peopling of the Southern Continent.

Concerning the palate, Dr. Adam concludes that "it is more Tasmanoid than Australoid" in certain features. One of these features is that "it is relatively broad like the Tasmanian palate; the Australian palate is relatively narrower". It is unfortunate that of the Tasmanian and Australian palates figured in Plate XI, that of the Australian would seem to be of a considerably higher relative broadness.

The question would seem to arise as to the possibility of any physical anthropologist sorting out the constituent racial elements present in any individual skull. Tables of figures of comparative measurements are impressive; but it would seem that they are incapable of solving the problem. Taking Dr. Wunderly's tables 1 and 2, in which he gives measurements for Australian, Tasmanian, Maori, Marquesan and Hawaiian skulls, it is at once apparent that it cannot be from these that he has drawn the conclusion that the Keilor skull is compounded of Australoid and Tasmanoid characteristics in about equal proportions. If the measurements of the Keilor skull are matched with the measurements given in the tables of the other skulls, it will be found that in fifty-seven instances they come nearest to those of Australians, in thirty to those of Maoris, in twenty-nine to those of Marquesans, in twenty-one to those of Tasmanians and in eighteen to those of Hawaiians. Surely this is a very disconcerting result to be achieved by the refinements of craniometry. On the other hand, it can scarcely have been on the anatomical features of the skull that Dr. Wunderly makes such a very definite statement, for the morphological characters referred to in the communication are quite insufficient for arriving at a dogmatic diagnosis of racial mixture between the Pleistocene ancestors of the present Australian and Tasmanian races. It might be considered among the triumphs of craniology to diagnose with certainty the product of racial mixture between the Australian and the Tasmanian of the historic period. It is a bold claim indeed to be able to recognize an isolated cranium of an individual as being the product of the racial mixture between the Pleistocene ancestors of these two races living (according to the geological report) more than 100,000 years ago.

It is probably the assertions of Wunderly and Adam that have led Mr. Mahony to include the sentence, "The Keilor skull, which combines Tasmanian with Australian characteristics, supports the theory that Tasmanians once occupied the Australian mainland", in his admirable survey of the whole question of the antiquity of man in Australia. From Australia it is postulated that the Tasmanians passed by way of the Bass Straits Islands into Tasmania. Perhaps, therefore, it would be well to point out that, altogether apart from the question of race mixture already mentioned, there are several other difficulties in the way of accepting this hypothesis. If Tasmanians and Australians had inhabited continental Australia side by side and had fused their races in Pleistocene times, it must be explained how it came about that the Tasmanian when first encountered by the white man had no dog, although the Australian had, even at the dawn of his story, dogs in plenty, for fossil dingo bones occur in Australia. No remains of the dingo, living or fossil, have ever been found in Tasmania or in the Bass Straits Islands; yet it is a historic fact that the Tasmanians eagerly seized on the cur dogs of the white man to assist them in their food quest. How came it that the Tasmanians remained ignorant of such familiar and important cultural developments as the use of the throwing stick, the stone-pointed spear, the boomerang and the shield, familiar enough and of widespread use in Australia?

The National Museum and its director are to be congratulated on having placed on record the first really well-authenticated example of human remains, assignable to a definite geological horizon, that has so far been brought to light in Australia. Here we have a genuine human document of first-class importance. The skull is safe in the custody of the National Museum, and it is much to be hoped that all the other human fragments will be placed in its permanent collections. There will be many opportunities for further examinations of the skeletal remains by anthropologists, and meanwhile it would perhaps be better to accept them as permanent documents rather than to assume that the conclusions drawn from their first examination are necessarily the final ones.

COMPETITIVE RUBBER PLANTS*

By G. MARTIN

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FAR more plants contain rubber than is generally realized, but few contain enough to make extraction worth while. For example, the dandelion (*Taraxacum officinale*) is typical of the plants in Great Britain which, on bruising, yield a latex or milky fluid containing rubber; but the milk contains much more resin than rubber, and the latter only amounts to about 0·2 per cent of the plant.

The Russian dandelion, kok-saghyz, is similar in general appearance to English dandelions, but contains a much higher proportion of rubber, usually about 10 per cent. Experiments on the cultivation of kok-saghyz are being made in Great Britain, under the general direction of the Royal Botanic Gardens, Kew, as well as in other parts of the Empire and the United States, but it will be difficult, for the time being, to spare in Great Britain the tens of thousands of acres of good agricultural land which would be required to produce 1,000 tons of rubber a year, which is only 1 per cent of our imports prior to 1939.

The rubber-bearing plants of Great Britain are few and insignificant compared with those in other parts of the Empire. According to a report of the Imperial Agricultural Research Institute of India, there are in that country 268 species of plants which are stated to contain rubber. A list of rubber-bearing trees, bushes and plants in Africa, recently prepared by

* Substance of a paper read before the Royal Society of Arts on December 14.

the Imperial Institute, contained the names of 137 different species. Rubber-bearing plants also occur in Northern Australia, Ceylon and the West Indies. Although it would appear that the Empire is rich in rubber-yielding plants, most of them yield a complex mixture of vegetable substances of which rubber forms only a small percentage. No product containing less than 10 per cent is likely to be of value as a source of rubber, and even this proportion raises difficulties. This is unfortunate, as several plants yield copious supplies of latex, the solid content of which contains between 10 and 20 per cent rubber hydrocarbon. Probably the best known of these plants is the bush *Euphorbia tirucalli* and other species of Euphorbia in South Africa. One tapper can collect about two gallons of Euphorbia latex a day, which is equivalent to about 6 lb. of solids containing, at the most, 1 lb. of rubber. The most expensive item in the operating costs of rubber production is tapping and collection, and more than ten times the labour force is required to produce the same weight of rubber hydrocarbon from Euphorbia sp. as from plantations in the East. In addition, the rubber hydrocarbon of Euphorbia is mixed with six or seven times its weight of vegetable resins which make it soft and difficult to vulcanize without purification. The usual method of purification is to extract the resins with a solvent, such as alcohol. The purified rubber is of fair quality, and can be used in association with better rubber for many purposes. The mechanical difficulties of purification are, however, considerable and have not yet been overcome on a large scale.

In view of these difficulties it is probably easier and more economical in man-power and materials to find uses for the unpurified product in directions where the strength and elasticity of rubber are only required to a mild extent. This is the policy which has been pursued in Great Britain in connexion with the utilization of Niger paste, which is the coagulated latex of *Carpodinus hirsuta*, a vine widely distributed in West Africa. The paste contains little over 10 per cent rubber hydrocarbon, but intensive investigations by a number of organizations have indicated directions in which it can be used without purification, and which will save a corresponding proportion of good rubber for important purposes.

The rubber-bearing plants of importance in the present emergency yield products containing at least 75 per cent hydrocarbon, and some of them between 85 and 90 per cent, which is almost as pure as rubber produced on the Eastern plantations. Reference should be made, however, to a tree, *Ficus vogelii*, widely distributed in the forests of West Africa, which yields a product containing 50 per cent rubber hydrocarbon. Single trees furnish as much as 10 lb. of solids annually. The product is too impure for the more exacting uses of rubber, and, prior to the present emergency, there was no market for it. It can be used, however, in manufactures where a high proportion of rubber is not required.

The source which dominates all others is, of course, *Hevea brasiliensis*, which is a large tree about 60 ft. high, generally grown from seed, and is not ready for tapping until five years after planting. The trees are planted about 100 to the acre, and each mature tree yields about 5 lb. of rubber per annum. Some trees yield much more than this, and by grafting the buds of large yielders on to a suitable stock, it has been possible to develop progeny which yield more than 1,000 lb. per acre. The trees are tapped by removing a shaving of bark from a portion of the circumference. Immediately the cut is made, rubber milk or latex commences to exude and slowly flows over the cut surface into a cup attached to the tree. Each tapping yields about 3 oz. or more of latex, containing about 1 oz. of rubber. One tapper can tap about 300 trees per day, and so obtains about 15 lb. of rubber. The latex is transported to the estate factory, where the rubber is separated by adding an acid. The coagulum is then passed through mangles and finally dried either in air or in smoke.

The outstanding advantages of Hevea as a source of rubber are the large yield per acre, the low cost of collection, the low maintenance costs and the ease with which rubber of the best quality is separated from the latex. On the other hand, Hevea takes many years to reach maturity, and each individual tree then requires the attention of a tapper at intervals of a few days, and it is only because yields are high and labour is cheap that rubber can be produced at about 6*d.* per lb. After the latex has arrived at the factory and can then be handled on a large scale, the cost of manufacture is extremely small.

In the case of a small plant, such as kok-saghyz, it is possible to envisage a cheap annual crop based on mechanical cultivators, harvesters and mass-production factories. The retail price of beet sugar suggests that dandelion farms, supplying central factories, may be able to produce rubber at 6*d.* per lb. so long as yields are good and the technical side runs smoothly. Yields are not yet good enough in a strictly competitive market, and factory treatment requires further study.

The difficulties involved are illustrated by the fact that guayule, a product of the bush *Parthenium argentatum* which can be grown and treated like kok-saghyz, has struggled along for twenty years, receiving intense scientific and practical study in California and is still unable to compete with Hevea. Guayule rubber is, however, a much more resinous product than kok-saghyz and the bush is rather difficult to cultivate, so that the slow progress of guayule is not a satisfactory guide to the rate at which developments may be expected in kok-saghyz.

A considerable amount of attention is now being devoted to a woody climber, known as *Cryptostegia grandiflora*, which is a native of Madagascar, but grows like a weed in northern Australia, in various parts of India, in Florida and the West Indies. The Americans think so highly of this plant that they have recently arranged to plant 100,000 acres in Haiti. A large area has also been planted in India, and experiments are in progress in Australia. The chief advantage of this plant is that it grows about 6 ft. in the first year, forming a stem about 1 in. in diameter, which is then ready for tapping. It can be planted 10,000 to the acre, is not exacting with regard to climate or soil, continues to thrive when cut and produces an abundance of seeds which are very fertile. The rubber is not quite as good as that from Hevea, but contains about 75 per cent hydrocarbon and can be used satisfactorily for practically all purposes. The method of tapping most favoured at the moment is to tie together the ends of, say, 12 shoots, cut off about 1 in., and then immerse them in a small container. A few drops of latex fall from each shoot and there remains behind a small button of rubber on the cut surface, which is subsequently removed. Estimates of yield per acre vary between

200 and 750 lb. per annum, but estimates have a habit of not being reached in practice, and experience at present is very limited.

Other sources of rubber were intensively developed thirty years ago and have only faded into the background because of the economic predominance of Hevea. Some of them are large trees like Hevea, some are vines and others are shrubs. They all yield reasonable amounts of good-quality rubber and are being exploited to-day in so far as labour is available.

The most important of the trees is *Funtumia elastica*, which is widely distributed in the forests of west and east tropical Africa. Under forest conditions, it is a large tree with a straight trunk and smooth bark and does not branch until it reaches a considerable height. The usual method of tapping is to remove a small vertical channel of bark, the tapper, by means of ladders and slings, climbing to a height sometimes of 60 ft. As he descends he makes inclined incisions, joining the main channel, and so forming a herring-bone pattern on the tree. The latex exudes and flows along each of these side-channels and down the main channel into a small receptacle attached to the tree near its base.

When Hevea is tapped, the cut surface remains vital, and, on removing a fresh shaving a few days later, the latex again flows and the irritation of continuous tapping causes the flow of latex to increase. This is known as wound response. In the case of Funtumia, the lower edge of the cut dries up and suffers from die-back, so that in order to obtain more latex it is necessary to remove a very thick shaving of bark or to tap in an entirely different position. This eventually results in the death of the tree. Ingenious methods have been devised to overcome this difficulty, but they do not appear to be universally successful. Whatever method is employed, the first tapping yields the most latex, after which the yields rapidly decrease, even when an interval of several months elapses between each tapping. The amount of rubber obtained at the first tapping is usually about 4 oz., so that in order to obtain 10 lb. of rubber, which is the minimum daily output of a tapper in Malaya, it is necessary for one man to tap forty Funtumia trees. In view of the height to which these trees are tapped, and the fact that one acre of forest may contain only two or three trees, it is impossible for wild Funtumia rubber to compete with plantation Hevea.

In the early days of the rubber-growing industry, it was urged that since Funtumia trees were so widespread in Africa, it was the ideal tree to grow on plantations in that country. The argument had considerable appeal; but tapping difficulties and the poor yield, with consequently higher costs of collection, were fatal, and most of the plantations were eventually abandoned. Those which have not been destroyed are proving of value in the present emergency, but so far the problem of economic production remains unsolved, and there is no indication that after the War the exploitation of these trees will be continued. The rubber is of excellent quality, but not quite so good as Hevea rubber.

Another tree which attracted much attention in the early days is *Manihot glaziovii*, more popularly known as ceara. It is a smaller tree than Hevea and can be planted more densely. Whereas Hevea plantations usually have 100 trees or less per acre, ceara plantations have about 300. The tree is also less exacting with regard to climate and soil. This suggested to the early planters that the ceara tree might be grown in localities where the conditions were not favourable to Hevea, particularly in parts of Ceylon and in East Africa. The tree grows very quickly from seed, and can be tapped after two years. This is of great interest in the present emergency, in which the development of quick sources of rubber is of strategic importance. It is only fair to point out, however, that no authoritative information is available about the yields of young ceara or about the quality of the rubber. The tapping of young trees with thin bark, small surface and poor yields presents considerable difficulty and has not been studied as a commercial proposition.

Even the mature ceara tree is not easy to tap, and the yields are so low in the dry areas that insufficient latex exudes to overflow into a receptacle. A higher yield is obtained in the more humid areas, but an annual yield of 200 lb. per acre, containing 300 trees, is above the average and compares unfavourably with Hevea. Very high yields are recorded for individual ceara trees—as much as 10 lb. per annum. This corresponds to 3,000 lb. per acre, if it is possible to develop reliable, high-yielding offspring, but the low yield is not the only factor operating against future development. The ceara tree does not stand up well to tapping, particularly in the dry areas. So late as 1914 it was reported from Ceylon that no method of tapping the tree was known which did not cause death. In addition, the bark of the ceara tree has a hard outside layer, which quickly blunts the tapping knives, and which also tends to separate from the inside layer which contains the rubber-bearing vessels. It is usual, therefore, first to remove the outside layer from the area which has to be tapped, and then to employ a conservative system of tapping so as not to injure the tree.

There are a number of abandoned ceara plantations, particularly in East Africa, which have now been reopened, but prospects after the War do not appear promising.

The most important indigenous sources of rubber in Africa are the numerous woody large vines, widely distributed in the tropical forests. The principal genera are Landolphia, Clitandra and Carpodinus, containing numerous species. The best sources of rubber are confined to four or five species of Landolphia in West Africa and a similar number in East Africa, together with a little Clitandra and Carpodinus. The vine rubber from these sources is of excellent quality, that from the Landolphia spp. containing about 90 per cent hydrocarbon in West Africa and 85 per cent in East Africa.

In the rubber boom of 1910, when the total output from all sources in Africa reached 20,000 tons, vines were recklessly tapped and, in many cases, completely destroyed. A vine requires about ten years to grow from seed and about five years to grow again when partially cut down, so that the damage done during the rubber boom is by now largely repaired; but the balancing of productive capacity against probable useful life is still important, particularly as there is a risk of obtaining much rubber at first and none during the rest of the war period.

A usual method of tapping is to cut the bark at intervals, and climbing among its twisted branches for the purpose is regarded as hard and dangerous work. The yield is 1–8 oz. of rubber per vine, and

after several months, when the cuts have healed, the treatment can be repeated. An area of forest containing two vines per acre is regarded as a rich source of rubber, so that 1 lb. of rubber per acre is an excellent yield. A cautious tapping treatment would probably have little effect on the life of the vine; but the tendency is to get as much rubber as possible with the least effort, so that it will not be surprising if the yield of vine rubber reaches a peak and then diminishes as the sources of supply are destroyed.

In normal circumstances vine rubber cannot hope to compete with plantation rubber produced in the Far East, chiefly because the harvesting of the rubber involves the same type of operations with much smaller yields and more difficult conditions. This comment does not apply, however, to some species of Landolphia, etc., particularly *Landolphia thollonii*, which, growing in poor soil in open country, does not develop into a climbing plant, but throws out long underground stems ramifying in all directions, with small tufts of foliage above ground at irregular intervals. The bark of these stems contains about 15 per cent rubber and in some areas, particularly in French Equatorial Africa, there is such a mat of stems that every footstep covers a treasure of buried rubber. The stems have been known to reach sixty yards in length, and as they are only a few inches below the surface they are not difficult to gather and cut off near the tap root. They are then dried a little to coagulate the latex, cut into convenient lengths and smashed with a mallet so as to facilitate the removal of bark. Finally comes the laborious operation of pounding the bark, so as to convert it into a powder and mass the rubber together into small lumps. It is estimated that 15 hours beating is required to produce 1 lb. of rubber. Since the supply of labour is limited, such a process cries out for mechanization. One method is to run the bark for some time through heavy grooved mangles, that is, ordinary rubber washing machines; but these machines are difficult to obtain under present conditions, and there is only a small output for a given input. A study of the problem in Great Britain and in South Africa suggests that the most suitable type of grinding machine is a rod mill, consisting of a revolving cylinder containing loose rods which rise and fall and rotate as the cylinder revolves. The mechanical method is essential to the success of several of the new sources of rubber, such as the Russian dandelion, root rubber, the bark of vine rubber from which the latex does not flow freely and even for bark shavings obtained on plantations in Ceylon, which were often thrown away because they contained only 5 per cent rubber. On a large scale it should be a fairly cheap method of obtaining rubber, particularly if a continuous process can be devised.

A survey of competitive rubber plants would not be complete without a reference to Castilloa and *Ficus elastica*. Both have been cultivated on a small scale in different parts of the Empire, but on account of small yields, and for other reasons, cannot hope to compete with Hevea after the War. The whole trend of this paper shows that trees which have to go through the same cycle of operations as Hevea in order to obtain rubber are hopelessly outclassed by the latter with regard to yield, quality and ease of treatment. Small plants may be more successful, however, because their cultivation and treatment can be mechanized, and operations can be based on an annual instead of a daily cycle.

OBITUARIES

Prof. W. W. C. Topley, F.R.S.

WILLIAM WHITEMAN CARLTON TOPLEY was born in 1887. He was educated at the City of London School, St. John's College, Cambridge, where he obtained a first class in the Natural Sciences Tripos, and St. Thomas's Hospital, London, and qualified in medicine in 1909. In 1910 he was appointed director of the Pathological Department at Charing Cross Hospital, and started a private practice in Harley Street.

In 1914 he accompanied Colonel Hunter to Serbia, where an epidemic of typhus was raging. There is little doubt that his sensitive nature was stirred by the tragedies he saw in a community affected by infectious disease, and that this experience decided his main line of research, namely, an experimental study of the factors involved in the spread of epidemic disease. He returned to England in 1916 and rearranged his life so that he could devote himself entirely to research and teaching. He quickly set to work and showed from the very outset how hard and fast he could work, a characteristic which has staggered all those who have followed his activities.

In 1919 Topley's researches were attracting much attention, and he made a preliminary report of them in the Goulstonian Lectures. In 1922 he accepted the chair of bacteriology at Manchester, and for five years rigidly limited his interests; with a small group working devotedly around him he studied the spread of epidemic disease in mice.

In 1927 he became professor of bacteriology and epidemiology at the London School of Hygiene. Here, in association with Greenwood and other colleagues, he carried on his researches, the results of which and the views which emanated from them he wrote up in his clear, forceful and interesting style. He delivered the Milroy and Harben Lectures, and in 1930 the importance of his work was recognized by his election to the Royal Society. In addition, he threw great energy into the academic diploma course of bacteriology which he had started, and wrote with G. S. Wilson a large text-book of bacteriology. He began, moreover, to take an interest in committee work, and allowed his scientific interests to develop more widely by seeking contacts with scientific men working in other branches of biological research.

In a very short time Topley was serving on the Council of the Royal College of Physicians, the Council of the Royal Society, the Medical Research Council, and the Animal Diseases Committee of the Agricultural Research Council. His book had been an outstanding success; and scientific workers from every side were asking for his time, help and advice. He responded to these added burdens by increasing the tempo of his work and thought, by working harder, and by arranging and rearranging his mode of life so as to attain maximum efficiency.

In 1939, certain that war was coming, Topley was determined to prevent, if possible, the tragedy of infectious disease spreading through the community. Largely due to his efforts, the Emergency Public Health Laboratory Service was set up in Great Britain to combat this danger. At the same time he gave his help to a group of pathologists who, as a result of the experiences of air-raiding in the Spanish War, were pressing for an effective blood transfusion service for the London area, and the London Emergency Blood Supply Depots came into being. As

the Medical Research Council was administering both these services on behalf of the Ministry of Health, he worked during 1939–41 at the Council's head office, developing both services and engaging himself in a host of other war problems with which the Council was concerned. In addition, he was available to all and every scientific worker who, in the stress of war, questioned whether his services were properly employed, or required moral support for carrying on. Even in the midst of all this work, he gave the Croonian Lecture before the Royal Society in 1941, entitled "The Biology of Epidemics". Those who heard him may have felt that this was the swan song of his research experience, but none thought that it was the last time they would hear him, in public, develop a story in his clear, logical and arresting manner.

In 1941 the Agricultural Research Council asked Topley to become its secretary. Few would have considered such a change or such an exacting post unless prepared to sever their old scientific life completely, but Topley could never view it in this light. He believed that if he but drove himself harder, he could master his new duties and keep his old interests and friendships alive. How well he mastered his new work in the two years allotted to him it is not yet possible to judge, but it is clear that revolutionary changes in veterinary research were impending. How anxious he was not to lose his old interests is shown by the very active interest he took in the part that he considered the University of Cambridge should play in the medical, veterinary and bacteriological sciences.

As a man in science, Topley was outstanding. The mainspring of all his activity was devotion to science. Disregarding, save for a caustic remark, those whose scientific integrity was in doubt, he gave without stint his sympathy, understanding and help to all other workers. No matter what it cost him, nothing was too much trouble if his help would increase a worker's efficiency and devotion. He was probably happiest when the young men of science sought his aid, for he knew that the future of science was in their hands and that the young were slightly scared of him. He did not understand why, and nor did they, when after a short time they always spoke of him as "Bill". A talk with him was not easily forgotten, for the ideas bubbled out of his bold and original mind, and he left a sense of exhilaration and enthusiasm which lessened difficulties and made the goal so much more worth the effort. He had that rare quality of brain which, though severely critical, was essentially constructive. He stimulated the hesitant, and spurred on the keen. His honesty of purpose and loyalty continually drew new friends to him, and he excelled in bringing groups of workers together. Frequently responsible for the inception and planning of a research, and for the guidance of the worker throughout, his generous nature allowed no recognition of the fact in the published work.

No one would have used so profitably (or enjoyed more) the period of reconstruction after the War, to further his wide scientific interests and the welfare of scientific workers and their technical assistants. This has been denied him, but his influence lives in so many that much that he desired must come to pass.

As a man, Topley was at times delightfully simple, and at others curiously complex. He had a strong sense of loyalty; nothing gave him more pleasure than his election to an honorary fellowship of his old College, and no man was more staunch to his friends. Yet he feared such loyalties lest they should hinder his service to science. He enjoyed recognition and praise for his election to the Royal Society, and the award of the Royal Medal of the Royal Society delighted him, yet he shunned these delights lest an undue taste for them should chance to warp his judgment. Severely critical as he was of others, he was much more critical of himself. No one was less in need of self-criticism, but this may have been responsible for the curious complexity which he sometimes exhibited.

Those of us who visited him in his home believe we hold the happiest memories. Topley was still the wise man of science, arguing and discussing; but he allowed more latitude to his exuberance, to his puckishness of mind, and he fitted so well into the delightful home background which his wife so unselfishly created for him.

Topley died suddenly at work in his office chair on January 21. Thus passed away, in a manner which he himself would have chosen, an outstanding man of his generation. A. N. DRURY.

Sir Aurel Stein, K.C.I.E., F.B.A.

SELDOM can there have been an instance of a task pursued so constantly, so indefatigably and with such zest through so long a life as by Sir Aurel Stein, who died on October 26, aged eighty. Oriental research, he acknowledged, had claimed him from his student days. More than that, the campaigns of Alexander the Great had fascinated him from first to last, so that he found a special satisfaction in following in his tracks, and, in some of his latest writings published since the beginning of the War in the *Geographical Journal*, turned again to the unravelling of his campaigns.

This pursuit of Oriental research and this fascination felt for the most dramatic incident in the intercourse of East with West, personal though they were, corresponded to a general urge in a period which has probably reached its close, so that, while from one point of view it is possible to regard his career as the fruit of his early self-preparation by work in the study and of persistent concentration on his aims, from another it was one of the main fruits of the impetus given to archæological studies by the viceroyalty of Lord Curzon and the reform of the Archæological Survey of India under Sir John Marshall. Though Stein was born in Budapest and educated in Vienna and Germany before first coming to England, his field-work was made possible by the Government of India.

It was under the Punjab Education Department that Stein first entered Indian Government Service, and while at Lahore he gave his spare time to the translation from the Sanskrit of Kalhana's "Chronicle of Kashmir" (Rājatār angīnī). Meanwhile, the vast regions of Central Asia were attracting explorers from many lands. The journey that claimed most attention at the time was that of the Swede, Sven Hedin, during the years 1893–97. This was undertaken mainly as geographical exploration, but he also carried out some archæological investigations in eastern Turkestan and on the Keriya River east of Khotan. It was, however, the linguistic interest of some birch-bark manuscripts brought back from Khotan in 1893 by Dutreuil de Rhins, to which Bühler directed Stein's attention, that led Stein in 1897 to plan his first journey to Central Asia. He found that antiquities were being brought in to Sir

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Further particulars may be had from the Agent-General and Trade Commissioner for South Australia, South Australia House, Marble Arch, London, W.1, England, who has reports of the Institute, copies of the calendars of the University of Adelaide and copies of the Institute of Medical and Veterinary Science Act, 1937, and regulations.

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(Signed) C. T. CH. DE CRESPIGNY,
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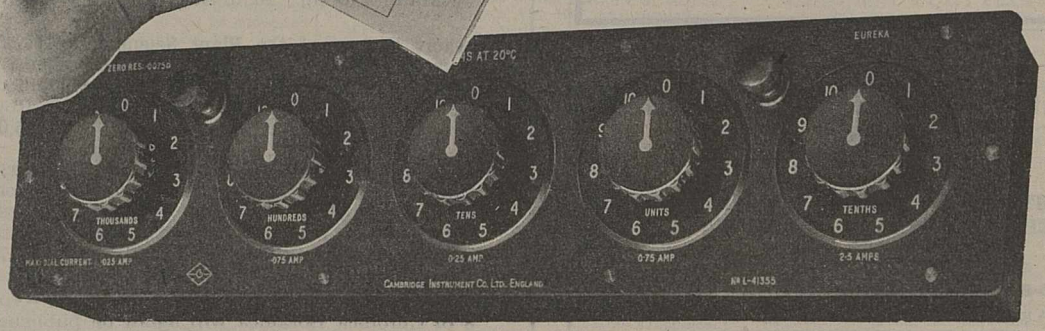

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George Macartney, then Consul-General at Kashgar, for transmission to Calcutta at the instance of Hoernle, who greatly encouraged Stein in his design of investigating their source. It was therefore from the first an archæological rather than a geographical exploration on which Stein started. His first expedition to Central Asia was delayed until 1900, when he set out via Gilgit and Kashgar for a year in the region of the Taklamakan Desert.

It is impossible even to sketch here the course or routes of Stein's three Central Asian journeys. They have been fully reported from several points of view by Stein himself, in narrative volumes, in full-length reports and also in two excellent and compendious sketches, a paper given before the Royal Geographical Society with the title "Innermost Asia: its Geography as a Factor in History", and published in the *Geographical Journal* of May and June 1925, and the section on his own archæological work in Central Asia which he contributed to an account of the work of the Archæological Survey of India published by the India Society in 1939 under the title "Revealing India's Past". Here we can only attempt a general estimate of his method and its fruits. His research was historical and directed especially to the solution of one historical problem—the elucidation of the relations between China and the West, the capacity of the trade routes, the nature of the cultural influences passing along them, the periods which saw these routes most used and the causes which led to the abandonment of them and of the settlements along their course. A striking fact is that whereas he started out with the idea above all of tracing the eastward expansion of the cultural influences of the Hellenistic West, and of India, he came more and more to be impressed by the purpose, organizing power and tenacity of the Chinese who opened these routes and so long maintained them. Hellenistic influence was found to end in the early years of the fourth century A.D., but Indian influence was long continued by the passage of Chinese pilgrims to the Buddhist shrines in India. For the early period his most important discovery was of the elaborate organization of a Chinese *limes* in the Han period, protecting the route through the Tunhuang Oasis and beyond from the incursions of the nomads of the steppe to the north; and of the route, across the bed of the dried-up inland Sea of Lop, connecting this region with Kucha without passing through the relatively exposed Turfan region.

For the history of art Stein's most important finds were the textiles of the Astāna cemetery and the cache of paintings and manuscripts in the walled-up chamber at the Caves of the Thousand Buddhas, near Tun-huang. These with the wall paintings, transported from the sites of Bazaklik, Murtuk, Miran and elsewhere to the new Central Asian Antiquities Museum at New Delhi, have added so much to the material for the study of Buddhist painting in China in the T'ang period as to revolutionize it. Unfortunately, the wall paintings, though listed by Dr. Andrews in his Catalogue of 1933, have not yet been published, and are therefore not yet fully available to students. The Tun-huang paintings, on the other hand, have been fully catalogued by Mr. Arthur Waley, and the whole series was mounted at the British Museum and a great part exhibited there in 1914 on the occasion of the opening of the King Edward Building. The collection was afterwards divided between the British Museum and the Government of India for the Museum at New Delhi, but in 1921 the two Museums brought out jointly a portfolio of reproductions in colour of selected examples from both collections, with an introduction by Laurence Binyon and descriptions by Stein himself. Their importance has therefore been fully realized, though much work remains to be done on them from the stylistic and iconographical sides.

Stein went no more to Central Asia, except for a brief and abortive journey. But, though prevented from following up one line of research, he started on the archæological survey of another great region. He had already traversed Sistan on his return from the third Central Asian expedition, and he now began a series of journeys which eventually covered the whole of that great bridge between the civilizations of East and West which leads from Mesopotamia, over the Iranian plateau, through Afghanistan, and so down into the Indus Valley; or across the Oxus into Turkestan. During all this period of more than twenty years he had two bases, his camp in the Kashmir highlands, and Corpus Christi College at Oxford, where the late president, Dr. P. S. Allen, the Erasmus scholar, always welcomed his friend on his visits to England. Of these journeys, the most important were the tours of the chalcolithic sites of Baluchistan in 1926–27 and 1927–28, and, since 1930, in south-western Persia. His accounts of the first were published by the Archæological Survey of India in its series of Memoirs; the later journies undertaken after his retirement from its service were chronicled in two large volumes. He also made expeditions to the Upper Indus region and followed the Roman frontier *limes* in Mesopotamia.

In all this wide area, Stein followed the course of ancient trade routes with his trained eye and indefatigable zeal. His pertinacity and complete absence of fear carried him over the wildest and most forbidding country. Indeed he was most truly himself when, with his surveying staff and train of porters alone, he viewed from some almost inaccessible spot ancient tracks and, as it were, a whole panorama of past history. Where written texts could illumine the records which he found on the ground, all the evidence which he found fell into a pattern. But in a region of such a long and complex history as he was now exploring, it was not to be expected that Stein should have been able to reach conclusions as definitive as in Central Asia. His explorations have mapped the sites which need to be studied: they call for the methods of the trained excavator and much comparative study before they can yield all their evidence.

Aurel Stein loved solitude. He was happy in a study, but happier in the wide open spaces. When he appeared in the lecture room, as he did in the United States at the Fogg Museum and elsewhere, and in London especially in the Royal Geographical Society's rooms, it was the nervous force of his small compact body and his piercing eye which impressed one with his indomitable spirit even more than the substance of what was said. At over eighty he was hoping to embark on a fresh field of exploration from Kabul, where death claimed him. It was his wish that his body should rest amid the beautiful scenery of Kashmir.

BASIL GRAY.

Dr. M. Radford

THE passing of Dr. Maitland Radford, medical officer of health of St. Pancras, at the age of fifty-nine, is of more than local or professional significance. He was a rationalist, reared in a progressive if not

revolutionary atmosphere, with Shaw, Wells, William Morris and Bradlaugh as friends of his family. He was a nephew of Graham Wallas, whose influence he always gratefully acknowledged. Educated at Abbotsholme and University College Hospital, his career in public health was that of a successful and efficient sanitarian. But, as a close colleague of his has written, "he was not a man to allow the local trees to obscure his vision of the public health wood, or as he might have said, the public health jungle".

Widely and deeply read in literature, philosophy and economics, it was perhaps in health education in its widest sense that he found great satisfaction. The Central Council for Health Education, of which he was vice-chairman, owes much to him. But it was not the leaflet or the poster or the film which interested him most. It was rather the plan, the purpose of it all, the thought of the human personality rather than its physical frame.

He was a man of principles and ideas, preferring the long to the short view. Modest and urbane in manner, he was frank in the confession of his doubts, and both adamant and passionate in defence of principle. He was one of the few men of whom it can truthfully be said that nothing would induce him to say and do anything which he did not believe to be right. His defence of the secular approach to moral problems at a recent conference on venereal disease, at which the Archbishop of Canterbury was the principal speaker, will long be remembered by those who heard it.

In conference or conversation—he preferred conversation—the ideas simply tumbled out, or to be more accurate, shot out. Some he pursued himself, others he left his colleagues to pursue. Strange though the country through which they led the pursuer, they were worth pursuing. He prodded the conventional—but oh, so gently. He flicked the obstinate with a wit as innocent as it was penetrating. He 'rollicked' the reactionary with a mirth that was infectious. He was, above all, a thinker; and with the world as it is, that marked him out and adds to our sense of loss. C. HILL.

WE regret to announce the following deaths:

Dr. Carl Bonhoeffer, successively professor of neurology at Königsberg, Breslau and Berlin and one of the editors of the *Monatschrift für Psychiatrie, Allgemeine Zeitschrift für Psychiatrie* and *Zentralblatt für Neurologie und Psychiatrie*, aged seventy-five.

Mr. Christopher Dalley, president of the Institute of Petroleum, an authority on petroleum engineering, on January 27, aged sixty.

Dr. A. Stansfield, emeritus professor of metallurgy, McGill University, on February 5, aged seventy-two.

NEWS and VIEWS

Scientific Terminology

THE enormous waste of human time and energy, nay also of human life, that has been caused by the use of wrong or vague words, and the misuse of good words, is well known to students of human thought through the ages. Many words have changed their meanings in the course of time, and new words have been adopted with ambiguous or multiple connotations. Though one would hesitate to suggest that the legal profession has been the chief perpetrator of such intellectual delinquencies, and of their *sequelæ*—for the theologians and philosophers must have run them very close—there is no doubt that the loose drafting of governmental Bills and Regulations, even up to the present day, has caused great confusion and, incidentally, served to redistribute wealth in a unilateral direction. As Mephistopheles remarked, "Mit Worten lässt sich trefflich streiten, Mit Worten ein System bereiten, Von einem Wort kein Iota rauben".

To-day most new words originate in the sciences or their applications, and many of them have been condemned or criticized owing to their lack of precision, their hybrid etymology, their ugliness or unwieldiness, or because they signify something different from identical or similar words used in common parlance. It has often been deplored that in Britain we have no institution or high authority to adjudicate on new words, like the French Academy does for France, albeit often with much delay; but there seems to be no reason why the scientific world should not take the bit between its teeth and appoint its own authority for rectifying bad words, including spelling, devising new words or deciding between rival suggestions. An 'omnibus' body, like the Royal Society, is clearly indicated to assume such a task. Through *ad hoc* subcommittees for groups of sciences, assisted by a few language experts, it could provide authoritative guidance, if not compulsory ruling, for scientific research workers, who are seldom as good at word-building as they are at 'things'. The main committee might also attack the problem of an international auxiliary language for use in science and technology.

Photographic Terminology

THE above reflexions arise from a perusal of a letter addressed to the scientific Press by the editor of *Photographic Abstracts*, entitled "Microphotography and Photomicrography, and other Terminological Inexactitudes". Although these two terms, signifying the production of very small photographs and the photographic reproduction of very small objects, respectively, are clear enough to experts, they are confusing to other people, and one can support the author's plea for the standardization of these and similar terms. 'Micro-' and 'macro-', he suggests, should be used in photography with a definite quantitative meaning only, and one might go farther and suggest that when these prefixes are used for scientific words, they should bear a precise quantitative meaning, as in microgram and microhm, leaving their vaguer signification to popular words like microcosm, macrocosm and perhaps 'microcookery' (the cooking of war-time rations). The word 'radiogram' is one that needs immediate attention, as it has three distinct meanings: (1) a combination of radio-receiver and gramophone, (2) a telegram transmitted by radio, and (3) an X-ray photograph (also called a radiograph or a skiagraph). Probably (3) would be best for scientific use. The word 'radio' itself might be banned from scientific writing, for, at least etymologically, it might refer to any kind of radiation. But such difficulties as these are not to be solved offhand; they would best be considered by an authoritative body, as suggested above.

Water Resources of Great Britain

MR. H. U. WILLINK, Minister of Health, in a statement in the House of Commons on February 10, said that the Government proposes as part of its general reconstruction programme to introduce legislation making possible further Exchequer assistance for the extension of piped water supplies in rural localities. This will apply also to sewerage in such areas. A White Paper is in preparation outlining the Government's general proposals with regard to water; these will include provision for an adequate scientific assessment of resources and for the control and co-ordination of their use and distribution. It is hoped to issue the White Paper about the same time as the introduction of the Bill. It will deal with schemes on national lines.

Standardization of Non-Ionizing Radiations

THE Medical Research Council has appointed the following committee to advise and assist in promoting the quantitative study of the non-ionizing radiations, particularly in relation to their medical applications: Prof. H. Hartridge (chairman), Mr. P. Bauwens, Dr. R. B. Bourdillon, Mr. E. Rock Carling, Prof. J. A. Carroll, Mr. J. Guild (nominated by the Department of Scientific and Industrial Research), Prof. F. L. Hopwood and Prof. W. V. Mayneord (secretary). In 1928 and 1937 satisfactory units for the measurement of ionizing radiations were agreed internationally, and there is urgent need of a corresponding standardization for the non-ionizing radiations. Under this heading will be included infra-red, visible and short-wave wireless radiations, but it may be found advisable to deal also with ultra-violet and ultrasonic radiations, since none of these was covered by the earlier recommendations.

Transmission and Distribution of Electricity in Mines

A PAPER on this subject was read before the Institution of Electrical Engineers in London on February 9 by B. L. Metcalf. In the South Wales coalfield, where approximately 16 per cent of the total output of Great Britain is raised, the transmission and distribution of electricity introduces special problems owing to the hilly nature of the country. To give some idea of the potential demand at collieries to be obtained, the load for a typical group of collieries is analysed. Some notes are included on the choice of switchgear for collieries and on the influence on this choice of the proposed amendments to the Regulations for the Use of Electricity in Mines. Information is given regarding the damage to transmission towers during the ice storm of 1940, and a proposal is made to amend the regulations of the Electricity Commissioners governing ice-loading for conductors. A new design of cross-arm for a single-circuit 33-kV. overhead line is illustrated. Recommendations are made for the standardization of equipment required for the electrification of collieries.

The magnitude of the potential colliery electrical load should be given full consideration in any plan for the generation, transmission and distribution of electricity in any industrial mining area. Electrification of the collieries in any area would be simplified and cheapened by greater standardization of the sizes of units adopted. Standardization could be applied with advantage to switchgear, transformers, compressors, haulages, winder drums, transmission-line cross-arms, cable sizes, voltages, etc. The subject of pit-head generation is touched on only as it affects the general problems of transmission and distribution, but it is one which demands full and thorough technical investigation in all its aspects, and in relation to the location of washeries, existing generating stations and transmission lines, coal freights and other local industrial loads.

Man's Influence on Seismic Movements

WALTER KNOCHE has an article with the title "La Accion Humana Como Una Causa Posible De Liberar Movimientos Sismicos" in *Anales de la Sociedad Cientifica Argentina* (135, Ent. IV and V, 1–41; 1943) which suggests a number of ways in which the progress of civilization can influence earth movements. A few of these will be referred to in the following brief summary. The weight of matter transported by the great rivers and deposited at their mouths depends on the denudation which takes place, and this, in turn, depends on the nature of the soil, the presence of vegetation, and other factors which are under the control of man. Variations in isostasy in the deltas of rivers as well as in the regions of denudation are, therefore, indirectly due to human agency. Then again it is pointed out that oscillations in the earth's axis might be produced by the displacements of matter through fluvial transportation, and this latter depends on man's interference with the vegetation. Another important factor is fires which destroy vegetation and so release a considerable weight over certain parts of the earth's crust. The loss of weight on land appears as an increase in the oceans, which receive a great portion of the burnt vegetation in the form of carbon and water. The weight of great cities with their inhabitants, such as San Francisco and Tokyo, is able to originate earth movements, more especially in those regions of the earth where there is a certain amount of instability. It seems possible to conduct research on the influence of re-afforestation in mitigating the danger of denudation and devastation on the earth's surface, and in this way to estimate the extent of the human factor in the production of earth disturbances.

The Dominion Observatory, Wellington

THE report for the year ended December 31, 1942, of the Dominion Observatory, Wellington (Bull. No. *R*28) deals chiefly with time service and seismology. During most of the year the control of the time service was greatly facilitated, enabling additional check time signals to be received from Greenwich and Washington. The clocks were seriously affected by local earthquakes on June 24, August 2 and December 2, but they suffered no permanent damage. The free pendulum was frequently disturbed by local earthquakes, and investigations showed that marked changes of rate are not due to defects in the clock mechanism but are associated with one or other of the following causes: (1) violent fluctuations in barometric pressure; (2) changes in the direction of local ground tilt; (3) local earthquakes. The severe outbreak of seismic activity in the Wairarapa district on June 24, 1942, followed by severe aftershocks on August 2 and December 2, has been already referred to, and a considerable number of subsidiary shocks also occurred, six hundred being recorded at Wellington. On June 27 a shock took place the epicentre of which was near White Island. The focal depth, 230 miles, was the deepest origin so far recorded in

the New Zealand region. Another notable occurrence was a shock on November 1, centred in the south-east Tasman Sea, about 150 miles off the Milford Sound coast. Information is given in the bulletin on various other matters connected with the different seismographic stations and their instruments, on the research carried out on the distribution of earthquake activity in New Zealand, and on matters of general interest.

War and Rheumatic Fever

ACCORDING to an article in the September issue of the *Statistical Bulletin* of New York, war conditions generally favour an increase of rheumatic fever in the armed forces. This was seen not only in the War of 1914–18 but also in the present conflict, in which many cases have been reported among the younger men enlisted. Susceptible individuals are usually attacked shortly after reporting for duty. About 40 per cent give a history of infection in childhood; but in a significant proportion there is no history of a previous attack. The seasonal distribution of the cases is typical, the peak being reached in the late winter and early spring. In the great majority of cases there is a history of upper respiratory infection or of scarlet fever. In the general population, however, both in the United States and in England, there has been a decline in rheumatic fever and rheumatic heart disease during a war period, the decline being attributed to decreased amount of poverty as a result of full employment, the better feeding of children, especially the increased provision of milk, and the evacuation of children from metropolitan areas.

Names of Biological Colours

PREFACED by a brief discussion, H. A. Dade (Mycological Papers No. 6: Colour Terminology in Biology. Pp. 25. Kew: Imperial Mycological Institute, 1943. 3*s*. 9*d*. net) has provided a useful dictionary list of the names of colours, cross-referenced as to synonyms, that are or may be employed, particularly as trivial names, in biology. Appended to this is a list of the words indicative of tone or texture, and two charts which give the position of the names in relation to Ridgway's "Chromatic Scale". This should prove very useful to systematic biologists, in particular those without adequate knowledge of the Classical languages, for quite frequently trivial names supposed to be indicative of colour are incorrectly applied, and sometimes so badly that they are misleading. It is to be hoped that now such an aid is available this will not occur so often in the future.

Equilibrium Diagrams of Binary Alloy Systems

"The Equilibrium Diagram of the System Aluminium-Zinc" is the title of the first of a new series of publications which the Institute of Metals proposes to issue of up-to-date equilibrium diagrams of binary alloy systems. Each of the series will consist of the diagram reproduced on a large scale and based on the most reliable work in each phase-field, a table providing all the important data connected with this diagram, critical notes and a list of references. This initial publication, the work of G. V. Raynor, appears to satisfy all these points in an excellent manner, and whets one's appetite for the three others so far promised, on the copper-tin, copper-zinc and copper-aluminium alloys respectively. It is available from the Institute at 4 Grosvenor Gardens, S.W.1 (6*d*. post paid).

Thoughts on Reconstruction

THE April, June and September 1943 issues of the *Krisson Bulletin* contain a series of articles well designed to encourage the development of a more scientific outlook generally. The first, "A Plea for Scepticism", should encourage a more critical attitude to some of the proposals for reconstruction and particularly to political theory. It includes a useful little bibliography. In the following issue are printed eleven paragraphs of "The Universal Rights of Man" from a pamphlet by Mr. H. G. Wells to be published later. This is a development from the "Declaration of the Rights of Man". This statement of the universal rights—the right to live, protection of minors, freedom to work, right to earn money, right to possess, freedom to go about, right to know, personal liberty, freedom from violence—which are in the nature of man and cannot be changed, but could be made the basis of a new and happier way of human life, is accompanied by an appeal not to take them for granted but to work for them and to guard them. The third article, "Educated? It *is* my Business", after quoting F. Sherwood Taylor's "The Century of Science", pleads for an attempt to understand our environment and to take an intelligent place in human organization.

Announcements

DR. E. F. ARMSTRONG has been appointed chairman of a commission appointed by the Conference of Allied Ministers of Education to report on the problems involved in the supply of scientific equipment to the occupied countries when they have been freed.

THE Council of the Institution of Naval Architects has awarded the premium of the Institution for the year 1943 to Dr. J. F. C. Conn, for his paper "Marine Propeller Blade Deflection".

A RESEARCH scholarship of the value of £400 a year and tenable for two years has been offered by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a committee of the Institution of Naval Architects and it is hoped to make the award in September. Full particulars of entry, which closes on July 31, can be obtained from the Secretary, Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

THE Chancellor of the Exchequer has stated in a written Parliamentary reply that the Government, after considering a report from the University Grants Committee, has decided to maintain the provision for universities and colleges in the Estimates for 1944 at its existing level.

THE Council of the American Astronomical Society has awarded the Annie J. Cannon Prize for women astronomers to Miss Antonia C. Maury of Hastings, N.Y., for her distinguished work at the Harvard College Observatory in the early days of spectral classification. Miss Maury at the turn of the century devised her own system of classifying the spectra of the stars on the basis of detailed descriptions of their characteristics as obtained from high-dispersion spectra. These details have since been shown to have great significance in revealing the physical characteristics of the stars.

LETTERS TO THE EDITORS

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

β-Radiation from Active Phosphorus and Sodium

In order to investigate the β-radiation from active phosphorus, phosphorus pentoxide was irradiated with 5 MeV. deutrons (current approximately 40 μ A.) in the cyclotron of this Institute. A very small fraction of the sample (about 0·01 mC.) in the form of $Mg_2P_2O_7$ was placed between two foils of about 0·02 μ thickness, the preparation forming a narrow strip 7 mm. × 0·5 mm. It was then introduced into a β-spectrograph of the lens type[1] with high intensity and good resolution (in this case 1·9 per cent), and provided with a very thin foil (0·2 μ) in front of the Geiger-Müller counter. To obtain the true distribution curve, the number of particles counted must be divided by the corresponding value of $H\rho$. The spectrograph was calibrated by using the I line of thorium B, the energy of which had been determined as $H\rho = 1750$ in the semicircular spectrograph of the Institute.

If we plot $\left(\frac{N}{f}\right)^{1/2}$ against $\sqrt{1+\eta^2}$ [where $f(z,\eta) = \eta^2 \cdot \frac{2\pi y}{1-e^{-2\pi y}}$; $y = z \cdot \frac{\sqrt{1+\eta^2}}{137\eta}$; $\eta = \frac{H\rho}{1700}$] we should, according to Fermi's formula of β spectra, obtain a straight line. The Fermi diagram obtained is seen in Fig. 1. Evidently the curves are quite straight except at lower energies. For energies where $\sqrt{1+\eta^2}$ is less than 2, the experimental curves give more particles than are predicted by the Fermi formula. It is possible that this can be explained by the occurrence of scattering in the backing foil or more probably in the source itself, a process which should undoubtedly give rise to low-energy electrons. In view, however, of the thinness of the foils and narrowness of the source, this can scarcely account for the very pronounced excess of low-energy electrons in comparison with the theoretical number. According to our conceptions of the β-emission by phosphorus, this constitutes a so-called 'forbidden transition'. The Fermi formula is rather developed on the assumption of a permitted transition and, according to Fig. 1, probably cannot explain the energy distribution in this case.

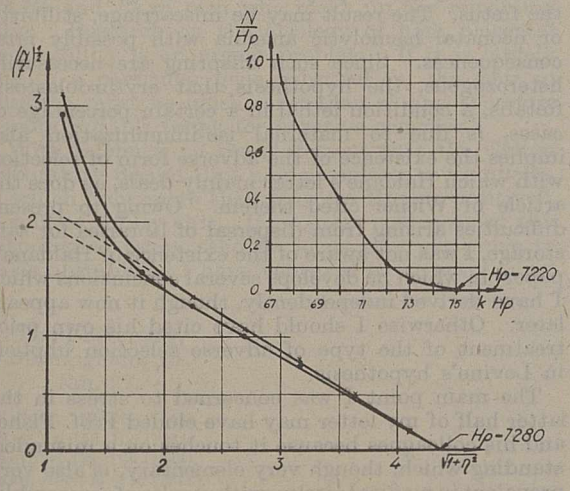

FIG. 1.

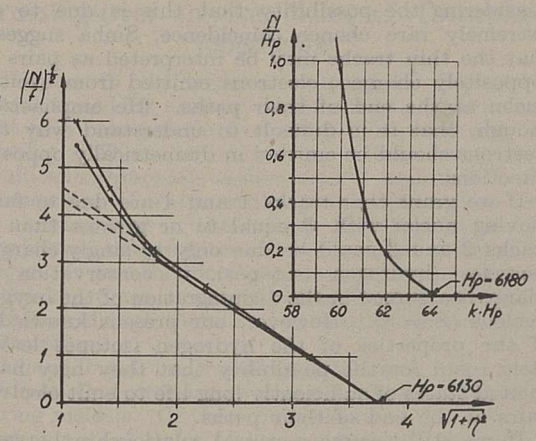

FIG. 2.

The straight part of the Fermi curve cuts the axis at $H\rho = 7280$, which fits well with the direct determination of the upper limit (corrected for the finite power of resolution) $H\rho = 7220$ or $1{\cdot}71 \pm 0{\cdot}02$ MeV., which is marked in Fig. 1. The value for the upper limit seems to be in good agreement with determinations by Lawson[2] ($H\rho = 7210$) and Lyman[3] ($H\rho = 7150$) made by the semicircular method.

With sodium, ^{24}Na, a β-radiation is emitted which also corresponds to a forbidden transition. To study this radiation, sodium hydroxide was irradiated in the cyclotron for some hours and a very small fraction of the sample in the form of sodium chloride was treated as before and introduced into the β-spectrograph. After correction for the falling off of the intensity due to the disintegration ($T = 14{\cdot}8$ h.) the two Fermi curves in Fig. 2 were obtained, where the upper limit is also marked. Apparently the Fermi curve is similar in shape to that for phosphorus, with more low-energy electrons than might be expected from the theory of permitted transitions. When $\sqrt{1+\eta^2}$ is greater than 1·8, the curve is, however, a straight line and cuts the axis at $H\rho = 6130$, where the direct determination gives $H\rho = 6180$ or $1{\cdot}41 \pm 0{\cdot}02$ MeV. This value agrees well with the value obtained by Lawson[2], $H\rho = 6150$, but disagrees with that obtained by Kurie, Richardson and Paxton[4] with the cloud chamber (1·7 MeV.).

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[1] Siegbahn, Kai, *Ark. f. Mat., Astr. o. Fysik*, **30** A, No. 1 (1943).
[2] Lawson, J. L., *Phys. Rev.*, **56**, 131 (1939).
[3] Lyman, E., *Phys. Rev.*, **51**, 1 (1937).
[4] Kurie, Richardson and Paxton, *Phys. Rev.*, **49**, 368 (1936).

Nuclear Disintegrations Produced by Cosmic Rays

SINHA has recently published[1] a remarkable cloud-chamber photograph of a four-pronged disintegration of an oxygen nucleus produced by a neutral cosmic ray particle. From the appearance of the tracks, he concludes that the two outer ones (tracks 1 and 4) are due to particles of a charge higher than that of an α-particle. The two inner tracks (2 and 3) appear to be due to doubly charged particles. Their end portions are crossed by thin ionization tracks. After

considering the possibility that this is due to an extremely rare chance coincidence, Sinha suggests that the thin tracks may be interpreted as pairs of (oppositely charged) electrons emitted from excited nuclei at the end of their paths. He emphasizes, though, that it is difficult to understand why the electrons should be emitted in diametrically opposite directions.

If we grant that tracks 1 and 4 are due to fast-moving nuclei with Z equal to or greater than 3, tracks 2 and 3 could be due only to singly charged particles (hydrogen isotopes), if conservation of charge is assumed in the disintegration of the oxygen nucleus ($Z = 8$). However, our present knowledge of the properties of the hydrogen isotopes leaves little room for the possibility that they may have excited states of sufficiently long life to emit electron pairs at the end of their paths.

If we still assume a causal relationship between the thin tracks and tracks 2 and 3—which will remain an open question until it is decided by further experiments—we are forced to conclude that a hitherto unknown process takes place. In such a situation we have only the most generally valid principles, like conservation of charge and momentum, as a guide. The simplest hypothesis compatible with these principles which would account for Sinha's picture appears to be the following. In the collision of a neutral cosmic ray particle with an oxygen nucleus, two new particles of opposite charge are created (2 and 3), and the oxygen nucleus broken up into two parts (1 and 4). To judge from their great ionizing power, the particles 2 and 3 have each double electronic charge and a mass which is considerably larger than that of two electrons. They are therefore intrinsically unstable, but apparently have a sufficiently long life, so that they do not decay until they have lost their kinetic energy. Each then decays into a pair of electrons, both negative in one case, and both positive in the other. Conservation of momentum requires that the decay electrons are emitted in diametrically opposite directions, and with equal velocities (equal specific ionization).

Disintegrations of nuclei by cosmic rays, or 'stars', have been studied by many observers in photographic emulsions. These stars appear to consist of proton and α-particle tracks, yet different observers disagree on the relative frequency of these particles[2]. When the number of particles in the 'star' is small, this type of disintegration may be pictured as a Bohr evaporation process[3]. However, where the number of singly or doubly charged particles approaches or exceeds[4] the atomic number of the original nucleus, it would seem necessary to assume the creation of new strongly ionizing particles. Sinha's picture may give a clue to the nature of these particles, which may have an ionizing power intermediate between that of a proton and that of an α-particle (for equal range). In this case they might have been identified with protons by some observers and with α-particles by others.

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Dec. 28.

[1] Sinha, M., NATURE, **152**, 568 (1943).
[2] For a detailed bibliography on this work, see Shapiro, M. M., *Phys. Rev.*, **61**, 115 (1942).
[3] Bagge, E., *Ann. Phys.*, **39**, 512 (1941).
[4] Blau, M., NATURE, **142**, 613 (1938). Idanoff, A., NATURE, **143**, 682 (1939).

Relationship between Dielectric Constant of Liquids and Solids and Dipole Moments

IT has been found that the molar electric susceptibility of liquids,

$$P = (\varepsilon - 1) \times M/d = 4\pi N(\alpha + \mu^2/kT),$$

where ε is the dielectric constant of the pure liquid and μ the moment. The derivation of this follows if we regard the dipole as needle-shaped. This assumption is inherent in the Debye equation for gases. In solids and liquids, owing to hindered rotation, molecular orientations are distributed according to the Boltzmann function μ^2F/kT, because the dipoles can become oriented only in two directions, along and opposite to the direction of the electrical field. This relationship is found to hold good for all normal liquids from hydrogen bromide ($0{\cdot}8D$) to nitrobenzene ($4{\cdot}2D$), and for solids such as hydrogen chloride, hydrogen sulphide, hydrogen bromide and hydrogen iodide which show molecular rotation at low temperature. In the case of associated liquids and divalent salts, kT is $\frac{1}{2}$. In ionic crystals the moment calculated from the dielectric constant has to be multiplied by the co-ordination number to give the same value as obtained by the molecular beam method. The results show that the alkali halides are 2/5 ionic or 'dipolar' in the gaseous and 1/15 in the solid state.

Details of this work will be published jointly with Miss Nagamani and Mr. Sathe.

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Levine's Hypothesis of Maternal Iso-immunization

MY recent letter on "Mutation and the Rhesus Reaction"[1] has provoked two replies. In one of them[2], Prof. J. B. S. Haldane raises an objection with which I hope to deal elsewhere at length when pressure of official duties is less exacting. In the course of the other[3], Prof. R. A. Fisher, R. R. Race and Dr. G. L. Taylor say that they "dissociate ourselves from the statement that 'Levine's hypothesis postulates a form of adverse selection . . .' ". Levine's hypothesis postulates that the blood of an $Rh(-)$ mother who bears $Rh(+)$ offspring by an $Rh(+)$ father produces an antibody which plays havoc with the red cells of the fœtus. The result may be miscarriage, stillbirth or neonatal hæmolytic anæmia with possibly fatal consequences. Since such offspring are necessarily heterozygous, the hypothesis that erythroblastosis fœtalis, a condition lethal in a certain percentage of cases, is due to maternal iso-immunization also implies the existence of the adverse form of selection with which Haldane's letter mainly deals, as does the article of Wiener cited therein. Owing to present difficulties arising from dispersal of libraries for safe storage, I was not aware of the existence of Haldane's paper[4] in which he develops several conclusions which I have derived independently, though it now appears later. Otherwise I should have cited his own prior treatment of the type of adverse selection implicit in Levine's hypothesis.

The main point I was concerned to stress in the latter half of my letter may have eluded Prof. Fisher and his colleagues because it touches on a misunderstanding which, though very elementary, is also very prevalent in medical circles, with results of some public

interest. Again, it is one which Haldane deals with at length in his paper. For the reason stated, I was not aware that he had done so until after my own letter appeared. Levine and his co-workers do not explicitly assert that the combination *Rh*(−) mother and *Rh*(+) fœtus constitutes a *sufficient*, in contradistinction to a *necessary*, condition for the occurrence of erythroblastosis fœtalis; but their writings are certainly open to that interpretation, and I have recently met several eminent clinicians, including two responsible officers of blood transfusion depots, who interpret Levine's hypothesis in the former sense. Now the approximate incidence of *Rh*(+) offspring of *Rh*(−) mothers is easy to calculate. Indeed such calculations appear in preliminary notes of the pioneer work being done by the Galton Laboratory Serum Unit. They show that such offspring are vastly in excess of any recorded statistics of the incidence of neonatal hæmolytic anæmias, even after generous inflation of the figures by due allowance for fœtal deaths.

There are several possible reasons for this. I have suggested one, and could suggest several others. Haldane[4] offers the interesting hypothesis that women differ individually with respect to permeability of the placenta. It would therefore be interesting to know if an *Rh*(−) *O* woman who had a history of miscarriage in a first marriage with an *Rh*(+) *O* man would sustain the family tradition in a subsequent union with an *Rh*(−) *A* man. In any event, there seems to be little doubt about the truth of either of two propositions: (*a*) that the genotype combination of the mother and offspring does not disclose a *sufficient* condition for the occurrence of erythroblastosis; (*b*) that it does disclose a *necessary* condition for a very high percentage of cases.

The distinction, if elementary, has some practical significance at the present moment, because voluntary donors at blood transfusion centres may be misled by popular or semi-popular expositions of Levine's important discovery, including his own in a recent issue of the *Journal of Heredity*. Indeed, my interest in its genetic implications was first excited by hearing of a Rhesus-negative young woman who had withdrawn her promise or offer of marriage when her donor fiancé proved to be *Rh*(+). I cannot improve on Haldane's own statement of the practical issue in his paper on the adverse form of selection which Levine's hypothesis implies: "it is obviously futile to urge that all *rh.rh* women, some 14% of the total, should be prevented or dissuaded from marrying the *Rh.Rh* and *Rh.rh* men who make up the remaining 86%. Research on the etiology of high placental permeability is an urgent problem. If it is largely due to a particular gene substitution, the gene in question must be much rarer than *rh* and therefore a more suitable target for negative eugenics."

With reference to the statement that the Galton Laboratory Serum Unit now postulates seven alleles, of which "not more than four are Rhesus positive", it suffices to say this. If progress continues at this encouraging tempo, the *Rh* locus may yet prove to be as unstable as I have ventured to suggest.

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The University,
Birmingham, 15.
Jan. 27.

[1] NATURE, **152**, 721 (1943).
[2] NATURE, **153**, 106 (1944).
[3] NATURE, **153**, 106 (1944).
[4] *Ann. Eug.*, **11**, 333 (1942).

Crossing-over in the Males of *Drosophila subobscura*

MEIOSIS in the males of the higher Diptera is characterized by absence of chiasmata. This means that as a rule genetical crossing-over occurs only in females. There are, however, a few exceptional families in *Drosophila melanogaster*[1,2] and *virilis*[3], the constitution of which can only be explained as due to crossing-over in the father. In these cases the exceptional offspring occurred in batches rather than singly. It was therefore supposed that crossing-over had taken place in one of the early spermatogonial divisions, though there is no cytological basis for this assumption.

I have found, in *Drosophila subobscura*, cytological evidence that crossing-over can take place in males during meiosis. Of three hundred testes from stocks containing 1–3 pairs of large autosomal inversions, one contained a lobule in late first anaphase, in which eight of the thirty-two nuclei in division showed single chromosome bridges, one a bridge and a fragment, and another two bridges. This is evidence that crossing-over had taken place in ten out of thirty-two cell divisions, because single crossing-over in inversions which do not include the centromere results in dicentric and acentric fragments. The dicentric fragments form bridges either at the first or second meiotic division, and the acentric fragments are lost.

Thus a male Drosophila still has the possibility of forming chiasmata. Normally, however, the meiotic chromosomes first emerge from a diffuse condition in the diakinesis stage of prophase; the pachytene stage where chiasmata are formed in a normal meiosis has never been seen. A slight alteration in timing, which affects all the cells in a lobule simultaneously, may permit chiasma formation, thus showing that the properties of the chromosomes have not changed radically. This results in the occasional appearance of a number of cross-over individuals in the progeny of a single heterozygous male.

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Jan. 25.

[1] Muller, *Amer. Nat.*, **50** (1916).
[2] Friesen, *Biol. Zbl.*, **54** (1934).
[3] Kikkawa, *Proc. Imp. Acad. Japan*, **9** (1933).

Fluctuations in Seaweed

RECENTLY, several communications have appeared in NATURE relating to seaweeds, their properties and uses. It is apparent that their commercial potentialities are much more considerable than has hitherto been realized, and that this is not merely a temporary effect of war needs. Obviously, progress must depend on the continuance of adequate supplies, yet little has been said as to the need for the study of their distribution, conservation and protection in favourable localities.

There are, indeed, two opposing views among those who have any opinion in the matter. The one is a firm belief that supplies are 'inexhaustible'; the other, that they are, like land crops, subject to serious fluctuations unless proper precautions are taken. It may be well to consider how far these views are based on general impressions or founded on fact.

In his lecture to the Royal Society of Arts in 1884 on "The Economic Aspects of Seaweeds", the distinguished chemist, E. E. C. Stanford, stated that the supply of material (for commercial purposes) was "almost unlimited". In a much more recent, though undated, brochure, entitled "Manucol", it is claimed (p. 5) that "Certain marine plants form an inexhaustible source of raw material for alginate production". This view has doubtless been the more readily accepted, since at certain times and places vast quantities of weed are thrown up by the tide after rough weather. The frequent lack of means to utilize them to the full would give the impression of great surplus. It is known that important substances for plant growth, such as nitrates and phosphates, undergo seasonal fluctuations in sea-water, being much depleted after spring growth and regenerated naturally in the autumn. One source of replenishment is the soil and detritus washed down from land by streams. These findings, however, do not relate at present to places with the largest yield of seaweed, and the cumulative effect of the complete removal of many thousands of tons of seaweed periodically is quite unknown.

The alternative view is borne out by experience in regions where the utilization of seaweed has been for long a local industry of importance. For example, on the coasts of Brittany harvesting seaweed has been subject to strict regulation for more than a century, while in Japan, still more vigilance and supervision has been practised since the expansion of the seaweed industry into a considerable export trade, during the present century. An account given by Yendo to the Royal Society of Dublin in 1914 gives some idea of the reasons for these developments. It was found, for example, that with repeated harvesting, certain beds of Laminarias became overgrown with a rapidly spreading submarine flowering plant. The prostrate shoots of these plants had to be cleared by hand before the Laminarias could be gradually re-established. By proper attention between harvestings, this condition could be prevented, and instructions were issued and enforced in the areas concerned. Seaweed 'farms' for the cultivation of Fucus and Porphyra were also established and apparently brought to a high degree of efficiency.

There are also certain general considerations which point in the same direction. The large deposits of drift seaweed which occur from time to time are frequently not reported, much less understood. Laminarias flourish in quantity on submerged reefs away from human habitation. Organized attempts to utilize them, if leading to the growth of communities of any size, with the necessary sewage disposal, may have unforeseen effects. Moreover, seaweeds, like other plants, have their diseases, and crops must be spaced to allow for effective regeneration. Other circumstances, such as the accumulation of oil residues from shipping, or the shift of tides, may alter productivity in particular areas. At present we have no effective means of estimation of quantity in relation to quality or to seasons.

On these and many other questions arising from the commercial exploitation of seaweeds, we have little or no information. Only a long-term policy of planned investigation can provide answers to some of them, and it has been well said that such investigation should be teamwork, including marine zoologists as well as botanists. It should not be forgotten, however, that knowledge of seaweeds is at a relatively low level, even on the systematic side. Much remains to be done before we shall have a real understanding of their life and their reactions to environment.

I understand that already a falling off in the amount of seaweed has been alleged by collectors in certain very productive regions. Is this due to faulty memories, or to lack of adequate means of estimation of quantity (comprising depth as well as extent, on the shore)? Or is it, on the other hand, a timely warning that the estimation and conservation of natural sources is already urgent? If the latter, much investigation will be needed to establish the principles upon which such a policy should be based.

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Spore-forming Bacteria causing Soft Rot of Potato and Retting of Flax

BACTERIAL soft rot of vegetables and the retting of flax are both due to decomposition of the pectin complex in the middle lamella, in the former case resulting in a loss of cohesion between the cells of the vegetable in the area invaded by the causal organism, and in the latter case resulting in a dissolution of the layer which binds the fibre bundles to the remainder of the cortex. It seems likely, therefore, that some bacteria may be furnished with the necessary enzymes to enable them to bring about both these changes.

In the course of an investigation carried out at this laboratory on the process of retting flax in tanks, large numbers of samples of retting liquor and of flax, taken at various stages during different processes of retting, were submitted to bacteriological examination. Tubes of nutrient broth, each containing a small cube of sterile potato, removed aseptically from the interior of a tuber, were found to be a suitable medium for testing for bacteria which produce soft rot of potato. Successive ten-fold dilutions of the retting liquor, or of an extract of the flax, were made in sterile Ringer solution, and duplicate quantities of 1 ml. from each dilution were inoculated into separate tubes of the potato medium, which were then incubated at 30° C. and were examined at intervals during a period of fourteen days. Soft rot of potato was detected by prodding with a stiff nichrome wire. It was found that, at or near the completion of the retting, soft rot was consistently produced by high dilutions of the liquor or of the flax extract, the 'count' of the causal organisms varying to some extent with the method of retting, but usually being between 10^4 and 10^8 per ml. of liquor or per gram of moist flax. Tests with similar media containing vegetables other than potato showed that bacteria causing soft rot of turnip were also consistently present, but that carrot or parsnip gave uncertain results.

It appeared from a large number of tests, made with tubes in which the potato had been rotted, that in the flora of retting liquor or of retted flax, ability to cause soft rot of potato was confined to spore-bearing bacteria, that the anaerobic spore-bearers were usually predominant among the causal organisms, but that aerobic spore-bearers with this characteristic were sometimes present in appreciable numbers. This observation may be compared with Ruschmann's statement[1], which is borne out by the literature, that

all aerobic and anaerobic retting organisms are spore-formers.

From two different rets a spore-bearing aerobic bacillus was isolated in pure culture; this produced soft rot in potato under laboratory conditions. The morphology and reactions—formation of acid and acetoin, but no gas, from dextrose, rapid liquefaction of gelatin, digestion of milk, and strong diastatic power—of the two cultures were identical and conformed with those of *B. subtilis*. Their identity with this organism was confirmed by Dr. T. Gibson of Edinburgh, to whom subcultures were sent.

Testing the ability of a pure culture to ret flax is rendered difficult by the fact that the flax used as a substrate may be appreciably altered in character if it is sterilized by heat. To obviate this difficulty an enzyme powder, capable of acting in the presence of an antiseptic which inhibits bacterial growth, was prepared from each of the two strains of *B. subtilis* by the following method, which is similar to that described by Dox[2].

A mass growth was obtained by seeding the surface of potato-mush agar sloped in ten 1-litre bottles. After incubation for two days at 30° C., the growth was washed off with water and the aqueous suspension was filtered through a Buchner funnel. The residue on the filter paper was ground in a large volume of acetone and left immersed for ten minutes. The acetone was filtered off at the pump and the residue was similarly treated, first with acetone for two minutes and finally with ether for three minutes. The residue after filtration was dried in a thin layer at 37° C. for two to three hours, and was then ground to a fine greyish-yellow powder which was tested as follows:

(1) 0·2 gm. of the powder was ground with 5 ml. of distilled water and the suspension was transferred to a test tube. Several thin disks of freshly cut potato (approximately 1 cm. in diameter and 1 mm. in thickness), and 0·2 ml. of toluene, were added to the suspension, which was thoroughly shaken. A control tube without the enzyme powder was prepared at the same time and both tubes were incubated at 30° C. When examined after 18 hours, the disks of potato in the enzyme preparation showed complete soft rot, disintegrating easily when manipulated with a stiff wire. Disks in the control tube were unaltered.

(2) Flax stems were cut into uniform lengths of about 4 in., and were packed tightly into a glass cylinder about 1 in. in diameter. A suspension containing 2·5–3 gm. of the enzyme powder and 2 ml. of toluene in 50 ml. of distilled water was poured into the cylinder until the flax was completely immersed. A control cylinder without the enzyme powder was prepared in the same way, and both cylinders were incubated at 30° C. Progress of retting was followed at intervals by means of the 'loose core' test, and a small quantity of toluene was added daily to each cylinder. The flax immersed in the enzyme preparation was completely retted in three days, the flax in the control cylinder being unchanged.

These experiments show that *B. subtilis* produces enzymes which rot potato and ret flax. The fact that the process of retting in tanks on a large scale is accompanied by the growth in large numbers of spore-forming bacteria which produce soft rot of potato suggests that they may also be largely responsible for the retting. It may be noted that ability of spore-forming bacteria to cause soft rot of potato, which Dowson[3] recorded for *B. polymyxa*, is certainly not, under laboratory conditions, confined to that species.

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[1] Ruschmann, F., *J. Text. Inst.*, **15**, T61 and 104 (1924).
[2] Dox, A. W., U.S. Dept. Agric. Bur. Anim. Ind., Bull. 120 (1910).
[3] Dowson, W. J., NATURE, **152**, 331 (1943).

Reported Asymmetric Synthesis of Santonin

THE announcement that santonin containing approximately 93 per cent of the *lævo*-rotatory variety (naturally occurring santonin is *lævo*-rotatory) has been obtained by Paranjape, Phalnikar, Bhide and Nargund[1] during the synthesis of santonin without apparently any asymmetric influence at any stage of the synthesis is of unusual interest. The realization of such a result cannot be excluded on the evidence given. On the other hand, it is contrary to all analogous experimental results so far recorded that methylation of an externally compensated and optically inactive compound should proceed at different rates on the *lævo*- and *dextro*-constituents of the externally compensated substance even when the asymmetric carbon atom is involved. It is possible, however, to conceive cases when a difference in reaction velocities of the *lævo*- and *dextro*- varieties of an externally compensated compound may be realized.

So far as present conditions permit, it would be useful if as large a number as possible of experienced investigators should repeat the methylation of 2-formyl*cyclo*hexanone under various conditions, and determine whether or not the resulting 2-methyl-2-formyl*cyclo*hexanone is or is not optically active. If any positive evidence is obtained the statistical analysis of the results would be interesting.

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[1] NATURE, **153**, 141 (1944).

Microbiological Assay of Riboflavine

PROF. R. H. HOPKINS[1] has added to Dr. Barton Wright's and Mr. Booth's[2] reply to the comments made by Happold[3] on the microbiological technique for the assay of riboflavine and has included a criticism of the work published by us[4]. Both communications concentrate on the point made by us regarding the amount of calcium in the medium, while ignoring other points of criticism which we made. Barton Wright and Booth state that the calcium effect is due to buffer action, this being incorrect, while Hopkins, relying on the papers of Holt, La Mer and Chown[5] on calcification in bone and on the solubility product of $Ca_3(PO_4)_2$ in water or in serum, states that the calcium concentration could not be influenced appreciably by added calcium chloride at *p*H 6·6–6·8. It should be mentioned that Holt *et al.* state that the solubility product is affected enormously by the presence of other salts and that a complex solution of amino-acids is very different from serum (protected by these workers against bacterial proteolysis). They also state "the precipitation of tertiary calcium

phosphate occurs so slowly that solutions of this salt may remain supersaturated for many days".

We are not concerned with theoretical considerations, we can but record our findings made frequently and separately by us and using an acid hydrolysate of casein, similar in all respects to that of J. H. Mueller[6] and to that of Snell and Strong[7]. We have also indicated, from a review of the literature, that mineral requirements may be modified by the pattern and amount of growth factors added to the medium.

But Prof. Hopkins asks a question by implication: if little or no precipitation occurs immediately after the addition of $CaCl_2$ to the cold sterile medium, what happens after seventy-two hours ? In our experience (in uninoculated controls), very little. It must be remembered also that we are not dealing with simple solutions; there is a rich variety of amino-acids present in the medium, cells are growing rapidly and glucose is being metabolized. Phosphates are utilized in both these processes and are removed from the medium, and finally the *p*H of the medium falls. All these factors will tend to increase the solubility of calcium, which in our experiments is never precipitated.

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F. W. CHATTAWAY.
MARY SANDFORD.
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School of Medicine, Leeds, 2. Jan. 12.

[1] Hopkins, R. H., NATURE, **152**, 724 (1943).
[2] Barton Wright, E., and Booth, R. G., NATURE, **152**, 414 (1943).
[3] Happold, Frank C., NATURE, **152**, 414 (1943).
[4] Chattaway, F. W., Happold, F. C., and Sandford, M., *Biochem. J.*, **37**, 298 (1943).
[5] Holt, E., La Mer, V. K., and Chown, H. ... *J. Biol. Chem.*, **64**, 509 (1925).
[6] Mueller, J. H., Klise, K. S., Porter, E. F., and Graybiel, A., *J. Bact.*, **25**, 509 (1933).
[7] Strong, F. M., and Snell, E. E., *Ind. Eng. Chem., Anal. ed.*, **11**, 346 (1939).

Cellulose Acetate Mounts for Rock and Mineral Fragments

EMBEDDING rock or mineral particles in a uniform thin sheet of cellulose acetate facilitates their optical examination, transport and storage, especially during the field study of graded concentrates derived from detrital or crushed rocks.

More than a hundred times the quantity of such particles can be mounted together than is possible in any normal Canada balsam/glass mount, while preserving all significant microscopical advantages of the latter. This fact enables more accurate quantitative mineralogical analyses of certain sands to be made, for example, by accommodating in a single mount the whole heavy-mineral concentrate from a bulk-sample of greater volume than it has been convenient to study in most cases hitherto. Areas of the film containing grains of critical importance can be marked with ink, greasy crayon or gummed paper masks, or removed for special treatment with scissors, a knife or razor blade.

The substance of the sheet is colourless, transparent and isotropic when unstrained, with a refractive index of about $N_D^{20^\circ}$ 1·4, depending upon the exact composition of the dispersion. It is light in weight, very flexible, insoluble in water and does not crease, crack or tear, even when handled comparatively roughly. In composition it is identical with that of the laminar moulds used by me for studying the finer structures of rock, mineral and metal surfaces[1].

To prepare such a mount, a cold dispersion of cellulose acetate in one part by volume of tetrachloroethane and two parts by volume of 'Cerric Thinner T.10' (Cellon, Ltd., Kingston-on-Thames), containing about 20 per cent (of the weight of cellulose acetate) of a plasticizer such as triphenylphosphate or dimethyl-phthalate, is flowed over a levelled sheet of clean plate glass, say, 23 cm. × 10·5 cm. × 0·6 cm., to a depth of 0·1–0·15 cm., the latter depending on the maximum diameters of the particles concerned. Immediately this has been done, the sieved rock or mineral powder, either before or after separation into fractions, is moistened with tetrachloroethane and shaken as evenly as possible over the dispersion layer, into which it sinks.

In about eight hours the compact film remaining after volatile parts of the dispersing medium have evaporated has a thickness about one tenth that of the original fluid layer. The film is then stripped from the glass, labelled and its edges trimmed with scissors, before being examined optically.

A trace of some suitable dye, when added to the parent dispersion, serves to distinguish any particular batch of mounts by its tint. Rectangular films, 23 cm. × 1·5 cm. × 0·01 cm., are of convenient shape and size for microscopical examination and can be stored or posted in standard foolscap paper envelopes without further protection. With regard to the permanence of these mounts, experience has shown that they have developed no appreciable discoloration, brittleness or shrinkage after three years of storage in such envelopes.

A. T. J. DOLLAR.
as from Geology Department,
University of Glasgow.
Jan. 23.

[1] Dollar, A. T. J., *Geol. Mag.*, **78**, No. 4, 253 (1942); NATURE, 152 248 (1943).

High-Angle Edge Flaking of Flint

MR. D. F. W. BADEN-POWELL'S criterion for intentional flaking[1] is invalid, for when applied to implemental forms from Eocene deposits it gives a false answer.

Mr. J. Reid Moir's contention that series of adjacent scars form a criterion of human work fails when applied to similar series of Eocene date. My own criterion is based on observed facts and not, as Baden-Powell suggests, on an assumption that primitive man was not likely to flake at obtuse angles.

Baden-Powell states that flaking at about 90° is necessary for removing flakes from Aurignacian and Magdalenian cores. This is not a fact, for it is well known that such cores are in their final or 'reject' state. They began with an acute angle which increased as flaking proceeded to about 90°, which is the limit of easily controlled flaking. The platform is then again made acute or the core is rejected.

Primitive man adopted flaking at acute angles because it is easy, is under good control, and yields acute cutting edges. Obtuse angle flaking possesses none of these advantages.

In reply to Mr. Henry Bury[2], I would point out that natural forces were sufficiently active to leave abundant traces of crushing, abrasion and striation on the Tertiary flints.

In the series of nine human industries I gave in *l'Anthropologie*[3] from which Bury quotes, the Abbevillian, one of the oldest industries, is placed next to the Campignian, which is of Neolithic age. In the series of sixteen industries published else-

where[4], the non-correspondence between age and content of obtuse angles is clearly evident. The "Cromerian" industry was not included in my list, because recent work on the site by S. H. Warren throws grave doubts on its origin.

The Zambesi flakes are too rolled to allow of angle measurement. They are clearly of human origin and the character of the flaking is normal.

ALFRED S. BARNES.

Dormers,
Farnborough, Kent.

[1] Baden-Powell, D. F. W., NATURE, 152, 663 (1943).
[2] Bury, H., NATURE, 152, 664 (1943).
[3] Barnes, A. S., *l'Anthropologie*, 48, 221 (1938).
[4] Barnes, A. S., *Amer. Anthrop.*, 41, 110 (1939); *Bull. Soc. Prehist. Franc.*, No. 1, Fig. 6, 10 (1939).

MY letter in NATURE of December 4 raised three main issues.

(1) If, as Mr. Barnes asserts, Kentish eoliths, etc., were formed by soil movement in Tertiary times, why, I asked, did the still more active movements of the Pleistocene produce no similar results? To tell us that natural forces left "abundant traces of crushing, abrasion and striation on the Tertiary flints" in no way answers my question.

(2) Seeing that the percentage of high-angle scars rises rapidly "as we pass from the later and more skilled to the older and rougher work", I suggested that a still further rise in Pliocene times was not impossible. Barnes replies that there is no correspondence "between age and content of obtuse angles"; but, on his own figures, there is. There may be recrudescence of rough work in late industries (Campignian, etc.), with local increase in the number of obtuse angles; but no early industry shows a low number.

(3) I thought that further information about the Zambezi implements might possibly affect Barnes's conclusions. I am interested to learn that he finds them "clearly of human origin", as my impression is that some of them (not figured) are very like Kentish eoliths. That remains to be seen.

HENRY BURY.

The Gate House,
Alumdale Road,
Bournemouth.

MR. A. S. BARNES says that Mr. J. Reid Moir's "criterion of human work fails when applied to similar series of Eocene date". This is not true, at least for the Bull-head Bed at the base of the Eocene in Suffolk, which was specially investigated by Moir[1] in order to settle this question. Moir came to the conclusion that there are essential differences between fractured flints of Eocene age and those of later date described as eoliths, although occasional Eocene flints can be found which show a superficial resemblance to flints flaked intentionally.

With regard to the use of steep flaking by Palæolithic man, I agree with Barnes's criticism of a statement in my letter in NATURE of December 4 that Magdalenian flakes can be removed from the core "only" by steep flaking. Obviously some of the flakes in Upper Palæolithic work were removed at lower angles than others; but the fact remains that Magdalenian man could, and often did, remove usable flakes at high angles. I am glad that Barnes admits that these flakes are due to human and not natural agency. Quite apart, therefore, from the steep flaking used for the butt ends of Acheulean axes and for Aurignacian edge-work, it seems established that at least some high angles are also seen on various Upper Palæolithic cores. This does not invalidate the interesting suggestion in Bury's letter in NATURE of December 4 that the rise of percentage of steep flaking with antiquity may be significant; it does, however, prove that steep flaking cannot be taken as a criterion of intentional work.

D. F. W. BADEN-POWELL.

University Museum,
Oxford.
Feb. 6.

[1] Moir, J. Reid, *Proc. Prehist. Soc. East Anglia*, 1, 4, 397 (1914).

Veterinary Education in Great Britain

THE leading article in NATURE of January 8 on veterinary education provides me with an excuse for mentioning some of the obstacles I see in our path. The present is a good time for discussion; for definite decisions, it is the worst time that has occurred during my rather long life. Never has the future of the nation, or the nature of the work lying ahead of the veterinary surgeon, been so unpredictable as it is to-day.

The Ministry of Agriculture looks forward to a need for a very much greater output of veterinary surgeons —I cannot see why. No doubt, it expects to increase the numbers and the work of whole-time inspectors, but this must be largely at the expense of the part-time and independent men; and it would appear to me that the general agricultural policy pursued pre-war—as much grass as possible and bring in concentrates from abroad—was designed to support a larger head of sheep and cattle than can be kept under any other system. Ploughing up grass means fewer, not more animals.

The Council of the Royal College of Veterinary Surgeons has a curriculum committee; I do not agree with many of its conclusions, but probably that is because I am old-fashioned. I do hope we are not likely to have a curriculum rammed down our throats by Government.

The present curriculum is well designed for the production of large-animal practitioners. Besides these, we have to provide small-animal practitioners; inspectors and research men for the Ministry of Agriculture; executive and research men for the Colonial Service; Royal Army Veterinary Corps men; and a diminishing number of municipal and county officials. The qualifications needed are very different, and it will always be impossible to train our students so as to be efficient for all these purposes, on graduation.

It will be the part of wisdom if we carry on with the *status quo ante* until after the War, taking no irrevocable steps, making no changes of constitution in the colleges.

When we see the number of each different kind of graduate that will be called for, we can try to arrange a suitable curriculum, reinforced by post-graduate classes; but we can never give experience. The most important part of veterinary education will always come after appointment.

A. W. WHITEHOUSE,
(Principal).

Glasgow Veterinary College, Inc.,
83 Buccleuch Street,
Glasgow, C.3.
Jan. 25.

ANNUAL MEETING OF CHINESE SCIENTIFIC SOCIETIES

A JOINT annual meeting of the Science Society, the Zoological Society, the Botanical Society, the Meteorological Society, the Mathematical Society and the Geographical Society of China was held at Pehpei, Chungking, during July 18–20 of last year. Despite the hot weather which prevailed then, 240 members attended the meeting, which was presided over by Dr. Wong Wen-hao. In his opening address, Dr. Wong said that a joint meeting like this is especially desirable in war-time, in that it is economical in time, labour and expenditure and will enhance co-operation between societies which are related in character. In view of the present tendency to overlook the study of pure science, Dr. Wong remarked that truth is what science values most, regardless of whether or not practical use can be derived from it; and he urged the pure scientists to stand firm. As a geologist and the Minister of Economic Affairs, he illustrated with first-hand examples how what appeared to be pure geology at first turned out later to be of much practical value in the detection of China's natural resources. The address of the Generalissimo was then read, in which he declares: "Pure science is the foundation of all applied sciences. If we wish to stand up among the modern great nations there must not be the slightest tardiness in the prosecution of pure science" (see also NATURE, Aug. 14, 1943, p. 180). While most of the official emphasis has been laid on the practical side in the recent tide of national industrialization, it will do the nation good to remind people of the significance of pure science.

In the business meeting held in the first afternoon, Dr. J. Needham was elected honorary member of the Science Society of China, in appreciation of his distinguished academic work and his service in promoting co-operation between Chinese and Western science, which had been so effectively carried on during the previous six months.

The six societies spent two mornings in communicating original papers dealing with their respective sciences; more than three hundred papers were read. Brief abstracts of these papers will be published shortly, in Chinese with additional English titles.

One of the two remaining afternoons was devoted to a discussion on "Science and National Reconstruction", with special reference to the problem of how science is to be promoted in China. Opinions were formulated on the following four points, which were presented to the Chinese Government for immediate adoption.

(1) The Government is requested to provide a large fund in the forthcoming national budget for, and only for, the furtherance of scientific research and of the scientific education of the masses.

(2) The personnel and equipment of the leading science institutes, such as those of Academia Sinica, must be materially augmented.

(3) The Government must endeavour to establish co-operation between the scientific workers on one hand and officials in charge of national planning on the other, so that the resulting plans may be more practical and fruitful.

(4) While the Government is considering sending a large number of young men of science abroad, it is deemed appropriate that such opportunities should be extended to mature scholars also. Here again, the Government is requested not to neglect pure science in favour of applied sciences and technology.

The last afternoon of the meeting was reserved for a discussion on "International Science Co-operation". To familiarize the audience with some idea of the subject under discussion, four specialists were asked to talk about the co-operative measures hitherto taken, along with the sound results accomplished therefrom, in agriculture, industry, meteorology, and medicine and public hygiene. Dr. Needham's address, entitled "International Science Co-operation in War and Peace", was read next by Dr. H. C. Zen, president of the Science Society of China. In this address, Dr. Needham reviewed the present position of co-operation between Chinese and Western science and the problems arising on the scientific side of the war effort of the United Nations in the Asiatic theatre; he urged, above all, that a science co-operation service should be made a regular part of the United Nations Relief and Rehabilitation Administration. The meeting was unanimous that international science co-operation, founded on international understanding and goodwill, is worthy of striving for. Indeed, Chinese men of science seek co-operation with no less enthusiasm than their friends of the West.

A scientific exhibition intended for the general public has been arranged by the learned societies of China during the present session.

DIRECTIVE AERIALS FOR RADIO COMMUNICATIONS

THE second discussion evening of the current session of the Wireless Section of the Institution of Electrical Engineers was held on January 18, when Mr. J. A. Smale introduced the subject of "Comparative Merits of Different Types of Directive Aerials for Communications". At the outset, it was made clear that the main objects of using directive aerials are to increase the field strength of the signal at the receiving station without increasing the power radiated by the transmitter, and to improve the ratio of signal to noise and interference at the receiving site; another desirable aim is to minimize interference with other users of the ether.

In long-distance communication, interest is confined mainly to wave-lengths between 13 and 100 metres; the maximum obtainable gain, in general, requires one linear horizontal dimension of some 10 wave-lengths, and, while this is realizable up to about 30 metres, it tends to impracticability at the upper end of the wave-length range. In the above range of wave-lengths, transmission is effected by one or more reflexions from the ionosphere, the characteristics of which give to the ray paths various degrees of inclination in the vertical plane. Consequently, aerials have to possess directivity in this as well as in the horizontal plane, and in some types these two directivities are dependent on one another.

The two main aerial systems used are of the broadside and linear or end-fire types. In general, the end-fire type have their horizontal and vertical directivities interdependent; the maximum concentration in the horizontal plane results in very low angles of radiation in the vertical plane, so that for short-distance circuits requiring higher angles no satisfactory compromise is possible. In the case of broad-

side arrays, individual control of directivities is valuable. A high degree of directivity in the vertical plane with broadside arrays, however, requires a height of several wave-lengths. As the wave-length increases, this height and the support of reflector as well as radiator curtains require fairly massive masts and corresponding foundations. The choice of aerials is influenced to a considerable degree by capital and maintenance costs, and availability of land, as well as by the technical considerations which lead to an overall improvement in the efficiency of the radio communication circuit.

Some of the earlier beam systems were built for very high directivity in the horizontal plane; but experience has shown that this may be overdone, since the reflecting medium is not sufficiently stable and accurate, and conditions can obtain when a transmitted beam, if too narrow, may be deflected right off the receiving aerials.

Similar structures can be used for transmission and reception, but the requirements are not necessarily the same. In general, the maximum forward gain is the chief requirement of transmitting aerials; while at the receiving station it is not so much a high signal-level that is required as a good discrimination of the signal in relation to the prevailing noise-level. During the period of maximum sunspot activity backward round-the-world echoes are troublesome, and aerials should have the maximum front-to-back ratio. Experience shows that this is more easily obtained with broadside arrays. This is true with normal broadside arrays; but even better ratios are possible if the aerial is erected off direction and electrically swung on to the forward direction; the result is that backward radiation is swung away from the great-circle bearing.

In the case of receiving aerials this applies also, but the chief requirement is the correct shape of polar reception diagram rather than gain, at least on wave-lengths greater than, say, 20 metres. With modern receivers the limiting factor above this wave-length is not input-signal level but signal-to-outside-noise ratio. In this case the power inefficiency caused by terminating resistances at the non-fed end of 'end-fire' arrays is unimportant; consequently, relatively simple and cheap aerials of the horizontal fish-bone type are adequate, take up small space, and on a given area of land can be multiplied for diversity reception. This type of aerial can be arranged for almost any degree of compromise between end-fire and broadside.

During the discussion, considerable attention was given to the rhombic aerial system, which has the advantage of retaining a reasonable directivity over a wave-length range of about two-to-one. Some of this versatility is lost when several rhombics are used in series in order to secure greater efficiency, but on the other hand greater control of the vertical radiation can be obtained, and this may be a distinct advantage in some cases.

The relative merits of horizontal and vertical polarization in the emitted radiation were discussed by one speaker, who stated that in some experiments with broadcasting transmitters, horizontal polarization had given the best results. It was agreed that a considerably wider horizontal distribution is used in broadcasting than in point-to-point communication, but not necessarily a wider diagram in the vertical plane, because the vertical angle to be covered is often of the same order in the case of communication services and broadcasting.

The chairman directed attention to the widespread interest aroused by the discussion, which showed that the subject is one of great importance to the engineer responsible either for long-distance broadcasting or point-to-point communication services.

REVISED FORMS OF THE CALENDAR

COLONEL C. A. GILL has published a small book entitled "The Reform of the Calendar—a Measure of Social Security" (Reigate: Ancient House Bookshop. Pp. 36. 1*s*.), which contains the proposals for a British Calendar. On p. 26 this Calendar is shown in full, and it agrees with the World Calendar (shown on p. 15), except that the days termed the 365th and 366th days are to be included as an eighth day in the last week of June and December respectively. It is suggested that the 365th day, June 31, should be called Mid-Year Day, and the additional day in leap years, bearing the date December 31, should be called Leap-Year Day.

A prime consideration in fixing the date of bank holidays should be the season of the year when they are most beneficial to the health of the community, and the following proposals are made, the advantages of which will be seen when it is remembered that the first day of each month commences with Sunday. A bank holiday should continue to be associated with Easter, but the date of the Eastertide holiday should have April 9 included. As Easter Sunday falls on April 8 in about 40 per cent of years, this arrangement will increase the length of the Eastertide holidays to four clear days on many years, owing to the inclusion of Good Friday. If Saturday, April 7, and Monday, April 9, were declared bank holidays, the dates of all secular events which now vary annually with the date of Easter Sunday could then take their time from the fixed bank holidays in April. It may be pointed out that April 8 is the date proposed by the World Calendar Association for Easter Sunday—a proposal which may some day materialize.

Other bank holidays which are suggested are Saturday, May 25, and Monday, May 27, irrespective of the date of Whit Sunday. Saturday, June 30, and Mid-Year Day, June 31, if declared bank holidays, would provide a three-day holiday at the end of June, Sunday, July 1, being, of course, included. The bank holiday on the first Monday in August falls on August 6 under the new scheme, and it is proposed to continue with this arrangement, Saturday, August 4, being also a bank holiday. Saturday, September 2, and Monday, September 4, would be bank holidays. As December 25 falls on a Monday, a holiday on Boxing Day with the previous Sunday and half Saturday would provide 3½ days' holiday at Christmas.

Another revised calendar has been proposed by Lieut. Willard E. Edwards under the title "The Edwards Perpetual Calendar" (printed by the *Honolulu Star-Bulletin*, Ltd.). In this, each week begins with Monday, and anniversaries and holidays always fall on the same day of the week. Each quarter has 91 days, and New Year's Day is set apart as a holiday and is followed by Monday, January 1, thus preserving the year of 365 days and the continuity of dates each year. In the case of a leap year, the first day of the second half of the year is Leap-Year

Day, a second holiday apart from any week or month, and is followed by July 1. April 14 is the date for Easter, which is partly in accordance with the Act of Parliament in 1928, providing for the stabilization of Easter between April 8 and 15. Friday, the 13th, is completely eliminated from the Calendar, thus removing the grounds of the superstition that exists concerning this date and day. Sunday becomes the seventh day of the week, and agrees more with the Biblical Sabbath or the psychological conception of the week. All future dates can be computed without the aid of a printed calendar by remembering that the first month of each quarter always begins on Monday, the second on Wednesday, and the third on Friday, the number of days in the corresponding months being 30, 30, 31.

It is claimed that this Calendar not only introduces simplicity regarding anniversaries and holidays, but also removes many complications in the commercial world, as there are 26 working days in each month and 91 days in each quarter.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, February 19

BRITISH ASSOCIATION OF CHEMISTS (at the Café Royal, Regent Street, London, W.1), at 2.30 p.m.—Twenty-sixth Annual General Meeting.

Monday, February 21

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. E. B. Bailey, F.R.S.: "Natural Resources of Great Britain", 1: "Minerals". (Cantor Lectures, 1.)

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Lady Broughton: "Greenland, Mexico and Yucatan" (Kodachrome Films).

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "The Use of Electricity in the Equipment and Testing of Aircraft" (to be opened by Mr. C. G. A. Woodford).

Tuesday, February 22

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Dr. Luis Araquistáin: "Some Survivals of Ancient Iberia in Modern Spain".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. J. Ramsbottom: "Fungi and Modern Affairs", 2: "Fungi as Agents of Disease and Destruction".*

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. B. S. Bramwell: "The Order of Merit—the Holders and their Kindred".

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Mr. V. A. M. Robertson: "The Engineering Evolution of London Transport".

Wednesday, February 23

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. Hugh Lyon: "Education To-day and To-morrow", 5: "The Future and Functions of the Boarding School".

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. B. J. Edwards: "A Survey of the Problems of Post-War Television".

Thursday, February 24

BRITISH SOCIETY FOR INTERNATIONAL BIBLIOGRAPHY (at the Science Museum, Exhibition Road, South Kensington, London, S.W.7), at 2.15 p.m.—Annual General Meeting; Mr. S. W. Gibson: "The Library and Information Department of a Large Engineering Firm"; Dr. S. C. Bradford: "The Universal Decimal Classification its Origin and Purpose, Structure and Use".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Jack Drummond: "Food Fads and Food Fallacies".*

KING'S COLLEGE (in the Department of Electrical Engineering, Strand, London, W.C.2), at 3 p.m.—Mr. S. D. Thorp: "Generator Protection".*

ROYAL AERONAUTICAL SOCIETY (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Dr. D. M. A. Leggett and Mr. H. Davidson: "Structural Features of German Aircraft".

BRITISH INSTITUTION OF RADIO ENGINEERS (LONDON SECTION) (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6.30 p.m.—Mr. C. E. Tibbs: "A Review of Wide Band Frequency Modulation Technique".

BRITISH ASSOCIATION OF CHEMISTS (ST. HELENS SECTION) (in the Lecture Room, Radiant House, Cotham Street, St. Helens), at 7.30 p.m.—Mr. H. Cole: "The Literature of Alchemy".

Friday, February 25

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Mr. E. Rock Carling: "The Medical and Surgical Achievement of Soviet Russia in War".*

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Discussion on "Troubles, Breakdowns and their Cures".

Saturday, February 26

SCHOOL NATURE STUDY UNION (at the Central Club, Y.W.C.A., Great Russell Street, London, W.C.1), at 2.30 p.m.—Thirty-eighth Annual Conference; at 3 p.m.—Prof. W. B. R. King: "The Evidence of Fossils".

APPOINTMENTS VACANT

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

SPEECH THERAPIST to serve the Crewe and Cheshire Education Committees jointly—The Director of Education, Education Offices, Imperial Chambers, Prince Albert Street, Crewe (February 23).

HEAD OF THE DEPARTMENT OF MECHANICAL AND AUTOMOBILE ENGINEERING, and HEAD OF THE DEPARTMENT OF ELECTRICAL ENGINEERING, at the Doncaster Technical College—The Chief Education Officer, Education Offices, Wood Street, Doncaster (February 24).

LABORATORY ASSISTANT IN THE DEPARTMENT OF BOTANY—The Secretary, Bedford College for Women, Springfield, Sidgwick Avenue, Cambridge (February 26).

PSYCHIATRIC SOCIAL WORKER (full-time)—The Director of Education, Education Offices, Middlesbrough (February 26).

LECTURER IN MATHEMATICS—The Registrar, Technical College, Sunderland (February 28).

SENIOR LECTURER IN MATHEMATICS—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham, Essex (February 28).

WOMAN LECTURER IN THE DEPARTMENT OF EDUCATION, qualified to lecture in EDUCATIONAL HYGIENE—The Registrar, King's College, Newcastle-upon-Tyne (February 29).

ELECTRICAL ENGINEER (to instruct and supervise General Electrical Installation Work, Maintenance and Repairs), and an ELECTRICAL MAINTENANCE FOREMAN (to assist with Installation and Maintenance Work), for a Modern Iron and Steel Works in Turkey—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. D.755.XA) (March 1).

LECTURER (man or woman) in the DEPARTMENT OF GEOGRAPHY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (March 1).

MONTAGUE BURTON PROFESSORSHIP OF INTERNATIONAL RELATIONS—The Registrar, The University, Oxford (March 4).

ENGINEER AND MANAGER of the Walsall Gas Undertaking—The Town Clerk, The Council House, Walsall (March 6).

LECTURER IN ELECTROTECHNOLOGY in Santa Maria, Chile—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. D. 763.XA) (March 8).

LECTURER (man or woman) IN BOTANY, and a DEMONSTRATOR (man or woman) in BOTANY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (March 8).

PROFESSORSHIP OF CHEMICAL TECHNOLOGY—The Vice-Chancellor, University of Madras, Triplicane P.O., Madras' India (March 31, by cable; at the same time advise the Office of the High Commissioner for India, General Department, India House, Aldwych, London, W.C.2).

UNIVERSITY LECTURER IN ANTHROPOLOGY—The Secretary of the Appointments Committee, Faculty of Archæology and Anthropology, Museum of Archæology and of Ethnology, Cambridge (April 15).

DIESEL MECHANIC FOR MINING PROPERTY on the Gold Coast—The Secretary, Overseas Manpower Committee, Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. 310).

ENTOMOLOGICAL FIELD OFFICERS by the Government of Kenya Medical Department—The Secretary, Overseas Manpower Committee, Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. 1270).

LIBRARIAN of the British Library of Political and Economic Science—The Acting Secretary, London School of Economics, The Hostel, Peterhouse, Cambridge.

WORKS MANAGER for the Sierra Leone Government Railway—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. O.S.30).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

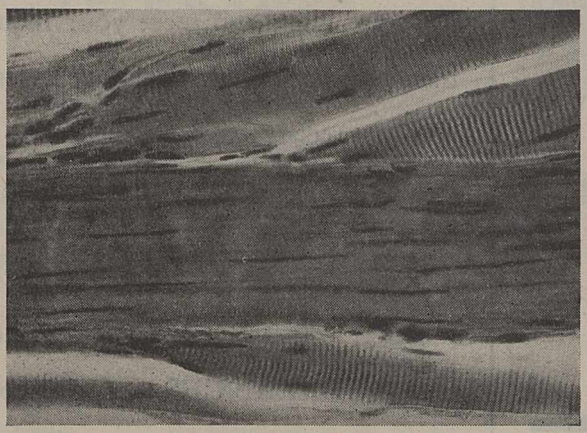
Great Britain and Ireland

The Case for the Abolition of Compulsory Mathematics in University Matriculation Examinations: a Reform of Vital National Importance. By David Brownlee. Pp. 24. (London: The Author, 56 Grange Road, W.5.) [181

National Smoke Abatement Society. Proceedings of the Eleventh Annual Conference held at the Caxton Hall, London, S.W.1, on 5th November 1943: Measures for Smoke Prevention in relation to Plans for Post-War Reconstruction. Pp. 24. (London: National Smoke Abatement Society.) 1s. [191

Employment After the War: a Memorandum submitted by the Social Credit Co-ordinating Committee for the consideration of Sir William Beveridge. Pp. 12. (Mexborough: Social Credit Co-ordinating Committee.) 3d. [201

ILFORD PLATES *for* PHOTOMICROGRAPHY



THE UNION OF MUSCLE FIBRES WITH A TENDON
By courtesy of F. J. Pittock, F.R.P.S., University College, London.

TECHNICAL DETAILS:

Stained	Delafield's Haematoxylin.
Magnification	400 diameters.
Objective	8 mm. Apo.
Ocular	× 10.
Sub-stage condenser	Abbe, N.A. 1·4.
Illuminant	6 volt 108-watt ribbon filament lamp.
Camera extension	58 cm.
Plate	Ilford Rapid Process Panchromatic (Backed).
Colour Filter	Ilford Micro 3 (Green).
Exposure	3 seconds.
Development	1½ minutes in Ilford ID-1 at 65°F.

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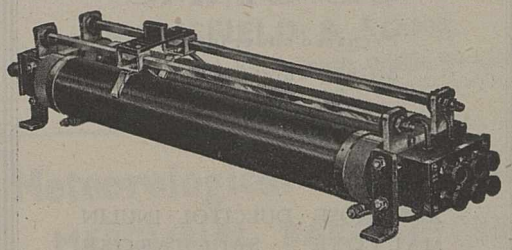

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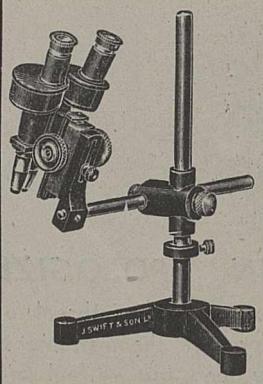

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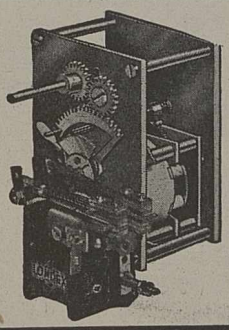

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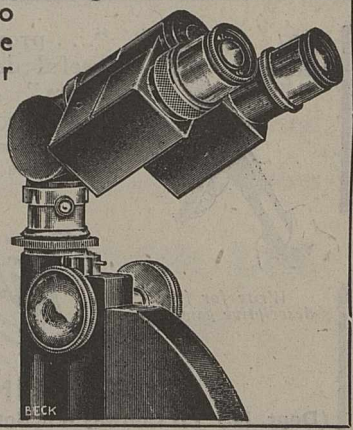

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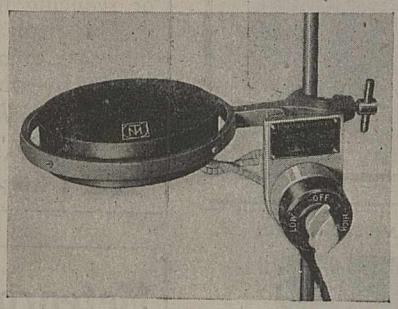

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