Vol. 153, No. 3888 SATURDAY, MAY 6, 1944 ONE SHILLING & SIXPENCE

NATURE

No. 3888 SATURDAY, MAY 6, 1944 Vol. 153

CONTENTS

	Page
Scientific Research in Great Britain	539
Taxation and Research Expenditure	542
Rheology : Practical and Theoretical. By Dr. L. R. G. Treloar	543
The Art of the Optician. By Dr. W. D. Wright	544
Water Purification. By Dr. H. T. Calvert	544
The Wellcome–Marston Excavations at Lachish, Palestine. By Olga Tufnell	545
Muscular and Mental Relaxation in Peace and War. By Dr. E. J. Boome	547
Synthesis of New Species of Wheats. By Dr. Anton Zhebrak	549
Obituary :	
Dr. J. K. Roberts, F.R.S. By Prof. Eric K. Rideal, M.B.E., F.R.S.	551
News and Views	552
Letters to the Editors :	
Radioactivity and the Origin of Life in Milne's Cosmology.—Prof. J. B. S. Haldane, F.R.S.	555
Nature of the Cation Exchanges during Short-Period Yeast Fermentation.—Prof. E. J. Conway and E. O'Malley	555
Effect of Colchicine on Golgi Bodies.—C. L. Foster	556
Plasma Cholinesterase in Male and Female Rats.—Dorothy B. Mundell	557
Prenatal Mortality.—Prof. F. W. Rogers Brambell and Ivor H. Mills	558
Diffusion Phenomena in Alternating Current Arcs.—J. J. O'Doherty	558
New Types of Optical Glass.—W. G. Bent	559
A Deluded Sparrow.—Dr. K. G. Britton	559
Wordsworth and Science.—H. A. Scruton ; Dr. V. B. Wigglesworth, F.R.S.	560
The Rare Gene *Rhy* in Mother and Son.—Dr. R. R. Race and Dr. G. L. Taylor	560
Technical Education of the Future	561
Relation of Academic Training to Industry	561
Correlation of Thixotropic Setting with Density in Silver Amalgams. By Dr. D. R. Hudson	562
A Simple Technique for Photomicrography. By Dr. W. N. Leak	563
Some South American Timbers	564
Petroleum : Past, Present and Future	565
Bombay Island. By Sir Lewis Fermor, O.B.E., F.R.S.	565

Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number : Whitehall 8831
Telegrams : Phusis Lesquare London
Advertisements should be addressed to
T. G. Scott & Son, Ltd., Talbot House, 9 Arundel Street, London, W.C.2
Telephone : Temple Bar 1942
The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad.

Registered as a Newspaper at the General Post Office

SCIENTIFIC RESEARCH IN GREAT BRITAIN

SCIENTIFIC workers have every reason to regard the debate in the House of Commons on April 19 on Sir Granville Gibson's motion calling for a bold and generous Government policy towards research with as much satisfaction as Mr. Attlee's encouraging reply. The debate itself ranged over a wide ground, and no scientific worker could desire to have so many of his points made more effectively or trenchantly than was done in its course. The case for adequate remuneration of the scientific worker was pressed even more forcibly than in the House of Lords debate last July, and the arguments on this point of Sir Granville himself, Mr. E. W. Salt, Mr. Edmund Harvey, Mr. J. Griffiths, Mr. Owen Evans and Captain Plugge, who touched also on the broad question of incentives, would have seemed incredible in a Parliamentary debate ten or twenty years ago.

The credit for this change of outlook must be attributed in no small measure to the work of the Parliamentary and Scientific Committee, the reports of which have done much to prepare the ground for the debate. It should be noted, however, that other recent reports dealing with scientific and industrial research, notably that from the London Chamber of Commerce, have tended to stress the importance of adequate remuneration if we are to attract men of outstanding ability to a career of scientific or industrial research, and the direction of such research. The note was equally prominent in the series of addresses on "Science and Industry" recently arranged by the Manchester Chamber of Commerce, and after Mr. D. Owen Evans's emphatic comment on the comparative salaries offered for research directors in the Government service, Mr. Attlee gave the assurance that the whole question of the payment of scientific men in Government service in relation to other Government employment of similar status is under consideration, and that already steps have been taken to raise the remuneration of the heads of research institutions.

The point is worth noting, less for its intrinsic importance or prominence in the debate, than as showing the measure of the progress made in recent discussions. The disposition to accord due status to the scientific worker is a factor the importance of which in recruitment and expansion of the ranks of research workers is not easily overstressed. Incidentally, it bears on the organization of the two-way traffic and constant interchange of workers to which Sir George Schuster and also Air-Commodore Helmore both referred in the debate. There are, as Sir George indicated, difficulties in arranging such interchange between research workers in the universities and in industry ; but whether or not a special inquiry, as suggested by Sir George, by a committee of university workers and industrialists is required, the establishment both in industry and in the universities of attractive, equable and comparable conditions of remuneration, status and service would remove one formidable obstacle to interchange.

That the importance of status and conditions of service of the research worker should receive recognition in this manner is the more encouraging because the whole spirit of the debate in the House of Commons showed an appreciation of the prime importance of establishing the conditions which not only attract first-class minds to research but also are conducive to creative work. Any idea that the value of research can be measured by the payment made to the research worker was as flatly squashed by Dr. Haden Guest as the idea that research results can be obtained to order was dispelled by the speeches of half a dozen members. Again, the importance of freedom of research work and of the freedom of the whole life of the universities was very well put by Mr. Edmund Harvey and by Mr. Griffiths, and the references to the operation of patent law were obviously prompted by a like concern to secure conditions in which fundamental research could be developed in complete freedom, and that knowledge made available as a result of public expenditure on industrial research should be used for public and not for private ends.

In the tributes paid to the achievements of research workers in Great Britain during and indeed before the War, and also in the refusal to regard quantity as more important than quality when British research effort is compared on a numerical basis with the research effort of other countries, and notably that of the United States, it was clear that members of the House of Commons realize that these factors of status, remuneration and conditions of work are all-important through their direct bearing on the research worker himself. In the expansion of research, whether in industry or at the universities, the personal factor is rightly put first, for unless the requisite quality is there, no amount of organization will enable us to overcome some of the handicaps under which we are placed in Great Britain, or to make the most of such advantages as we may possess.

This agreement on the prime importance of quality in the research worker himself was accompanied by equally emphatic agreement that, in the main, the fundamental research on which progress ultimately depends must be the task of the universities. For this purpose alone, expansion of the universities to meet the post-war situation is imperative ; but it is equally imperative to expand the teaching side so as to provide industry with the increasing number of scientific workers required, and, urgently, to be ready to re-train for careers in science and in research men from the Forces who will be released by demobilization. The extent of this expansion is a matter for discussion, but there is already a large measure of agreement that the present annual grant to the universities of Great Britain should be doubled or trebled at an early date, and that capital expenditure of some £10,000,000 will be required over the first five years following the War, and possibly double that figure in a long-term policy. Mr. Attlee, in his reply, made it quite plain, without committing himself to figures, that the Government recognizes there must be much greater expenditure both on fundamental research and on teaching at the universities.

With this general measure of agreement went a further consensus of opinion that adequate provision has not yet been made for continuing in times of peace the fruitful collaboration between science and industry which has contributed so much to the war effort. That was the central question raised by Sir Granville Gibson in moving his resolution, and the evidence that the present position is not regarded as satisfactory is to be found in the suggestions which came from all parts of the House as to the scope of that effort, the organization or co-ordination of our research effort itself, and finally the means by which the effective utilization of results in production can best be secured.

First, as regards scope. Mr. E. W. Salt, who referred in particular to the report of the Parliamentary and Scientific Committee on coal research, emphasized the opportunities which await intensive scientific research in this field ; he was strongly supported by Mr. Owen Evans, who put in a powerful plea that our industrial research should be directed to the industrial processes which exist in Great Britain, to the discovery of new industries, and especially to the utilization of raw materials which exist at home and in the Colonial Empire. In particular, he stressed the inadequacy of our geological surveys both at home and in the Colonies. In this plea he was followed by Mr. James Griffiths, who urged the necessity for central direction from the Government if we are to make the fullest use of existing scientific knowledge on the utilization of coal and build upon it a new integrated industrial structure.

Agricultural research in its broadest aspects found equally strong support. The expansion of our research effort in such fields as animal diseases and nutrition, food and nutrition, soil fertility, and biology, including fisheries, was repeatedly urged, and though the formation of an Economic and Social Research Council to take its place by the side of the Agricultural and Medical Research Councils and with the Department of Scientific and Industrial Research was not specifically mentioned in the debate, this vital group of human studies was clearly present in members' minds, as was shown in Mr. Shepherd's plea for research into distributive costs.

The unevenness of the present front of both scientific and industrial research was thus well brought out in the debate, and it was natural that there should be considered the further question as to the ways and means by which this can best be remedied. For the most part, the question as to the means by which some co-ordination could be effected in the expansion of the universities was that with which members were concerned. Mr. Price expressed the opinion that it would be better to bring the machinery responsible for giving grants to the universities more directly under the office of the Lord President of the Council, who already has the Department of Scientific and Industrial Research under his wing. This was one of the points considered in the report of the London Chamber of Commerce, although the committee responsible reached no decision as to whether or not the suggested central research board should be responsible for allocation of grants to the

universities for research. What Mr. Price had chiefly in mind, however, appears to have been that the right point of view is more likely to be represented if the machinery is handled by the department of the Lord President of the Council than by the Treasury.

Mr. Harvey suggested that it would assist, if not the University Grants Committee, at least the work of the universities, if there were formed an advisory council for the universities, to allow for the interchange of experience, for the development of work in harmony in different parts of Great Britain, the prevention of overlapping and the discussion of arrangements for new chairs for new subjects, so that money will not be squandered by three or four universities trying to start a new chair in a particular subject when one university would be sufficient if the effort could be concentrated. This suggestion was dismissed a little summarily by Mr. Attlee, but those who have advanced the idea of a universities advisory council are at least as aware as Mr. Attlee of the tenacity of the universities in regard to their independence and individuality, and of the practical difficulties of establishing any such body. In this connexion the proposal for the formation of a joint standing council of representatives of the University of Manchester and the Chamber of Commerce might have potentialities for university co-operation as well as for co-operation between science and industry.

To dismiss the suggestion without any constructive proposal as alternative is going too far at the present time. However generously the Government may be disposed—and able—to augment the grants for teaching and research at the universities, the best use cannot be made of the money available unless it is distributed in accordance with some definite plan based on national needs and not those of individual universities or even of regions. Sir Ernest Simon's recent pamphlet affords decisive support on this point for such criticism of duplication and waste as is to be found in "Redbrick University", for example. It should not prove an insuperable task to recast the functions and powers of the University Grants Committee to provide the essential machinery for such co-ordination if the establishment of a new body is inexpedient. Beyond this, there is the question of new universities and of the expansion of the technical colleges to university status—a question which should be considered from a national point of view.

Another suggestion, ventilated in the debate by Mr. Wootton-Davies, was that fundamental research should be organized by some sort of parliament of science—that universities should be represented on some sort of committee or parliament, with some directive force such as a Minister of Science to direct it. This suggestion also was rejected by Mr. Attlee; but while he rightly said that we need in all departments persons who are trained in the scientific method and appreciate what it means, as well as departmental research, he again failed to deal constructively with a proved need for co-ordination.

If, as Sir Granville Gibson said, it is necessary to plan the application of science to industry, it is no less necessary to plan, not in detail but broadly, the whole of research. The allocation of the Government grant to research as between industrial, agricultural, medical and other research, and pure and applied research, should not be haphazard but planned in accordance with national needs. This was Dr. Haden Guest's argument for making permanent the Scientific Advisory Committee of the War Cabinet.

To Dr. Haden Guest's suggestion that the Scientific Advisory Committee should be asked to prepare a plan for the development and carrying on of scientific research for a ten-year period, Mr. Attlee made no reply; but in regard to the means by which the effective utilization of research in industry can be secured, his attitude was more reassuring. On this question Sir George Schuster's contribution to the debate was the most important. He emphasized three things: the necessity of creating a more scientific frame of mind in British industry—which means many workers trained in science and a rapid development in all forms of scientific and technical education. Secondly, the closer contact between those engaged in scientific research and those concerned with its practical application—the two-way traffic already referred to; and thirdly, the discovery of further means of assisting the stage of development and the practical evolution of new industrial ideas. While deprecating some of the comparisons made with the United States, Sir George said that we have much to learn from them; in particular he referred to the Mellon Institute and its system of industrial fellowships as a method worth consideration by the small firms of Great Britain.

On this point Mr. Attlee stated that the Government recognizes the need for the establishment of some fund to meet the cost of developing new inventions and of providing facilities for testing new ideas for industry. The best way to meet this need and to fit it in with the work of the research associations is now under examination. Mr. Attlee was also careful, however, to point out that Government support for research must be backed by a readiness to use the results of that research. There must be receptive minds in those responsible for the conduct of industry and in the general public. Although the Government can do much to stimulate research, the main responsibility for applied research must continue to fall upon industry itself, and in many industries this is less a question of further expenditure than of assigning to research its proper part and status in the organization.

The personal encouragement scientific workers may well derive from the debate should stimulate them to further efforts in the task of education, no less than to determined thinking about the many difficult problems of organization and co-ordination on which the debate also touched. Certainly there could not have been put into their hands a more convincing demonstration of the dependence of a permanent increase in agricultural and industrial productivity on scientific research, on the speedy application of its results and the training and skill of the working population. The whole nation, as well as industry, must be roused to go forward adventurously and with faith in its future, to seize the opportunities in the post-war world which are so clearly within its grasp.

TAXATION AND RESEARCH EXPENDITURE

A FEATURE of recent reports on industrial research has been the emphasis which has been placed on the influence taxation is capable of exerting upon research expenditure. The Federation of British Industries, for example, has advanced the principle that all expenditure on research and development should be chargeable against revenue, either immediately or over the commercial life of any asset created. This principle was strongly endorsed by the Industrial Research Committee of the Federation, which in its report last autumn referred to the deterrent effect on the expansion of research of any narrow interpretation of what is allowable expenditure for taxation purposes. The London Chamber of Commerce, expressing its agreement with this view, urged further that the cost of pilot plant, as well as of laboratory buildings and equipment, should be made chargeable against equipment. The question has been further examined by the Parliamentary and Scientific Committee, which in a memorandum on Taxation and Research examined the present position and instanced some of the defects of the present system. This memorandum was based on the ideas first that in modern conditions no industry can maintain its competitive position unless it devotes adequate effort and money to scientific and industrial research. This applies with special force to British industry, having regard to the conditions and tasks which will confront it after the War. Secondly, the money required for such research will be substantially greater than in the past. Again, judged by standards in other industrial countries, and quite apart from its own exceptional needs, British industry has in the past devoted far too little effort and money to scientific and industrial research; and lastly, an increase in the productivity of labour, which is one of the main consequences of industrial research, is a vitally important factor in making possible an improvement in wages and social services. The recent debate in the House of Commons on Government provision for research showed that these ideas are widely shared.

The memorandum went on to urge that every impediment to the undertaking of scientific and industrial research by British industry should be removed and inducements provided to stimulate progress. In particular, the memorandum recommended that the law relating to the taxation of profits should be amended so as to recognize the principle that all expenses incurred on research and development are allowable as deduction from taxable profits, with the corollary that receipts from a lease or sale of discoveries should be brought into taxable profits. Expenditure on research which creates a tangible asset with a measurable life, and expenditure on the purchase of patents and processes, should be similarly allowable over a period of years. All other expenditure should be allowable in the year when it is spent. No distinction should be made between pure research and applied research and development. A special writing-off allowance on capital assets provided solely for research purposes was also suggested, as well as the increase of depreciation rates for industrial buildings and plant to include obsolescence by an arbitrary addition to the rates allowed for wear and tear.

Sir John Anderson went far to meet these proposals in his Budget speech, which may well be regarded as something of a landmark in this respect. Recognizing first the supreme importance of appropriate allowances for capital expenditure in relation to reconstruction to enable British industry to meet the post-war challenge, he proposed a special allowance of 20 per cent of the cost of new plant and machinery, and as a part of post-war policy that the obsolescence allowance should be given when plant and machinery are scrapped, whether the particular piece of plant or machinery is replaced or not. With regard to buildings such as factories and buildings associated with them for welfare purposes or storage, he proposed an annual depreciation allowance of 2 per cent with an initial allowance of 10 per cent as an immediate instalment.

Referring to scientific research, the Chancellor of the Exchequer believes there is a case for modifying the distinction drawn for income-tax purposes between capital and revenue expenditure on research. He therefore proposes that any research expenditure of a capital nature, including expenditure on laboratory buildings, plant and machinery, should be allowed for a period of five years, or for the life of the asset, whichever is the shorter, as a deduction from profit for income-tax purposes. Further, any payment, whether for capital purposes or not, made by a trader to a central research body approved by the Department of Scientific and Industrial Research, should be allowed as and when made as a deduction in computing the profits of the concern.

Sir John Anderson, after observing that we should not depreciate our own efforts in the field of research, went beyond these proposals to relieve from taxation funds devoted to research, and expressed the hope that there would be much wider pooling of ideas in the field of research, and that the industrial research worker should be encouraged to regard himself not only as a servant of the organization which pays him, but also as a contributor to the sum total of available knowledge. Referring to chemical industry and the extraction of products from oil and coal, where plastics is only one of the fields opened up, he said that there should be no obstacle placed in the way of chemical industry in obtaining raw materials from oil. He was not prepared to place scientific proposals before Parliament at the moment, but proposed to arrange with the Minister of Fuel and Power for an inquiry to supply the data required for specific proposals.

Following so swiftly on the debate in the House of Commons on Sir Granville Gibson's motion on April 19 (see p. 539), the Chancellor's speech should give the liveliest satisfaction to scientific workers. His speech, no less than his proposals, leave no room for doubt as to the importance the Government attaches to research, or its appreciation of the contribution scientific workers have made to the war effort. That

such proposals and recognition should find so prominent a place in the Budget speech affords firm ground for the hope that scientific workers will be given a full opportunity to play their part in reconstruction, and that the Government is determined to establish the conditions in which scientific and industrial research may make the largest possible contribution to the progress and well-being of the nation.

RHEOLOGY: PRACTICAL AND THEORETICAL

Ten Lectures on Theoretical Rheology

By Dr. Markus Reiner. Pp. iv+164. (Jerusalem: Rubin Mass; London: H. K. Lewis and Co., Ltd., 1943.) 22*s*. 6*d*. net.

A Survey of General and Applied Rheology

By Dr. G. W. Scott Blair. Pp. xvi+196. (London: Sir Isaac Pitman and Sons, Ltd., 1944.) 18*s*. net.

RHEOLOGY probably owes much of its appeal to the fact that it has not yet developed into a fully established science with a generally accepted subject-matter and method of treatment. The study of the "flow and deformation of matter" might include almost anything in Nature, and indeed there are few industries in which problems essentially rheological in character do not arise. These problems frequently have to be attacked by chemists, physicists or engineers whose training has provided them with only a very meagre basis on which to work, and the appearance of two books on rheology by two of the best-known pioneers in this field will be especially welcome to them.

The two authors approach their subject at very different angles. Dr. Reiner, taking the point of view of the mathematical engineer, develops his subject by methods of the kind with which we have become familiar in the classical theory of elasticity. He says, in effect, "These equations represent possible types of behaviour of matter; let us see whether we can find materials which behave accordingly". Dr. Scott Blair, on the other hand, sets out from the experimentally observed rheological phenomena (of which he possesses an encyclopædic knowledge), tries to find equations to represent the data, and hopes that an explanation may emerge.

Dr. Scott Blair shows us that the essence of a rheological investigation is the determination of the relation between the three variables, stress, strain and time. Starting from a consideration of the two extreme 'ideal' materials, the Hookean elastic solid and the Newtonian viscous liquid, he leads up to the discussion of those more complex materials (which are the special concern of rheology) for which both the amount of strain and rate of straining vary with time, under constant applied stress. Such materials combine some of the characteristics of both the solid and liquid states. Altogether there are at least nine main types of deformation (or flow), which are presented in the form of a table, but this is not considered to be exhaustive. Thixotropy, dilatancy, plasticity, false body and a number of other rheological phenomena are discussed in detail, and particular attention is paid to the question of definition of the terms employed. The book contains a full discussion of the significant information to be sought in a rheological investigation, and a critical examination of the experimental methods available. A valuable feature is the inclusion of a comprehensive collection of references, carefully arranged and annotated. (But why Roman numerals for volume numbers?)

In the second part of the book Dr. Scott Blair deals with a subject which has so far received comparatively little attention by rheologists, namely, the very important practical question of the relation between physical measurements and psychological judgments. The problem confronting the rheologist in industry is to find quantitative methods of assessing properties which the skilled craftsman is in the habit of judging by thumb-and-finger methods. The concepts entering into the judgment are usually mixed, and seldom consciously appreciated. The situation is very well illustrated by the concept of 'firmness', which has been the subject of a special investigation by the author and his collaborators. From the results of this investigation one is forced to conclude that the concept of firmness is not based on a mental analysis of perceptions into concepts of the kind with which ordinary physics deals, such as, for example, average applied force or total strain. The judgment appears to be a direct reaction to the total situation, in which all the relevant components are appreciated as a single integrated pattern or *Gestalt*. Here one is in danger of becoming involved in the philosophical mystery of the relation between the conscious perceiving mind and the external (?) perceived universe. But without going so far, one must recognize that Dr. Scott Blair has brought out the rather fundamental difficulty of what might appear at first sight to be a straightforward problem in rheology, and this presentation of his unique experiments will be generally welcomed.

Dr. Reiner begins his "Lectures" with an analysis of stresses and strains, using tensor notation. He develops the conception of a general rheological equation relating stress and strain and the time-derivatives of these variables. By suitable choice of the terms of this equation, special cases are obtained which represent possible types of rheological behaviour. Arranging the types in order, we have at one end the Euclid (incompressible and undeformable) solid. Then follow the Hookean (ordinary elastic) solid, and the Kelvin (viscous) solid, in which the elastic deformation is subject to a time lag. At the other extremity we have the Pascalian (incompressible non-viscous) liquid, the Newtonian (viscous) liquid, and the Maxwell (elastic) liquid, in which the stress decays with time. The properties of these types are discussed, and compared with actual materials. The intermediate region contains the more complex types, some of which are discussed in detail. The table may be compared with the rather similar table of deformations given in Dr. Scott Blair's book.

A number of special problems are considered, including, in particular, the theory of breaking. It is shown that a Kelvin solid breaks when the *strain* reaches a given value, while in a Maxwell liquid failure occurs at a critical value of *stress*.

It would appear that in respect of purely elastic strains, the tensor methods used in this book are applicable only when the strains are small. Many rheologists would like to know what methods to apply in the case of large deformations.

Both the works under review, which are in a sense complementary, should be studied by all who are interested in rheology. L. R. G. TRELOAR.

THE ART OF THE OPTICIAN

Optical Workshop Principles

Being a translation of "Le travail des Verres d'optique de Précision", by Col. Charles Dévé. Translated by Thomas L. Tippell. Pp. xiv+306. (London: Adam Hilger, Ltd., 1943.) 20*s*. net.

IT may at first sight seem surprising that a second book on the grinding and polishing of lenses should have been published by Hilger's so soon after their publication of "Prism and Lens Making" by Mr. Twyman. But there are at least two reasons which justify such a course. In the first place, lens-making is a craft, and each craftsman's account of his experience has something of value to every other craftsman. In the second place, the author is a Frenchman, and it is much to be desired that information about the techniques employed in one country should be made available in other countries. It is a novel experience to find the names of pioneers turn out to be names of Frenchmen rather than Britons, while the sources of specially suitable material or apparatus are quoted as French rather than English.

The book is based on the instruction given at the Institute of Theoretical and Applied Optics, Paris, to students of optical glass-working, and Part I is specifically addressed to working opticians. Part II is of a somewhat more advanced character and is intended primarily for works managers and senior workmen engaged in the supervision and direction of high-grade optical work. There is a great deal of useful information in the various sections, from recipes for cements and details about abrasives and polishers to methods of testing by interference and otherwise and to processes of etching, silvering and so forth. But by far the most important part of the book is concerned with the mechanical problems involved in producing a surface of given shape and curvature.

It is no easy matter to evaluate the relative effects of the different motions, rotational and translational, of either the tool or the work on the shape of the surface being ground, yet without some knowledge of the underlying principles, the average workman may easily go astray when he is put to a novel or unaccustomed task. The chapters dealing with the production of spherical and cylindrical surfaces, the effect of the size of tool, the pressure to be exerted, the surfacing of lenses of deep curvature, retouching, thermal deformations, working of metallic mirrors and so on, which include several theorems regarding the distribution of wear under various conditions, are a valuable contribution to the art of lens-making. An unusual, though not unwelcome, feature in a book of this type is the inclusion of a number of exercises to demonstrate the application of the principles which have been described.

It is somewhat surprising to find that the author has not dealt to any serious extent with the nature of the action of the abrasive on the surface of the glass during grinding and polishing. Even if the actions of the workman cannot be adjusted to modify the character of a ground or polished surface, it would have been interesting and instructive to learn whether the author considers, for example, that the polish on a surface arises from thermal flow or from extremely fine abrasion.

The translator is to be congratulated on his English rendering of the text, and on the useful vocabulary of French technical terms with their English equivalents. The footnote which he has added as a correction on p. 224 is itself in error; but in general the book would seem to be commendably free from mistakes.

As the translator remarks in his foreword, it was unfortunate that owing to the War the author and translator were not able to exchange ideas, as this might have allowed for the omission, or amending, of one or two passages which to an English reader may well seem too simple and naïve; this would apply, in particular, to the opening paragraphs of Chapter 1. But without the author's authority any such amendment would obviously be unwarranted.

W. D. WRIGHT.

WATER PURIFICATION

The Purification of Water Supplies

By George Bransby Williams. Pp. 95. (London: Chapman and Hall, Ltd., 1944.) 7*s*. 6*d*. net.

THE appearance of a book on the purification of water supplies is most opportune at the present time when it is generally realized that all is not well with the water supply of Great Britain, especially the supply in rural districts, and when it is recognized what an important part water will have to play in the reconstruction problems with which the country is faced.

The author has attempted too much in too short a space. He has, in less than twenty pages, attempted to give a review of the principles of chemical science as evolved from the time of the Egyptians thousands of years ago, through Grecian, Roman and Arabian knowledge to the work of the Curies and of J. J. Thomson and Rutherford on the electronic structure of the atom. Such an attempt might well have proved disastrous; but not so in this case, and a readable chapter has resulted.

The book is arranged in eight chapters, each dealing with one or more aspects of the material considerations which arise in order to render a natural water fit for human consumption. These various aspects are enumerated rather than explained, and the experience of American and Indian practice is drawn upon very largely, while the accumulation of knowledge acquired by British practice is drawn upon to a less extent.

The chapter dealing with colloidal matter in water can only be described as sketchy, and in the chapter dealing with chemical precipitation the theories of coagulation and flocculation are inadequately explained.

The book serves a useful purpose in directing attention to the various points which must be considered when subjecting water to purification processes, and in stressing the fact that efficient scientific control of all operations connected with purification of water supplies is essential. Water purification is not a matter for the amateur, but is a subject which deserves far more co-operative attention from the engineer, the chemist and the biologist than it has received in the past.

A more careful proof-reading would perhaps have added to the value of the book. For example, Fig. 4 on p. 52 should have referred to the "accelator" type of water softener and not to the "accelerator" type; sodium bisulphide (p. 76) is not used for dechlorination, but sodium bisulphite has been so used. It would have been possible to make a better selection for the eleven illustrations in the text.

H. T. CALVERT.

THE WELLCOME–MARSTON EXCAVATIONS AT LACHISH, PALESTINE*

By OLGA TUFNELL

THE broad purpose of archæology is to increase our view of history. The field archæologist works for the historian ; together they try to extend our line of vision, to indicate fresh points of view and fields of inquiry, and to sketch in the background and elaborate the detail of the known historic scene.

We owe our knowledge of Egyptian and Mesopotamian history almost entirely to recent archæology, but the history of Palestine has been preserved for nearly four thousand years, and is a unique means of control for archæological data, which can be checked against Biblical tradition.

The geographical position of Palestine makes it a land bridge connecting Asia and Africa. Many people left traces of their passage and assimilated something of the countries they passed through. Experience has shown that, if we are to assess cultural connexion or influence, style of decoration is more reliable than form or technique. Shape and method can be re-invented, but style is an æsthetic expression which in its less primitive stages shows marked individual characteristics. Thus the potsherd is sometimes more important than the palace, but all material remains add something to the perspective of the past.

With these thoughts in view, it was the intention of the expedition which became the Wellcome–Marston Archæological Research Expedition to the Near East to tap the lines of communication across the land bridge at strategic points, and to follow them in whatever direction they might lead.

Sir Henry Wellcome with Sir Charles Marston, Sir Robert Mond and Mr. H. D. Colt first considered the choice of a site in 1932, and the possibilities were discussed with Mr. J. L. Starkey, who became director of the Expedition, which set out in the autumn of that year. The choice of a site as a control point is influenced by practical considerations, water supply, accessibility, expense, quite as much as by geographical position and historic importance. Among the sites considered, Tell ed Duweir seemed to fulfil the requirements, though the soil was much encumbered by heavy limestone blocks, and the area of eighteen acres obviously required many years of systematic work. The promoters of the Expedition did not hesitate to undertake the task, trusting in Mr. Starkey's great abilities.

It is immaterial whether or not Tell ed Duweir can be definitely identified with Lachish. Its central position in the Shephelah, on the main Gaza–Hebron road, between Gaza and Jerusalem, shows that it must have been an administrative town of importance throughout its long history from the Early Bronze Age—say about 3000 B.C.—to the Persian conquest about 400 B.C. The lack of Greek and Roman remains facilitates excavation and was apparently due to a reorganization of the road system when the point of intersection of various routes was shifted to Beit Jibrin.

The Early Bronze Age appears to have been the most flourishing era at the site chosen. The extension of a limestone ridge, surrounded on three sides by valleys, which later became a 'Tell' or mound through the accumulation of debris, was already occupied. The circle of adjoining hills and the lower slopes of the mound were thickly pitted by caves, artificially enlarged, where a troglodyte population lived and traded outside any line of defence which may have existed on the crest of the ridge itself. The extent of the area covered by these dwellings is approximately 200 acres ; so vast a centre of early life is unusual in Palestine, and the contents of these caves are easily exposed, in contrast to the stratified levels on the mound, which are below 45 ft. of town deposit. In order to obtain a connected view of events, as illustrated by the sherds, two sections were examined. The lower 10 ft. at the north-east corner probably date from the fourth millennium, and could reveal much that is new and foreign to local culture.

Some hundred and fifty pottery forms have been drawn and recorded from the cave dwellings, and they should add their quota to the steadily increasing knowledge of the Early Bronze Age, in which four distinct phases can now be recognized.

In common with observations from other sites, we note a tremendous cleavage in cultural affinity at the beginning of the Middle Bronze Age at Tell ed Duweir. The people dwelt in houses and built walls around them ; the caves were often used as burial places. There is a total change in pottery technique, and a marked increase in the use of copper, which had already made an appearance in the transitional stage—only represented at Tell ed Duweir by a series of poorly furnished tombs. Scarabs were added to the equipment of the dead, and among the daggers one was found to be inscribed. Apart from many incised marks on Early Bronze Age pots, this is the earliest inscription yet found at Duweir, and it is close to the Sinaitic script associated with the origin of the alphabet.

For the first time, a system of defence became necessary, either against the dissatisfied remnants of the previous population, or against further newcomers of the invaders' kin. So far as we know, the earliest method of defence at Tell ed Duweir (though excavation may reveal an earlier one) consisted of a fosse some 8 m. broad, cut in the limestone, while the material taken from it was piled against the natural scarp of the mound to form a slope or glacis. It has been examined at the north-west corner of the mound, where the slope was cut into by the Iron Age city wall. But it was a fortunate position, for after clearance of the packing, a small oval grave was discovered, cut into the native rock. The body was immature, and the group of pots and bowls were all distinctive types. The position of the grave, and its relationship to the layers of thrown limestone from the excavation of the fosse, leave no shadow of doubt that it preceded this engineering work by some years.

Since Sir Flinders Petrie's excavations at Tell el Yehudiyeh, a small fort to the east of the Nile Delta, where he first discovered fosse and glacis fortifications, it has been assumed that the people who built them were also responsible for a particular kind of black pricked ware and 'button-base' juglets found at the site. The people known as 'Hyksos' or 'shepherd kings' set up a foreign dynasty in Egypt lasting about two hundred years, towards the end of the Middle Bronze Age. On comparing the evidence from Tell

* Substance of a Royal Institution discourse delivered on February 18.

Fara, south of Gaza, it is significant that in the graves of the period no button-base flasks were found, either of the red burnished or black pricked ware, though the typical fosse and glacis defences existed.

As Mr. Starkey pointed out in 1933, there is some further evidence provided by a decorated pot, found with a mass of other pottery on bedrock in the fosse. It is therefore undoubtedly later than the oval grave and the fortification. The decoration compares with similar motives, notably the bird and fish, from other sites in south Palestine and in Syria of the same period, about 1600 B.C., and the style of drawing in both areas is similar.

Prof. Speiser, in his account of excavations at Tell Billa on the Orontes, has directed attention to the duplication of the whole repertoire of decorative motives found at this period in Palestine in level 4 of his site. In addition, the cuneiform correspondence from Tell el Amarna, and Ta'annek in Palestine, reveals the presence of governors and officials with names of non-Semitic origin, belonging to the dialect used by this Hurrian people from north-east Syria. Prof. Speiser suggests that the Hurrians as represented at Tell Billa (3) were conspicuous among the later 'Hyksos' groups. They were possibly the dominating class in Palestine before the Hebrew invasion, and if so, it would account for the loyalty of some of Egypt's local governors, during the troubled times which are so dramatically described in the Tell el Amarna letters.

It seems that we are gradually acquiring the facts in south Palestine which will enable us to differentiate between the influence of the so-called 'Hyksos' people and that of the non-Semitic Hurrians, who figure so largely in the ethnic movements north of Palestine in the second millennium.

The relationship between the Yehudiyeh pricked ware, the fosse and glacis, and the three structures of the Fosse Temple (the contents of which were published in a volume of that name in 1940) will assist in this intricate problem. The actual position of the temple on the disused fosse emphasizes the intrusive nature of the cult, and we have yet to discover the earlier centre of worship, which presumably occupied a prominent position on the mound.

A point which links the Fosse Temple cult to that of the Hebrews in the following century is that the sacrificial bones found in the structures were almost exclusively those of the right foreleg; sheep (or goat), ox, and two wild beasts, gazelle or ibex, were represented. In the Mosaic peace-offering the right shoulder was offered before the altar and retained by the priest, and this ritual was also observed by the Babylonians.

Of objects with foreign connexions from the Temple deposits, I should mention the 'lion hunt' scarab of Amenhetep III, who reigned between 1411 and 1375 B.C. Duplicates have been found in many provincial centres, and they record that the king killed "lions terrible, 102, by the 10th year of his reign". It was found on the altar of Structure III, but in common with the ivories and glass associated with it, these temple treasures seem to have been preserved since the enlargement of Structure I. Its presence at Duweir marks the point of junction with Egyptian written records and opens their rich annals of imperial expansion.

A Mykenæan cup (1500–1400 B.C., according to Helladic sources) is the first link with that culture, and it formed part of the altar-group belonging to Structure I. Some twenty-five forms are identical with the wares usually attributed to Cyprus and Syria.

The development of the temple can be traced through two hundred and fifty years of comparative peace and growing prosperity. The earliest structure was founded about 1475, and the third building, greatly enlarged, was destroyed by fire with most of the temple equipment about 1223 B.C., on evidence provided by a cartouche of Rameses II. This destruction also overwhelmed the Bronze Age town; indeed, most of the contemporary cities of Palestine and Syria were involved in a similar catastrophe.

There is nothing to show from Duweir as to the force which effected the destruction. It was only gradually that the life of the city was resumed, and it is likely that foreign trade connexions were not so flourishing as they had been in the late Bronze Age town, when examples of three scripts, Sinaitic, hieroglyphic, with its cursive form hieratic, were in contemporary use, quite apart from cuneiform which also occurs in south Palestine.

From the beginning of the Iron Age other sources of written record become helpful. The Old Testament is full of administrative detail, and it is clear that the officials of the time were occupied in problems of local defence, particularly after Solomon's death about 935 B.C. Rehoboam, his son, fortified fifteen cities in Judah, and Lachish, with its neighbour Azekah, among them.

An inner and outer stone wall still encircles the mound at Tell ed Duweir. Though it is battered and burned, the line can be traced without a break. The upper courses were built of brick, and both brick and stone surfaces were faced with a coat of white lime plaster. Though this system of defence may have been intended as protection against Egypt, there is good reason to attribute the signs of the first attack to the invasion of the Assyrians under Sennacherib about 700 B.C. The commemorative relief in his palace at Nineveh, found by Sir Henry Layard, shows the assembled might of his army before the city of Lakhisha. The method of attack is shown in great detail, and at Tell ed Duweir we see corroborative evidence of some similar event; we find sling shots, fragments of scale armour, a helmet crest and arrowheads in profusion.

A cave had been used about this time as a repository for skulls; they had been thrown in through a hole in the roof and many had rolled down the conical heap to the sides of the chamber. The bodies had been moved to this cave after disintegration, and a few skulls showed signs of burning. The series of seven hundred skulls has been studied by Mr. D. L. Risdon with Dr. G. Morant of the Galton Laboratory. The adults were younger on the average than the usual cemetery population, which gives colour to the supposition that they died in a catastrophe. Mr. Risdon's statistics place the Lachish series in close connexion with the contemporary Egyptians, with two differences.

Sir Arthur Keith, in a valuable article published in the Palestine Exploration Fund Quarterly Statement (January 1940), wrote as follows: "Mr. Risdon notes among the Lachish people two characters which are non-Egyptian, namely narrowness and prominence of the bridge of the nose and curvature of the cheek-bones. From these characters alone I should have suspected that the Lachish people were

racially different from the Egyptians." Sir Arthur referred to the Lachish series as "the first complete account of the racial characters of a people living in Palestine during biblical times".

In the same depository of skulls, three examples were found to be trephined. This operation was common so early as neolithic times in Europe, North Africa and even the two Americas. It is also practised by primitive people to-day. The specimens from Duweir are unique, being the only ones so far discovered in the Near East, and their presence shows once again the many influences which affected the coastal strip. It is not possible to say whether the operation was therapeutic or magical. Two methods occur at Duweir: one was removal of the disk by cross cuts, as seen in two skulls where the sharp edges indicated that the patient died shortly afterwards, and there is a triangular type more akin to the European method of scraping, which gave the patient a better chance of recovery.

The Babylonian campaigns which mark the virtual end of the city are well attested both in their own and Biblical records. The period between 700 and 600 B.C. is represented on the mound by a district of shops and houses protected by a city wall which had been repaired since Sennacherib's attack. The Babylonian commander was aware of the perils of leaving partially destroyed fortifications, and he burned long sections of the wall by heaping great piles of olive trees and brushwood against them. In the charred debris, we still find the calcined olive stones which show that destruction took place in the autumn just before harvest time.

At the gate of the city, in the guard-room of this last period of fortification, while sorting a mass of blackened sherds, Mr. Starkey with Mr. Harding found the now famous "Lachish Letters". They form an invaluable link with the Bible record; for the first time we can study the handwriting of contemporaries of the prophet Jeremiah, written in the beautiful pre-exilic script, which is allied to our own alphabet through the Phœnicians. Dr. H. Torczyner, who undertook the publication of the letters, has noted many Biblical names and directs attention to phrases which have all the flavour of Old Testament language. Letter IV includes the sentence, "if in his turning (on his rounds) he had inspected, he would know, that for the signal stations of Lachish we are watching, according to all the signs which my Lord gives, because we do not see (the signals of) Azekah". These words imply that Lachish and Azekah were still linked in the same system of defence as in King Rehoboam's reign.

The defences of Duweir were finally broken about 600 B.C., but the town enjoyed a short period of revival during the Persian occupation. The Persian residency crowned the site for a few years, and was built on the massive foundations of the earlier Judæan fort.

In presenting the shadowy traces of the many peoples who passed by, it is hoped that in years to come some one will carry forward the work which James Leslie Starkey began.

REFERENCES.

"Lachish I." By H. Torczyner. (Oxford University Press, 1938.)

"Lachish II." By O. Tufnell, C. H. Inge and L. Harding. (Oxford University Press, 1940.)

Biometrika, 31, 99 (1939). "A Study of the Cranial and other Human Remains from Palestine, excavated at Tell Duweir (Lachish) by the Wellcome-Marston Archæological Research Expedition". By D. L. Risdon.

MUSCULAR AND MENTAL RELAXATION IN PEACE AND WAR*

By DR. E. J. BOOME

RELAXATION means more than just a holiday or a lazy time; it means concentration and not inertia.

The relaxation of muscular exercises, in moderation, re-creates the body and conduces to physical fitness, which is one of the chief bases of mental poise and well-being. But relaxation is much more far-reaching in its effects and more constructive in its processes. Beginning with a muscular loosening, it leads to a gradual re-creating of the individual. This form of self-treatment, apparently very simple, is more complex than is realized by the beginner.

Everyone feels the state of tension in the world to-day and the need for some antidote to counteract it. This tension—always in the world even in time of peace—is greatly aggravated by war conditions. In individuals it is expressed by muscular hypertonicity, in mental worry, fear, anxiety, in emotional repression and nervous strain. These factors sometimes react upon each other and cause a breakdown.

Nervous cases tend to become more frequent in days of fear and anxiety such as we have all been through during the past four years. Some people come back automatically to normal, but others do not. Often the attitude of friends and relations intensifies the feelings of these people. Even medical men sometimes say: "There is nothing wrong with you, it's only your nerves or your imagination". Nowadays, we are more careful because we realize that such an attitude only makes these patients ponder more over their ailments, imaginary or otherwise. This makes matters worse, as they become almost convinced that there is really something wrong with them and turn to patent medicines which claim to cure all their ills.

Annie Payson Call, in her book "Power Through Repose", very wisely said:

"Where is the good of taking medicines to give us new strength, while at the same time we are steadily disobeying the laws from the observance of which alone the strength can come? No medicine can work a man's body, while the man's habits are constantly counteracting it. Where is the use of all the quietening medicines if we only quiet our nerves in order that we may continue to misuse them without their crying out? They will cry out sooner or later."

In order to prevent this, we must first investigate the causes of hypertension.

The body reacts on the mind and vice versa. This happens in cases of real illness, particularly if the patient has never been ill before. He gets anxious about his condition and even becomes angry with himself for being ill. This sets up and increases mental and muscular tension and retards recovery. A cheerful patient, on the contrary, generally recovers more quickly.

Work never killed anybody, but the *worry* which is added to and mistaken for work has caused many a breakdown. In war-time there is often the element of fear added, which increases the wear and tear of one's daily occupations. Many people waste 50 per

* Substance of a Chadwick Trust Lecture delivered on October 5 at the Royal Institute of Public Health and Hygiene.

cent of their efficiency and adversely affect the environment of those working under them because of their own anxious temperaments. Often they cannot see the harm they are doing to themselves and others and scornfully refuse any suggestion of treatment.

In Great Britain 20,000,000 are employed, many on war work. 40,000,000 weeks a year are lost from sickness, of which it is estimated that we lose 8,000,000 weeks of work a year through gastric and nervous disorders. Many so-called gastric disorders are not due to disease of the gastro-intestinal tract but to functional dyspepsia—an emotional disturbance which shows itself by gastric disturbances. A similar proportion of imagined 'nervous dyspepsia' found among civil defence workers (ambulance, fire brigade and rescue services) clear up with a change of scene and rest.

War-time restrictions which control the lives of 8,000,000 civilians give a sense of frustration, and may cause nervous illness and anxiety in some people. This discontent and frustration caused by war-time conditions may be alleviated by the Ministry of Labour schemes for 'rest-break' homes for war workers. These are to be greatly extended, and soon a network of these hostels will be established throughout Great Britain. Pamphlets such as "Fighting Fit in the Factory", explaining the necessity for rest whenever possible and telling workers the best way to relax, can help.

Much is being done by the Ministry of Labour and National Service to make the life of the workers as harmonious as possible.

Some so-called 'authorities' say that complete relaxation is impracticable in everyday life. It is not only practicable but also desirable. The complete process is obviously not possible in all circumstances and places, but we need not use so much unnecessary muscular energy in the ordinary ways of life, such as clenching the jaw when writing or pushing against the floor with the feet when riding in a bus. Legs should sometimes go 'off duty'.

Relaxation in Crafts and Sports

Most crafts and sports depend upon rhythm to attain the best results. Rhythm again depends on correct timing, which can only be carried out by muscular balance. This is brought about by alternate muscular contraction and relaxation. The excitement of some forms of sport may cause hypertension, and the more this increases the less efficiently are the necessary movements carried out.

In yachting the helmsman must have complete muscular control to steer a steady course, as well as being mentally wide awake to take decisions and give orders to his crew.

Rhythmic timing is shown in such diverse sports as boxing and fishing, while success at golf and many other sports depends on accurate timing.

Eric Linklater in the "White Man's Saga" gives a beautiful description of the boxer. He says :

"There is beauty in boxing when men stand upright and step lightly. There is design in their movements, and significance as charged as that of the ballet. Counterpoise follows on poise, defence on attack, reaction on action with a balance, a trim symmetry that quickens as the blood beats and grows and swells into a pounding orchestration of thudding fists and shifting, sliding feet; for an instant there is repose, the sculptured austerity of two figures, motionless, poised like statues on the verge of life; and then their static energy is again released to mingle dynamically in a crescendo of action".

Tobias Matthay in "The Visible and Invisible in Piano Technique" emphasizes the important changes of state of exertion and relaxation of the playing limb which form the real basis of good technique, but which, being invisible, have escaped attention.

Physiological Facts with Regard to this Thesis

Resting muscle is alkaline, whereas over-worked or fatigued muscle contains lactic acid. The amount of the latter is in proportion to the amount of tension.

Pain and violent emotion of any kind such as anger or fear cause chemical changes by releasing toxic substances and excessive glandular products into the system, which have to be carried away and thrown out by the blood stream into the channels of excretion. Excessive adrenalin in the blood may lead to vascular troubles and other harmful conditions unless dissipated either by action or muscular relaxation.

Long-distance runners are massaged so that the muscle gets rid of its waste products more quickly. Return flow of blood to the part is increased after contraction and relaxation, so circulation is increased.

Medical Examination

Muscular relaxation is of the greatest assistance in medical examination. If a candidate for superannuation and pension or life insurance presents himself before the medical examiner strung up to a state of tension, he will show signs of quickened heartbeat and his chest will tighten up with inhibition of breathing. He may stand stiffly to attention, thinking he is thus making the best of himself, which causes his blood pressure to go up under the strain he makes himself undergo. If the medical man can persuade him to relax the task is much simpler, time is saved and the candidate feels happier. A 'bedside manner' really is a useful, if not an essential, asset to a medical man. It means he is himself relaxed, has poise and can thus command confidence.

Often the practice of relaxation can cure stammering and relieve high blood pressure.

Stammering

This distressing condition was one of the reasons I became interested in relaxation. In 1919, I was placed in charge of centres for stammerers. In those days we used only voice training and speech drill, treating the symptom and not the cause, and the results were depressing.

Psychological and temperamental readjustments are of great importance in the treatment because the stammerer's outlook on life in general and himself in particular is depressed and usually negative.

Relaxation calms and reassures the sufferer and enables him to carry out his day's work quietly and efficiently. All his characteristic symptoms of tension disappear and he becomes a strengthened, stable and self-respecting person, ready to face the world with confidence.

Asthma is a nervous complaint rather like stammering. Good results are obtained by relaxation therapy in these cases, and diminution in frequency and severity of attacks follows treatment. The nervous tension and anxiety so frequently found in these cases are much diminished. The breathing becomes easier, confidence is restored and the distress is abated.

With regard to birth palsy, I have seen excellent results with muscular relaxation for the paralysed limbs. Relaxation seems to give increased confidence, with consequent improvement in gait, and also to make the best use of the injured muscle.

In cases of tennis leg and tennis elbow, relaxation is an important part of the treatment.

According to the late W. Trethowan, 85 per cent of cases of spinal curvature are due to functional nervous disorder and are not indicative of any organic disease. This condition usually denotes that a larger call is being made on the child than its general physique will stand. It is often found during adolescence and may be associated with enlarged tonsils, adenoids, constipation or over-pressure in study.

Attention to the general health usually results in the disappearance of the defect. Early cases of spinal curvature respond better to a midday rest in the recumbent position than to exercises. It is useless to try to heal the muscles by working them. Muscular relaxation practised under expert guidance is of untold value; it not only rests the patient but also is definitely curative in effect.

An elementary school teacher of great experience told me that children suffered less when the *Blitz* was at its height, because they were in the shelters early and went to sleep. During later raids they no longer went to the shelters regularly but played in the streets and went to bed late. When the sirens sounded they were got out of bed, with resulting greater fatigue and emotional disturbance. In one day raid in 1943 there were bombs and machine-gunning in the streets which caused an increased amount of tension at the time and delayed progress in relaxation therapy at some of our speech centres. On the morning after the winter raids of 1943 it was interesting to notice that the children relaxed voluntarily for a much longer time than usual.

The evacuation of school-children has shown that far more children suffer from enuresis than was generally supposed. Some cases are the result of neglect in training, but the majority are attributable to nervous causes. Some children develop this habit on being evacuated to the country, but in many cases it stops if the child settles down happily. If the enuresis is of long standing and the child is unhappy, it may be necessary for the case to be sent to a special hostel, though it is doubtful whether this segregation is satisfactory in all cases. A nervous, sensitive child may develop a sense of shame difficult to eradicate even after the enuresis has been cured.

Stammerers suffering from enuresis have been cured of this habit through relaxation, and cases have been known where the enuresis has ceased after one week's attendance at a centre.

In the case of writer's cramp, there is, in addition to the physical condition, a psychological factor. These cases are helped greatly by relaxation.

Dr. Grantly Dick Read says that pain in childbirth could be largely eliminated if mothers were trained to relax from the fourth to fifth month of pregnancy for a few minutes each day. So much pain in normal child-birth is due to a misapplication of the sense messages of fear to the brain, which leads to a tension of the fibres.

Conclusion

Relaxation in some form has been known throughout the ages. Even animals and plants relax for specific periods.

Primitive races still instinctively use it, and ancient races of the East have never ceased to practise it, perhaps because their civilization is of longer duration than ours and was arrived at more slowly.

There is nothing new in the art of relaxation, and its complete story has yet to be told. It is not the panacea for all ills, but it can alleviate physical, nervous and emotional conditions.

The inner peace and tranquillity that may be developed by means of relaxation may pervade a man's life; so that we can still say with the Psalmist: "Commune with your own heart upon your bed, and be still".

SYNTHESIS OF NEW SPECIES OF WHEATS*

By Dr. ANTON ZHEBRAK

Timiryasev Agricultural Academy, U.S.S.R.

AS generally known, the species of wheats existing in natural conditions are classified into three chromosome groups of 14, 28, and 42, according to the number of chromosomes in their somatic cells. The most widespread species represented by a great number of varieties of races, biotypes and agricultural sorts is the bread wheat *Triticum vulgare*. This species is the most polymorphic and is represented by spring as well as winter sorts of wheats. The record frost-resisting agricultural sorts are found only among *Triticum vulgare*, which belongs to the group with the highest number of chromosomes.

The fact that a number of very valuable agricultural and biotypical qualities has developed in the process of evolution among the highest chromosome species of wheats *T. vulgare*, supports the chromosome that the high chromosome species are undergoing evolution and adapting themselves to various conditions of environment more rapidly than the species with a low number of chromosomes. Hence the problem of introducing wheats into new areas might best be solved by increasing the number of chromosomes. The above, as well as a number of purely theoretical considerations, led us to take up the question of obtaining high chromosome forms of such an important cereal as wheat. However, as most species of wheats are already polyploids, no more valuable and more fertile types can be obtained by an increase in the number of chromosomes in pure wheats, as this would probably lead to highly sterile forms.

We therefore began our effort to obtain high chromosome forms of wheats by doubling the number of chromosomes of interspecific hybrids and not that of pure species.

We selected two species of wheats for hybridization, namely, *Tr. monococcum* and *Tr. Timopheevi*. Both these species are immune from a number of fungal parasites and insects and, what is most important, they have isolated chromosome complexes producing, when crossed with other species, absolutely or highly sterile hybrids. By increasing the number of chromosomes of such highly sterile hybrids we restore fertility and obtain amphidiploid types with higher numbers of chromosomes than those of the parental species of wheats.

* A report on this work was made by Dr. Anton R. Zhebrak in 1940 at the December session of the Timiryasev Agricultural Academy, in 1942 at the November session of the Academy of Science of the U.S.S.R. in Tashkent, and was repeated at the session of the Timiryasev Academy in March 1943.

We began our research into methods of obtaining amphidiploids of wheats in 1936. At first, in order to increase the number of chromosomes, we used various agents—chemicals, temperature, X-ray treatment, etc.—which had been employed by numerous scientific workers prior to us. Unfortunately these agents did not lead to the desired results. Only in 1938, after the publication of the work of Blakeslee and Avery on obtaining polyploid forms among plants by colchicine treatment, did we succeed in obtaining the first amphidiploid types of wheat. At that time we had obtained hybrid seeds of the following combinations: *T. durum* Desf. × *T. monococcum* L., *T. polonicum* L. × *T. durum* Desf., *T. durum* Desf. × *T. Timopheevi* Zhuk., *T. persicum* Vav. × *T. Timopheevi* Zhuk.

In the spring of 1938 we treated hybrid seeds of the above-mentioned combinations with a 0·1 per cent colchicine solution and obtained amphidiploid spikes from the following hybrids: *T. durum* Desf. × *T. monococcum* L., *T. durum* Desf. × *T. Timopheevi* Zhuk., *T. polonicum* L. × *T. durum* Desf.

The amphidiploid spikes *T. durum* × *T. monococcum* and *T. durum* × *T. Timopheevi* were of normal fertility and widely differed from the sterile amphihaploid spikes. We found forty-two chromosomes in the somatic cells of the amphidiploids *T. durum* × *T. monococcum* and fifty-six chromosomes in the amphidiploid *T. durum* × *T. Timopheevi*.

The spikes of *T. polonicum* × *T. durum* hybrids which had been subjected to treatment with colchicine solution in the seed stage contained various numbers of grains: 7–10 and 25–30. Next year (1939) the plants obtained from ears of various fertility were investigated. It was discovered that the ears with low fertility contained amphidiploid grains giving 56-chromosome plants, while spikes with a high fertility gave plants with twenty-eight chromosomes. Thus on the basis of these investigations we ascertained that in the highly sterile *T. durum* × *T. monococcum* and *T. durum* × *T. Timopheevi* hybrids the doubling of the number of chromosomes led to the restoration of normal fertility while the increase of the number of chromosomes of normally fertile hybrids of the first generation of *T. polonicum* × *T. durum* produced polyploid plants of low fertility. We are continuing experiments with them, however.

The amphidiploids *T. durum* × *T. monococcum* have forty-two chromosomes in their somatic cells and occupy an intermediate position between *T. durum* and *T. monococcum*. We consider this amphidiploid a new species of wheat and have named it *Triticum Edwardi* Zheb. The characteristic peculiarities of this species are the intense greenness of the sprouts and the adult plant, the erectness of the stems and their high tillering, the lack of pubescence (hairlessness) of its glumes. The glumes are triangular with blunt crenature. Spikelets are arranged along the stem in a straight line. The side of the ear is wider than the front. The kernel is large and somewhat asymmetrical.

We have classified the amphidiploid *T. durum* × *T. Timopheevi* ($2n=56$) as new species, *Triticum soveticum* Zheb. In 1939–40 we obtained such 56-chromosome types by crossing *T. Timopheevi* with numerous sorts of nineteen varieties of *T. durum*, six varieties of *T. turgidum*, three varieties of *T. persicum*, three varieties of *T. polonicum* and one variety of *T. orientale*.

Thus 56-chromosome amphidiploid types have been obtained from crossing *T. Timopheevi* with thirty-two varieties belonging to five 28-chromosome species. As there is no great difference in external morphological characteristics and all the above-mentioned amphidiploid types may be easily crossed among themselves and contain the same number of chromosomes, we have classified them as a single botanical species *T. soveticum* Zheb. The amphidiploids of different varieties of *T. durum* × *T. Timopheevi* will form the respective varieties of the new species *T. soveticum* ssp. *durum* Zheb., and similarly for other crosses. Thus the species *T. soveticum* Zheb. obtained experimentally is represented by five sub-species and thirty-two varieties. The number of varieties can be increased by mutational changes, as well as by taking advantage of the variability of the hybrid by crossing different sub-species of *T. soveticum* between themselves. We effected such crossing in 1942.

The most characteristic and general attributes of all sub-species of *Triticum soveticum* Zheb. are the following: dark green pubescent shoots, erect bush and dark green colour of the stem and entire plant. The leaves are pubescent. At the base of the leaf the plant has a ligule and auricle. It possesses high tillering capacity. The spike stem does not break easily. The glumes of the spikelets are pubescent. The colouring of the spikes varies: white, red, black and intermediate shades. The grain is red, glassy, large and long—8–12 mm. The absolute weight of a thousand grains is about 100 grams. This species varies widely in all combinations. It has 56 chromosomes.

The amphidiploids of *T. Timopheevi* with different species of 28-chromosome wheats occupy the intermediate position between *T. Timopheevi* and these species. But as they differ widely from the original species in many characteristics, their number of chromosomes and their ability to cross, we place them in the new species, *T. soveticum*, but in designating the sub-species retain the name of the original 28-chromosome species with which the crossing with *T. Timopheevi* was performed. The peculiarities of the varieties of the 28-chromosome wheats in *T. soveticum* are not always apparent owing to the prevalence of a number of morphological characteristics of *T. Timopheevi*.

The new properties of the amphidiploid types of wheats are: (1) the exceedingly large absolute weight of the kernel, which greatly exceeds that of the parent species (1,000 selected kernels of various combinations weigh between 100 and 110 gm.; the weight of a thousand average grains is about 80 gm.); (2) the amphidiploid species have a longer vegetative period than their parents; (3) various amphidiploid combinations such as sub-species *durum*, *turgidum*, *orientale* have acquired the ability to survive the winter in Moscow.

A new type as regards the number of their chromosomes are the amphidiploids *T. vulgare* × *T. Timopheevi* and reciprocal crossings. Such amphidiploids are obtained from the following varieties of *T. vulgare*: *lutescens*, *milturum graecum*, *alborubrum*, *albidum* and *erythrospermum*. These varieties include spring as well as winter forms. The amphidiploids resulting from crossing with the winter sorts of *T. vulgare* are spring wheats with late ripening. The fertility of these amphidiploids is not high, usually one or two kernels per spikelet. They have seventy chromosomes and belong to the decaploid group. The amphidiploids vary greatly in their morphological characteristics and the length of their vegeta-

tive period. We have classified them as a separate species called *Triticum Borisovi* Zheb. The basic peculiarities of this type are the dark green colour of the shoots, the pubescence of the shoots and leaves and the glumes of the spikelets. The stem of the spike is only slightly brittle. The grains are tightly wrapped into flower paleæ. The number of chromosomes is seventy.

We have also obtained 70-chromosome amphidiploids from crossing *T. durum* × *T. vulgare*. Their fertility is not high but they differ in their morphological characteristics. In some combinations the kernel is good. A more complete account of these amphidiploids will follow later upon completion of more extensive research.

Both the 70-chromosome amphidiploid types have a common peculiarity: their lower fertility as compared with the 42- and 56-chromosome types.

In conclusion, I wish again to stress that colchicine is exceedingly effective as a factor in increasing the number of chromosomes. This is shown by the facts outlined in our work, from which it may be seen that, in a brief period, we succeeded in obtaining more than ninety amphidiploid types of wheat belonging to the three chromosome groups 42, 56 and 70, which may be considered as new botanical species. To the best of our knowledge these amphidiploid types of wheat have been obtained for the first time, and amphidiploids in general, in such large quantities, also for the first time.

OBITUARIES

Dr. J. K. Roberts, F.R.S.

IT is difficult for the colleagues and friends in the Laboratory of Colloid Science, and others who have been intimately connected with John Keith Roberts, to realize that he has departed from us. He died on April 25, aged forty-seven.

I first met 'J. K.' when he was working in the Cavendish Laboratory. At that time, under the genial guidance of Lord Rutherford, the main interest in the Cavendish lay in the problems of nuclear structure. To 'J. K.', however, the nucleus had no attraction; he was both by training and inclination steeped in the classical tradition of physics based upon thermodynamics. He was at the time engaged upon the problem of the extent to which thermal energy is exchanged when gas molecules hit and leave a solid surface. He found that the values for the accommodation coefficient were coming out unexpectedly higher than anticipated from Baule's calculations. In my Department we were searching for different methods by which layers of gas adsorbed at metal surfaces could be detected and examined, and it seemed possible that the high values for the accommodation coefficient which Roberts found were due to the presence of a chemisorbed layer of gas on the tungsten wire which he was using. If this proved to be the case, the accommodation coefficient might serve as a useful tool for exploring surfaces.

Roberts welcomed with enthusiasm the suggestion of moving from the Cavendish to next door, and taking up this field of inquiry. He devoted the next ten years of his life to this problem. In this investigation he was strikingly successful. Roberts not only showed how one could trace and follow the building up of adsorbed monolayers on tungsten wires by means of the accommodation coefficient of neon as an indicator, but also later developed methods for actually measuring the heat of adsorption of gases on thin wires by making the wire one arm of a Wheatstone bridge. A series of papers both experimental and theoretical testify to the great skill, painstaking accuracy, and attention to detail which characterized all his work. Methods had to be worked out for circulating pure neon over scrupulously clean wires and for the admission of gases at minute but regulated pressures. The apparatus was essentially simple, but the elimination of contamination in the system indicates the extraordinary cleanliness which he achieved. Many important discoveries were made, and what had hitherto been matters of opinion experimentally tested. Thus it was found that when the tungsten wire was clean, chemisorption of several elementary gases occurred without appreciable energies of activation, that a slow process of activated diffusion could take place into the wire, and that gases could be quantitatively displaced from the surface. When diatomic gases were chemisorbed as atoms, holes were left in the surface which play an important part when chemical reactions take place in the adsorbed phase. He showed that there could be a transition from immobile to mobile monolayers, and revealed how the influence of mutual interaction between the adsorbed particles could be traced both in the form of the adsorption isotherm and in the thermal behaviour on adsorption.

Apart from this field of inquiry, which he made particularly his own, Roberts took a great interest in many other problems, especially in the mechanism of melting of a crystalline solid and in the origin of the elasticity in rubber. He was always ready to give his advice and criticism to those commencing research. Here, for Roberts, no trouble was too great, no time too long. Many have gained from the lasting impression he made by his directness and simplicity of approach in experimental attack, his insistence upon rigour in argument and soundness in thermodynamic treatment. His lectures were clear and attractive, and his book on thermodynamics has already gone into the third edition. Little can be said at present about his activities in the War, but he took a post in a naval research establishment that was difficult administratively, and involved research and development along important and novel lines. Here he was an unqualified success.

In the laboratory Roberts was always cheerful and ready to deal with all the vexatious details which arise—this in spite of his health, which was never good. At times a leg gave him much trouble, but no one ever heard a word of complaint. He took much pleasure in the fact that his work was appreciated, both at home and abroad. He had been elected to the fellowship of the Royal Society and quite recently made a fellow of Christ's College, and was looking forward to his return to Cambridge, where his heart lay. ERIC K. RIDEAL.

WE regret to announce the following deaths:

Dr. J. A. Campbell, of the research staff of the National Institute of Medical Research, on April 20, aged sixty.

Lieut.-Colonel Stanley Casson, reader in classical archæology in the University of Oxford, aged fifty-four.

Mr. H. B. Walters, O.B.E., keeper of Greek and Roman antiquities in the British Museum during 1925–32, on April 24, aged seventy-seven.

NEWS and VIEWS

Botany in the University of London

King's College

PROF. T. A. BENNET-CLARK, of University College, Nottingham, has been appointed to the University of London chair of botany, tenable at King's College, London, as from October 1944. Prof. Bennet-Clark was educated at Marlborough College and Trinity College, Cambridge, and in 1923 was placed in the first class of the Natural Sciences Tripos (Part II) list and was the Frank Smart Prizeman. He worked for a time under Dr. F. F. Blackman until, in 1924, he was appointed as assistant to the professor of botany, Trinity College, Dublin. During these years, research on the metabolism (especially the respiration) of succulent plants yielded results of great interest. This line of research continued after his appointment in 1931 as lecturer in botany in the Victoria University of Manchester. His appointment to Manchester coincided with an increase in the number of research students there, and a large proportion were then attached to plant physiology and under his guidance investigated the metabolism, especially of acid-producing plants, including fungi, while research on another aspect of plant physiology served to focus attention on the important part which protoplasmic activity may play in water absorption by plant cells. Under his direction plant physiology at Manchester received a considerable stimulus. In 1936 he was appointed to the chair of botany at University College, Nottingham, where a heavy burden of teaching has not restricted his other activities. Since 1937 he has served the Society of Experimental Biology as botanical secretary. Botanists throughout the country will wish him success and happiness in his new appointment.

Birkbeck College

BY the appointment of Dr. C. T. Ingold to the chair of botany, Birkbeck College maintains a strong mycological tradition built up during the period of office of Dame Helen Gwynne-Vaughan. Dr. Ingold is well known for his studies on the aquatic Hyphomycetes, and for work on mechanisms of spore dispersal in fungi. He is a keen and first-class naturalist, and one of the limited band of those who 'know their higher Basidiomycetes', so that it is a real pleasure to tramp the country with him as guide. He conveys his enthusiasm with success to students and colleagues. Dr. Ingold was a student of the Queen's University, Belfast, and has served on the staff of the University of Reading. Latterly he has been head of the Department of Botany at University College, Leicester. His published work includes papers on permeability, aquatic fungi and algæ, and an attractive book on spore dispersal.

Transmutation of Wood

IN a short message printed in *The Times* of April 17, attention is directed to what is claimed to be a new chemical treatment which makes wood nearly as hard as steel, transmuting it into a new material, part wood and part plastic, announced by the du Pont Company in the United States. From the brief description given, it appears that this new material is only one of the many forms of what has become known as 'improved wood'. Until specimens have been examined it is not possible to verify the claims. In preparing a material of this kind it is, in general, sought to improve the strength properties and the dimensional stability of wood by a combination of impregnation with synthetic resins and densification under heat and pressure. The manner of effecting this varies from process to process. It was believed for some years that the use of synthetic resins was essential for the production of improved wood, but only recently the U.S. Forest Products Laboratory has demonstrated that much of what is done by the earlier processes can be achieved through the use of heat and pressure alone.

In the use of synthetic resins for making 'improved wood', most success has been achieved with the phenol-formaldehyde type. Hitherto the amino resins have not been favoured for the manufacture of improved wood, presumably because they have been found to be chemically not so stable as some other types and to have somewhat inferior ageing characteristics under warm and humid weather conditions. It remains to be seen, therefore, whether the urea/formaldehyde resin involved in the Dupont process incorporates any new feature which marks it out as superior to others of its class. It is stated that the monomer combines with the natural acids in the wood; but the more conventional view of the setting process would appear to be that these acids merely behave like all other acids which are known to catalyse the setting reactions in urea/formaldehyde resins. The two claims which it will be most interesting to confirm are that almost any species of timber can be treated—particularly as nothing is said as to the thickness of piece which can be treated—and that all dimensional change is prevented. So far as existing experience goes, this latter claim seems to be incompatible with the implied retention of the best other properties of wood. Should these claims hold good after a period of years, the process will mark a big advance in the field of wood-plastic composites.

Development of the Highlands of Scotland

A CRITICAL study in the February number of *Agenda* by Mr. Hugh Quigley on "The Highlands of Scotland : Proposals for Development", urges that the one policy which will make a permanent contribution to the Highland civilization is in effect to make a collective regional unit of the Highlands after the pattern of the Tennessee Valley Authority. Mr. Quigley strongly criticizes the creation of the North of Scotland Hydro-Electric Board, which has only indirect influence on the problem of Highland reconstruction; it regularizes the supply of electricity, but electricity has not been, and is not, the sole essential for new developments. The lack of industrial enterprise is not to be attributed to any defect in availability or price of electricity. The economic condition of the Highlands has not changed materially since the Hilliary Committee reported in 1938. The War, if anything, has caused further deterioration through cutting of timber, much of it immature, and restriction of communications, but has, on the other hand, brought greater activity to the ports. Reconstruction cannot be carried out piecemeal but must cover as wide a range of economic factors as the state of our knowledge and the limits of administrative ability will permit.

Reconstruction in the Highlands should be entrusted to a Highland planning authority with powers similar to those of the Tennessee Valley Authority and over-riding control over the North of Scotland

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

UNIVERSITY COLLEGE of SOUTH WALES AND MONMOUTHSHIRE

COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY

The following Chairs in the University College of South Wales and Monmouthshire will become vacant at the end of the current academic year:

(*a*) Philosophy;

(*b*) Zoology and Comparative Anatomy.

Salary £850 per annum.

Twelve copies of application and testimonials (which need not be printed) must be received by the undersigned, from whom further particulars may be obtained, not later than May 31, 1944.

The inability of any candidate who may be engaged on national service to take up the appointment at the beginning of next Session will not prejudice his claims to the appointment.

LOUIS S. THOMAS,
Registrar.

University College,
Cathays Park, Cardiff.

SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY

GRANTS-IN-AID

The Committee will, in July, allocate a limited number of Grants-in-Aid to young men and women employed in chemical works in, or near, London who desire to extend their education for a career in chemical industry. Applicants must not be under 17 years of age.

Applications should be made as soon as possible, and, in any case, not later than May 22, 1944, whereupon forms will be issued requiring particulars of age, nature of employment, and the manner in which the Grant would be used.

Address: The Director, Salters' Institute of Industrial Chemistry, Salters' Gardens, Church Road, Watford, Herts.

UNIVERSITY OF GLASGOW

LECTURER IN CHEMISTRY

Applications are invited for the post of Lecturer in Chemistry, to date from October 1, 1944. Applicants should have special qualifications in Inorganic or Physical Chemistry, with teaching and research experience. The commencing basic salary will be between £400 and £550 per annum, depending upon qualifications and experience. At present there is also a scheme of family allowances, and in addition there may be a war bonus of £20. Further particulars may be obtained from the undersigned, to whom applications (3 copies), with names of two referees, should be sent not later than May 26.

ROBT. T. HUTCHESON,
Acting Secretary of University Court.

April, 1944.

UNIVERSITY COLLEGE, LEICESTER

Applications are invited for the post of LECTURER in Charge of the Department of BOTANY. Salary £500 per annum with participation in the Federated Superannuation System for Universities. Duties to commence October 1, 1944. Applications to be sent not later than May 27 to the Registrar, from whom further particulars may be obtained.

LEVER BROTHERS & UNILEVER

Lever Brothers & Unilever announce that after reinstatement of the large number of their technical staff who have been employed on National Service they will still have vacancies in their research departments and their factories for a considerable number of qualified chemists, physicists, and engineers. At a later date applications for these appointments will be invited. An appreciable proportion of the positions available will be suitable for scientists capable of controlling Research Sections, and applicants will require to be in the 30/40 age group. The remaining posts will require men with good scientific and technical training in the age group about and below 30. Whilst applications are not invited at present, if intending applicants would like further information regarding these posts they should apply to the Personnel Department, Lever Brothers & Unilever Limited, Unilever House, Blackfriars, London, E.C.4.

UNIVERSITY COLLEGE OF SWANSEA

The Council invites applications for the post of LECTURER in the Department of MATHEMATICS. The salary will be determined according to qualifications and experience, with a minimum of £400 and a maximum of £500 per annum. The appointment will date from October 3, 1944.

Further particulars may be obtained from the Registrar, University College, Singleton Park, Swansea, by whom applications must be received on or before Saturday, May 20, 1944.

EDWIN DREW,
Registrar.

UNIVERSITY OF LONDON

The Senate invite applications for the University Readership in Chemical Pathology tenable at University College Hospital Medical School (Salary £950). Applications (10 copies) must be received not later than first post on Monday, May 15, 1944, by the Academic Registrar, University of London, at Richmond College, Richmond, Surrey, from whom further particulars should be obtained.

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of LECTURE-ASSISTANT IN MATHEMATICS. Stipend £300 per annum. Duties to commence June 25, 1944. Applications must be submitted not later than May 13, 1944, to the Registrar, the University, Manchester 13, from whom further particulars may be obtained.

THE UNIVERSITY OF LIVERPOOL

The Council invites applications for the post of ASSISTANT LECTURER (GRADE III) in the Department of INORGANIC AND PHYSICAL CHEMISTRY, at an initial salary of £350 per annum. If engaged in National Service, the person selected will not be required to take up the appointment until released from his present duties. Applications, together with the names of three referees, should be sent to the undersigned as soon as possible.

STANLEY DUMBELL,
Registrar.

April, 1944.

Biochemical Research Assistant, preferably with research experience, required by reputable, old-established firm working in the medical field. Applicant must have degree in biochemistry and be fully conversant with standard biochemical technique. The laboratory is situated in the West End of London. The salary will be according to qualifications and experience.—Write, in first instance, giving full details of experience, qualifications and salary required to Box 181, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Organic Research Assistant, preferably with research experience, required by reputable, old-established firm working in the medical field. Applicants must have honours degree in chemistry. The work will be pure organic research, and the laboratory is situated in the West End of London. Salary will be according to qualifications and experience.—Write, in first instance, stating qualifications, experience, and salary required to Box 182, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Applications are invited from a qualified scientist, with a sound knowledge of plastic materials, particularly in relation to their electrical properties, for a Research Laboratory (scheduled E.W.O.) situated in Manchester.—Apply Box 183, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

A Research Laboratory (scheduled E.W.O.) situated in Manchester invites applications from qualified chemists and physicists. Opportunities exist for men with sound knowledge of inorganic chemistry, plastics, the testing of materials, and chemical engineering.—Apply Box 184, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Laboratory Assistant wanted for boys' Public School—modern science block. Applicants state salary required and give references.—Apply, Headmaster, St. Albans School, Abbey Gateway, St. Albans.

Research Assistant required (Biology and/or Physics) for Hospital Laboratory. Applications with full particulars to be sent to the General Superintendent, Christie Hospital and Holt Radium Institute, Manchester

For Sale: Cambridge Scientific Instrument Co., Millivoltmeter, accurate Calibration, equal new, £10. Ditto one in glass and wood case with recording drum type, little used, £35. Metal thermos, 1 gallon, equal new, £3 10s. Large copper incubator oven, glass inner door, £15.—Harger, 172 Bedford Street, Liverpool, 7.

Wanted Urgently: Bacteriological laboratory autoclave, maximum working pressure 30 lb. per sq. inch, state how heated. Also bacteriological incubator, preferably water-jacketed, working temperature 37° C., state how heated and make.—Box 187, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

Hydro-Electric Board. The activities of the Forestry Commission should be wound up so far as they apply to the Highlands of Scotland, and its functions transferred to a Scottish national parks section of the planning authority. The Scottish Department of Agriculture should cease to own and administer land and its holdings transferred to the planning authority. The Planning Section of the Scottish Department of Health should be considerably extended and its functions widened to cover supervision of development schemes proposed by the planning authority, and, until the latter is formed, of the North of Scotland Hydro-Electric Board. Reform and re-alignment of Highland local authorities must accompany or result from the creation of a planning authority: in their present form they are incapable of contributing usefully to any fundamental scheme of economic reconstruction.

Patent Law Reform

A COMMITTEE has been appointed to consider and report whether any, and if so what, changes are desirable in the Patents and Designs Acts, and in the practice of the Patent Office and the Courts in relation to matters arising therefrom. In particular, the committee is to consider the conduct of legal proceedings arising out of the Patents and Designs Acts, including the constitution of the appropriate tribunals; and, in connexion with the prevention of the abuse of monopoly rights, it will suggest amendments to facilitate settlement and the reduction of the cost of legal proceedings and encourage the use of inventions and the progress of industry and trade.

The committee is constituted as follows: Mr. Kenneth Swan, K.C. (*chairman*), Mr. Hubert Gill, Mr. James Mould, Captain B. H. Peter, Dr. D. R. Pye, Mrs. Joan Robinson, Mr. H. L. Saunders and Dr. A. J. V. Underwood.

Trade Unions in Great Britain

MRS. MARY AGNES HAMILTON'S pamphlet "British Trade Unions" (Oxford Pamphlets on Home Affairs, No. H.47. Oxford University Press. 6*d*. net), which gives a brief survey of trade union history in Britain, is of particular interest for its description of the position of the trade unions in relation to the State and to society in Britain to-day. While the value of the trade union as a training ground for democracy is well brought out, and also its dependence upon democracy as a condition of effective functioning, neither the essential strength nor the weakness of trade unionism is indicated so clearly as might be expected. Mrs. Hamilton quotes Mr. Bevin's enunciation of the central idea "the liberty of the ordinary man and the right relationship between fellowmen" which is also the central idea of democracy; but she fails to point out that the co-operation and collective bargaining represented by the trade unions is indispensable in the industrial and economic conditions of to-day. Without them our war effort could not easily have attained its present pitch, nor could many advances in welfare and the like have been so readily achieved. Equally she overlooks the innate conservatism of the trade unions, which is the real weakness that has hindered their making their full contribution to the development of democratic ideas and practice and to social and economic progress—a weakness as marked in the newer unions of technical and professional workers as among the older unions of manual workers in its customary sense.

Institute of Metals

IN his presidential address to the Institute of Metals on March 15, the new president, Dr. W. T. Griffiths, devoted much of his attention to the widefelt need for a greatly increased number of trained metallurgists in industry. Apart from stressing the demands to be made on institutions of university standing, he mentioned the probability that, in conjunction with other metallurgical bodies and the Board of Education, there is the probability of the immediate institution of National Certificates in Metallurgy similar to those already existing for engineering. This movement received both his own welcome and that of the Council of the Institute. The demand for the greater recognition of the profession of the metallurgist is under consideration by all three metallurgical institutions, and the probability was mentioned that some qualifying board, independent of, but working in co-operation with those bodies, would soon be set up. The desirability of co-operation between the Institute of Metals and the Iron and Steel Institute, already close, becoming still more intimate, a development to be welcomed on many grounds, was stressed, and the announcement that Mr. Headlam-Morley, the secretary of the Iron and Steel Institute, is to act, for the time being, as secretary of the Institute of Metals in succession to Mr. Shaw-Scott, is a clear indication of such an increasing unity of purpose.

The Institute of Metals Medal for 1944 was awarded to Lieut.-Colonel the Hon. R. M. Preston, president during 1940–42 of the Institute.

The Golgi Apparatus

IN his presidential address to the Section of Zoology and Entomology of the thirty-first Indian Science Congress at Delhi, Prof. Vishwa Nath gave a general account of his own views on the nature of the Golgi element. He regards Golgi nets, dictyosomes, batonettes, rods and crescents as optical illusions, and one appearance only as genuine—that of a spherical osmiophil and argentophil cortex enclosing a spherical chromophobe core. These plainly correspond with the externum and internum of Hirsch, and although Prof. Nath is strongly opposed to the vacuome theory of Parat, yet it seems likely that the chromophobe cores correspond with Parat's vacuoles. He opposes strongly the opinion that the Golgi element is concerned with cellular secretion, and argues that, on the contrary, it is transformed into such objects as others think it secretes. He is concerned to show that in forming the acrosome, the Golgi element is completely used up, a conclusion with which many students of this cell inclusion will find themselves in disagreement. It seems possible that the difference between secretion and transformation may to some extent be a verbal one, scarcely calling for the expression of such strong opinions as those of Prof. Nath. The greater part of the address was very clearly worded. Students of the Golgi element find themselves in disagreement on several matters, and it is helpful to all concerned when views are unequivocally expressed.

Nutrition Problems in Venezuela

THE August issue of the *Boletín de la Oficina Sanitaria Panamericana* contains a note on this subject, which was discussed at the eleventh Pan-American Sanitary Congress at Rio de Janeiro in

1942. As regards nutrition in Venezuela, the same conditions exist as in the other Caribbean Republics, and in some respects as in those in the other Latin American republics. All the publications on the subject come to the same conclusion, namely, that the labouring class is inadequately fed and consumes excessive amounts of carbohydrates compared with other elements such as proteins, vitamins, etc. In many cases a family has to spend 75 per cent of its income on food alone. Farm workers, on the other hand, though receiving much lower salaries, spend less on their food, or 47 per cent of their income, which adequately provides for their food. This situation would be much improved by an educational campaign.

Earthquakes Recorded at Kew

DURING the period December 1, 1943–February 1, 1944, eight strong earthquakes were registered at Kew. Of these, three were in December, four in January and one on February 1. Two earthquakes were registered on December 1, the first being at 06h. 18m. 50s. G.M.T. from an epicentre tentatively calculated to have been 14,600 km. distant. The maximum amplitude attained at Kew was 26 μ. The second on December 1 was registered at Kew at 10h. 47m. 59s. G.M.T., and this also attained a ground amplitude at Kew of 26 μ. Its epicentre has been calculated by the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association to have been at lat. 20·2° S., long. 68·1° W., which is in south-west Bolivia. Its depth of focus was probably near 100 km. On December 23 an earthquake was registered at Kew at 19h. 21m. 32s. G.M.T. and attained a maximum amplitude at Kew of 115 μ. Its epicentral position has been calculated by the United States Coast and Geodetic Survey to have been near lat. 6° S., long. 152° E., which is east of New Guinea. Other earthquakes occurred on January 5 (two), 10, and 16. The earthquake on February 1 registered at Kew at 03h. 27m. 59s. G.M.T., had a maximum ground amplitude at Kew of 1,000 μ; it has already been mentioned in the columns of NATURE as having occurred in Turkey.

Two earthquakes not apparently registered at Kew in any strength occurred on December 21, at 13h. 46·4m. G.M.T., from an epicentre near lat. 13° N., long. 70·5° W., and on December 23 at 15h. 56·0m. G.M.T. from an epicentre near lat. 13·3° N., long. 70·4° W. Both are in the Gulf of Venezuela. These shocks were registered at Tucson, St. Louis, Spring Hill, Georgetown, San Juan, Philadelphia, Burlington, Lincoln, Fordham, Pasadena, Huancayo and Chicago, and their provisional epicentres were calculated by the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association.

Prof. Alexander Macalister, F.R.S. (1844–1919)

PROF. ALEXANDER MACALISTER, the famous Cambridge anatomist, was born on April 9, 1844, in Dublin, where he was educated at Trinity College. He qualified at the Irish Royal Colleges in 1861, became M.B. at Trinity College ten years later and M.D. in 1876. After acting as demonstrator of anatomy at the Royal College of Surgeons in Ireland, he was appointed professor of zoology, and eight years later professor of anatomy and chirurgery, at Dublin. In 1883 he succeeded Sir George Murray Humphry in the chair of anatomy at Cambridge, and held this post for thirty-six years. He was a prolific writer. Besides his "Text-book of Human Anatomy" (1889) for which he is best known, he was the author of "Introduction to Animal Morphology" (1876) and "Morphology of Vertebrate Animals" (1878) as well as of numerous papers on animal morphology, human anatomy and small text-books for students. He was a man of remarkable versatility, being an able mathematician as well as versed in archæology, Egyptology and draughtsmanship. Like his cousin, Sir Donald Macalister, he was a proficient linguist, having knowledge of fourteen languages. He received many honours. In 1881 he was elected a fellow of the Royal Society. He was made hon. LL.D. of the Universities of Edinburgh, Glasgow and McGill and hon. D.Sc. and senator of the University of Dublin. His name has been attached to the fovea gastrica and the annulus femoralis s. cruralis.

Announcements

ON the joint recommendation of the presidents of the Royal Society and the Institution of Civil Engineers, the Council of the Institution of Civil Engineers has awarded the James Alfred Ewing Medal for 1943 to Group Captain Frank Whittle. The Ewing Medal is awarded annually for specially meritorious contributions to the science of engineering in the field of research.

AT the ninety-seventh annual general meeting of the Palæontographical Society held in the rooms of the Geological Society at Burlington House on April 26, with the president, Prof. H. L. Hawkins, in the chair, it was resolved that the Society's Council be empowered to take such steps as be necessary to mark the approaching centenary of the Society in 1947. A committee has therefore been formed to consider suggestions as to how the occasion should best be commemorated; the secretary is Dr. C. J. Stubblefield, H.M. Geological Survey and Museum, London, S.W.7.

ACCORDING to the *Lancet* of April 8, Brigadier-General Leon A. Fox, director of the United States Typhus Commission, says that more than 1,800,000 c.c. of typhus vaccine supplied to Governments in the Middle East under Lend Lease since last June now are a gift of the United States Government. The Typhus Commission has instructions to make the vaccine available to public authorities wherever typhus epidemics appear. Shipments have gone to Egypt, Persia, Iraq, Cyrenaica, Eritrea, Palestine, Trans-Jordan, Tripolitania, Saudi Arabia and Aden.

IN the course of a review published in NATURE of February 19, p. 207, it was stated that the American Philosophical Society became a local scientific association for Philadelphia after the American Association for the Advancement of Science was formed. This is incorrect. The members of the Society come from all parts of the United States and there are at least fifty foreign members. It holds three general meetings a year, which are attended by members and others from all parts of the country, and is generally recognized as the most distinguished organization in America dealing with all fields of learning.

LETTERS TO THE EDITORS

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

Radioactivity and the Origin of Life in Milne's Cosmology

ACCORDING to the cosmological theory of Milne, we may either describe events in terms of a time t with a finite past, and Euclidean space, or of a time $\tau = t_0 + t_0 \log \frac{t}{t_0}$, where t_0 is the present epoch on the t-scale, and hyperbolic space. On the t-scale the radius of the material universe is ct, the spiral nebulæ are receding, and the lengths of rigid objects are proportional to t, but spectral frequencies are constant. On the τ-scale the nebulæ are not receding, nor is matter expanding, but spectral frequencies are proportional to t at the instant of emission, the light from distant nebulæ being red because it was emitted long ago. The two descriptions of the universe lead to the same predictions regarding all observable events.

It seems worth pointing out some consequences of this theory for geology and biology. The results of these sciences are most naturally expressed in the τ-scale and hyperbolic geometry. For on the t-scale the year and day are a good deal longer than they were in palæozoic times, and a dinosaur's bones are larger now than they were in life. On the other hand, on the τ-scale the amount of energy needed to raise a given object through a given distance is invariant with time, and mechanics are very nearly Newtonian. The heat conductivity of a gas at least, and probably of a solid, is invariant. On the other hand, the rate at which energy is liberated by subatomic or chemical change is constant on the t-scale, but increases on the τ-scale.

This is readily seen in the case of radioactivity. The decay 'constant' is only constant on the t-scale. Thus of N_0 radioactive nuclei present when $t = 0$, $N = N_0 e^{-\lambda t}$ survive to time t. The radioactivity of a given mineral sample, measured by the number of transformations per sidereal year, is

$$-\frac{dN}{d\tau} = \lambda N_0 \frac{t}{t_0} e^{-\lambda t}.$$

So the 'constant' on the τ-scale varies with t. Thus the 'years' of the geological time-scale based on radioactivity are not sidereal years on Milne's theory. Taking $t_0 = 2 \times 10^9$, the earth has gone round the sun $5{\cdot}55 \times 10^8$ times since a rock of radioactive age 5×10^8 'years' was formed, and $2{\cdot}77 \times 10^9$ times since a rock of age $1{\cdot}5 \times 10^9$ 'years' was formed.

The radioactivity $-\frac{dN}{d\tau}$ of a given piece of rock reaches a maximum when $\lambda t_0 e^{\tau/t_0 - 1} = \lambda t = 1$. Thus for ^{238}U, with $\lambda = 1{\cdot}5 \times 10^{-10}$ (year^{-1}), the maximum will occur at $t = 6{\cdot}75 \times 10^9$, or about A.D. $4{\cdot}3 \times 10^9$ on the τ-scale, when it will be about 2·4 times as active as to-day, though containing less uranium. The radioactivity of rocks containing potassium will increase for a vastly longer period; and still later, elements now regarded as stable may show an activity appreciable on the τ-scale, and having appreciable thermal effects if conductivity is constant. Of course, these arguments would still hold if the nuclei in question were formed after $t = 0$, $\tau = -\infty$. These considerations have a considerable bearing on the thermal history and future of the earth. The possibility that similar considerations apply to the stars should make us sceptical of certain extrapolations into the remote past and future.

Consider a living organism at a time in the past when t was comparatively small. It had to do work of various kinds. The measure of most types of work on the τ-scale is independent of t. But the amount of energy available from a chemical reaction such as an oxidation, or the breakdown of adenosine-triphosphoric acid, the immediate source of muscular energy, was not constant. Presumably the energy yield of a given molecular transformation varies with t like that of a given atomic transformation. Thus, in the past, chemical change was less efficient as a source of mechanical energy than it is to-day. Further, the rate of unimolecular breakdown of an enzyme-substrate compound such as myosin-adenosine-triphosphoric acid is sometimes at least the limiting factor in biochemical reactions liberating free energy. If the unimolecular 'constant' is k on the t-scale, it is $\frac{kt}{t_0}$ on the τ-scale, as with the 'constant' of radioactive decay. Thus the actual rate of energy liberation may be expected to vary as t^2.

If so, at a sufficiently early stage, a living organism would have been unable to provide even the small energy needed for cell division or amœboid movements. At a later time, life of a simple sort would have been possible, but locomotion would have been very difficult, and large swimming or crawling animals could not have existed.

Thus on Milne's theory we should expect, first, that life could not originate until a considerable fraction of time on the t-scale, and therefore almost all eternity on the τ-scale, was past, and secondly, that large and fairly complex motile animals should not have originated until a much more recent date. For even when $t = \frac{t_0}{\sqrt{2}}$, or $\tau = 690{,}000{,}000$ B.C. (late Pre-Cambrian), energy for motion would only have been generated at half its present rate. Further, in the remote future, even if the universe degenerates towards thermal equilibrium, or cold matter plus low-frequency radiation, the mechanical efficiency of chemical processes may so increase that life is still possible.

More or less analogous, though sometimes opposite, conclusions follow from other theories, such as those of Eddington and Dirac, in which the fundamental parameters of physics vary with time. These theories are at least possibly true, and biologists who are interested in the remote past and future of life should be aware of their possible implications.

J. B. S. HALDANE.

Department of Biometry,
University College, London,
at Rothamsted Experimental Station,
Harpenden, Herts.

Nature of the Cation Exchanges during Short-Period Yeast Fermentation

DURING the fermentation of glucose by yeast, Pulver and Verzar[1] showed that potassium was absorbed from the external fluid and released again towards the end of fermentation. Leibowitz and Kupermintz[2] showed a similar occurrence in bacteria (*B. coli*). These workers believed the potassium changes to be

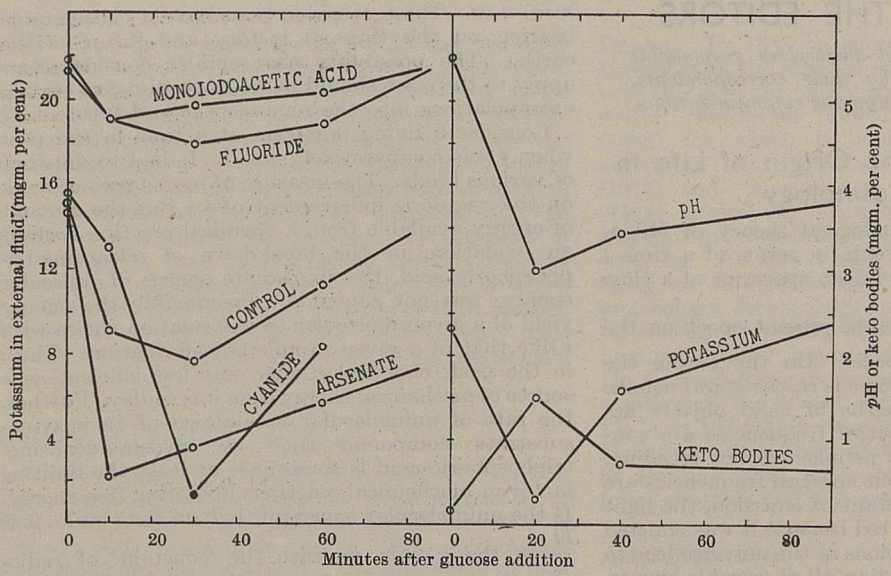


FIG. 1*a*. 1 VOL. YEAST, 3 VOL. *M*/200 KH_2PO_4 CONTAINING INHIBITORS IN *M*/200 STRENGTH, MIXTURE ALLOWED TO STAND FOR 30 MIN. AND 0·15 VOL. OF 18 PER CENT GLUCOSE ADDED. FIG. 1*b*. SAME MIXTURE WITHOUT INHIBITORS.

specific for this ion, but it was shown by us[3] that 'ammonia' yeast in which all the potassium of the cells was replaced by NH_4^+ behaved in a similar way with respect to the NH_4^+ ion. An explanation of the process was advanced in which it was considered that potassium entered with phosphate and, this being esterified, held the potassium inside electrostatically, more potassium entering then to equalize the products of potassium and phosphate ion concentrations without and within. Towards the end of fermentation, this process was presumably reversed, and so accounted for the potassium or ammonium released.

Subsequent investigations here have shown that such an explanation accounts only for a small part of the potassium absorption, and the phosphate that entered did not return like the cations to the external fluid. The fuller explanation would seem as follows. The cations which enter the cell during fermentation appear to do so very largely in exchange for hydrogen ions formed by the dissociation of pyruvic acid (or phosphopyruvic acid) formed towards the outer edge of the cell.

The evidence on which this is based is briefly as follows :

(*a*) The change of hydrogen ion concentration in the external fluid synchronizes fully with the potassium ion change (as shown in Fig. 1*b*), and the titration of the external fluid back to the original hydrogen ion concentration more than accounts for the potassium absorbed.

(*b*) The liberation of the hydrogen ion is due to pyruvic acid formation, since inhibitors which prevent its formation, for example, fluoride and monoiodoacetic acid, greatly depress the potassium absorption or the hydrogen ion formation (Fig. 1*a*), and monoiodoacetic acid more than fluoride. Also the analysis of the yeast and of the external fluid shows changes in keto acid formation which are likewise synchronous with the potassium and hydrogen ion changes.

(*c*) The interchange of potassium and hydrogen ions as a movement towards equilibrium is supported by the fact that if no potassium is present outside before fermentation, comparatively large amounts come out when glucose is added, thus reversing the direction of the potassium passage. Also, if the external potassium is raised and the solution outside the yeast cells be maintained as unbuffered as possible (using only potassium chloride and well-washed yeast) the hydrogen ion increases parallel with the potassium increase, and reaches very high levels. On the other hand, if the *p*H be maintained at 2–5 with comparatively low potassium outside, the proportion of potassium absorbed increases with increasing *p*H. Such experiments are in strong support of the view that the potassium and hydrogen ions are interchanging as a movement towards some point of equilibrium (or steady state, the movement in itself being conditioned by a fall of free energy).

(*d*) The ratio of the potassium and hydrogen ion concentrations outside is at the same time quite different from the ratio in the yeast cell as a whole, so that the hydrogen ion production would seem to be confined to some part of the yeast cell. When yeast, for example, is first pressed to get rid of as much external fluid as possible, frozen in liquid air, and then thawed so as to release the internal fluid of the cells, this latter has a *p*H of approximately 5·8. This *p*H does not decrease if the fluid is extracted from the fermenting yeast cells. It shows rather a slight increase.

(*e*) Supporting evidence for spaces in yeast with different permeabilities is given by the time curve of entrance of urea, and also of ammonia (with carbon-dioxide bubbling as in making the 'ammonia' yeast). Distinct breaks on these curves appear, presumably indicating zones with different permeabilities.

E. J. CONWAY.
E. O'MALLEY.

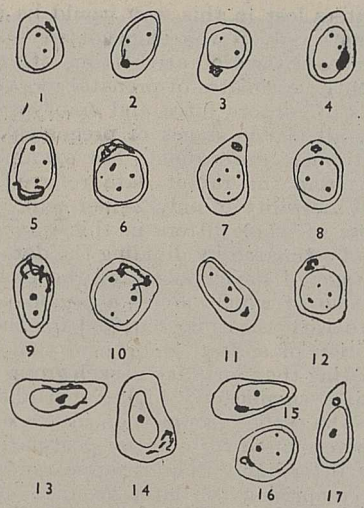
Biochemistry Department,
University College,
Dublin.
March 16.

[1] Pulver, R., and Verzar, F., *Helv. Chim. Acta*, **23**, 1087 (1940).
[2] Leibowitz, J., and Kupermintz, N., NATURE, **150**, 233 (1942).
[3] Conway, E. J., and O'Malley, E., NATURE, **151**, 252 (1943).

Effect of Colchicine on Golgi Bodies

DURING the course of an investigation on the mitotic activity of the mouse parathyroid gland at different ages[1], using the colchicine technique, very marked alterations in the morphology of the Golgi bodies were observed in material prepared by the Nassonov-Kolachev method. Since the initial observations were made on immature animals, the glands of adult colchicine-injected mice were also investigated.

The results of these experiments are shown in the



1 and 2, cells from 2 days ♀ parathyroid, untreated; 3 and 4, cells from 2 days ♂ parathyroid, untreated; 5 and 6, cells from 12 days ♀ parathyroid, untreated; 7 and 8, cells from 12 days ♀ parathyroid, 0·02 mgm. colchicine for 9½ hr.; 9 and 10, cells from 20 days ♀ parathyroid, untreated; 11 and 12, cells from 20 days ♂ parathyroid, 0·03 mgm. colchicine for 9½ hr.; 13 and 14, cells from adult ♂ parathyroid, untreated; 15 and 16, cells from adult ♂ parathyroid, 0·1 mgm. colchicine for 22 hr.; 17, cell from adult ♂ parathyroid, 0·1 mgm. colchicine for 3 hr.

accompanying illustration. In the case of the adult animals 0·1 mgm. of colchicine was given subcutaneously and the animals were killed at varying intervals after the injection. Immature animals were given a dose in proportion to their body weights and were killed after 9½ hours.

It will be seen from the figures that both the reticulate Golgi bodies of the juvenile gland (Figs. 5, 6, 9 and 10) and the more dispersed and thread-like Golgi material of the adult (Figs. 13 and 14) are affected in the same manner. The effect is particularly striking in the adult gland, where the cells have very varied Golgi-body configurations, probably associated with different states of cellular activity[2,3]. In these instances there is a reduction in size and a marked condensation of the Golgi substance into one and sometimes more granular structures, which frequently assume a ring-like form (Figs. 8, 16 and 17). In one instance (Fig. 17), a marked effect was observed so soon as three hours after injection. This reduction in size and dispersion of the Golgi bodies tends towards a morphological resemblance with those of very young mice (Figs. 1–4).

The effect of colchicine on the mitochondria of parathyroid cells was not so striking, because changes in the extremely small granular mitochondria were not immediately obvious. Most of them, however, were spherical in shape, indicating a marked reduction in the proportion of the rod-like forms normally to be seen in untreated animals. In four instances the duodenum of injected animals was examined and it was found that both the proximal and distal mitochondria of the epithelial cells of the villi were spherical in form; the thread-like type to be found on the distal side of the nucleus was not observed.

It is well known that many substances influence the form of the Golgi material in cells. There are the naturally occurring œstrogenic substances acting upon the cells of the anterior lobe of the pituitary[4] and the uterine mucosa[5]; toxic substances produced in pathological conditions acting on a great variety of cells; and substances foreign to animal tissues such as morphine, which itself has a marked effect on the Golgi bodies of the spinal neurones of rats[6]. In all these instances, above a certain threshold value, the effect consists in hypertrophy of the Golgi element commonly followed by fragmentation. By contrast, the effect of colchicine on the parathyroid is to cause a reduction in the degree of dispersion of the Golgi material, an effect somewhat similar to that produced by the injection of the parathormone itself[7].

C. L. FOSTER.

Dept. of Biology,
Middlesex Hospital Medical School,
London, W.1.
March 20.

[1] Foster, C. L., NATURE, 151, 277 (1943).
[2] Foster, C. L., *J. Endocrinol.*, 3, 244 (1943).
[3] De Robertis, E., *Revista Medica Latino-Americana*, No. 323 (1942).
[4] Severinghaus, A. E., in "Sex and Internal Secretions", edited by Allen, E. (1939).
[5] Horning, E. S., *J. Endocrinol.*, 3, 260 (1943).
[6] Horning, E. S., in "Cytology and Cell Physiology", edited by Bourne, G., 131 (1942).
[7] De Robertis, E., *Anat. Rec.*, 78, 473 (1940).

Plasma Cholinesterase in Male and Female Rats

Beveridge and Lucas[1] found that the serum cholinesterase activity of mature female rats was three to five times greater than that of mature males or immature females. Similar differences in the cholinesterase activity of rat liver due to sex were also reported by Zeller and co-workers[2]. These reports were made before Mendel and Rudney[3] had established that there are two cholinesterases in the body—one a specific or true cholinesterase, exerting its maximum activity at low concentrations of acetylcholine (about 3 mgm. per cent), and the other a non-specific or pseudo-cholinesterase, capable of hydrolysing other esters besides those of choline and having its maximum effect at high concentrations of acetylcholine (above 300 mgm. per cent). Beveridge and Lucas[1] and Zeller[2] had estimated rat cholinesterase at high concentrations of acetylcholine which would mask the activity of the specific enzyme and thus represent mainly the activity of the pseudo-cholinesterase.

Recently, acetyl-β-methylcholine and benzoylcholine, specific substrates[4] for true and pseudo-cholinesterase respectively, were used to determine the activities of these two enzymes in the plasma of albino rats, and the values obtained were compared with the activity of the plasma towards acetylcholine. Average results for three groups of rats, mature females, mature males and immature females, are shown in the accompanying table.

In agreement with the results of Beveridge and Lucas, it is seen that the activity towards acetyl-

CHOLINESTERASE ACTIVITY OF RAT PLASMA.

	No. of animals	μl. CO_2 evolved by 1 ml. plasma in 20 min.		
		Acetylcholine (0·06 *M*)	Benzoylcholine (0·006 *M*)	Acetyl-β-methylcholine (0·03 *M*)
Mature females	12	606·8 ± 203	128·6 ± 49	62·0 ± 8·3
Mature males	13	170·5 ± 25·4	30·4 ± 9·7	51·7 ± 10
Immature females	20	155·8 ± 29·5	30·5 ± 4·9	43·7 ± 8·1

choline is three–four times higher in the mature females than in the other two groups. The activity towards benzoylcholine, being about four times greater in the plasma of the mature females, parallels the activity towards acetylcholine and shows that the higher activity is due mainly to the pseudo-cholinesterase. Although the differences between the groups in their activities towards acetyl-β-methylcholine are significant statistically, the true cholinesterase certainly would not account for the much higher values found in the plasma of mature females at high concentrations of acetylcholine, since this enzyme contributes little to the activity at these substrate concentrations.

Thus the greater activity of the plasma of mature female rats towards acetylcholine, as compared with that of mature males and immature females, is due mainly to the activity of the pseudo-cholinesterase.

I acknowledge the assistance of a grant from the Banting Research Foundation.

DOROTHY B. MUNDELL.

Banting and Best Department
of Medical Research,
University of Toronto.
March 16.

[1] Beveridge, J. M. R., and Lucas, C. C., *Science*, **93**, 356 (1941).
[2] Zeller, E. A., and Birkhauser, H., *Helv. Chim. Acta*, **24**, 120 (1941).
[3] Mendel, B., and Rudney, H., *Biochem. J.*, **37**, 59 (1943).
[4] Mendel, B., Mundell, D. B., and Rudney, H., *Biochem. J.*, **37**, 473 (1943).

Prenatal Mortality

IN the interesting article[1] on "Prenatal Mortality and the Birth-Rate", Dr. A. S. Parkes states, "The amount of prenatal mortality from the time of conception to the time of birth is known to be considerable in many mammals, figures so high as 40 per cent or more having been determined". At least in one mammal, the wild rabbit, a much higher mortality has been recorded, and investigation has shown that with the technique normally employed the full extent of mortality may be overlooked.

It was estimated in a recent paper[2] that the prenatal mortality in wild rabbits in Caernarvonshire in 1941 was not less than 45–58 per cent. More recently[3], with much more extensive supplementary data obtained in 1942, it has been shown that the prenatal mortality approximated to 64 per cent. Of this enormous mortality, 60 per cent is accounted for by the total loss of whole litters about the twelfth day of gestation. The remaining 4 per cent represents a sporadic loss of approximately 10 per cent of the ova in the surviving litters. Further work in progress is designed to show whether this mortality is general in other areas.

The prenatal mortality in polytocous animals is estimated normally by comparing the number of corpora lutea in the ovaries with the number of macroscopically visible embryos in the uterus. This is possible because, as a rule, embryos that die are reabsorbed *in situ*, without disturbing the course of gestation of the remaining embryos. Abortion is a common sequel to embryonic death in monotocous animals, but in polytocous animals it occurs rarely, unless the embryos die near full term. However, if all the embryos in a polytocous animal die almost simultaneously and are reabsorbed *in situ*, the effect on the estimate is much the same as if they were aborted, for once the re-absorption is complete, the mother, being no longer pregnant, would not be included in the sample on which the estimate is based. Hence litters lost in this way would be included in the estimate only if the embryos were actually in process of re-absorption at the time of examination. Consequently, estimates of prenatal mortality, based on counts of corpora lutea and embryos in samples including all visible stages of pregnancy, are liable to be extremely misleading. For example, such an estimate, from the rabbit data referred to, would disclose a mortality of only 24 per cent.

The loss of whole litters in this way can be detected and estimated by dividing the data, according to the stage of development of the embryos, into groups, each of which covers a period nearly commensurate with the time required for the complete re-absorption of a dead embryo of that stage, and by estimating the mortality in each group separately. Clearly, if a significantly higher mortality is found in any of the earlier groups than in the later groups, it can be accounted for only by postulating the loss of whole litters and their disappearance from the samples comprising the later groups; because the corpora lutea persist throughout gestation, and the discrepancy between the number of them and of embryos represents the whole of the loss of ova in that animal from the time of ovulation.

Unfortunately, this method of fractionation requires extensive data and is laborious; but it is clear that until the method has been applied to polytocous mammals, other than the rabbit, it is unsafe to conclude that prenatal mortality in them does not exceed existing estimates and that the loss of whole litters is not of more frequent occurrence than has been supposed hitherto.

F. W. ROGERS BRAMBELL.
IVOR H. MILLS.

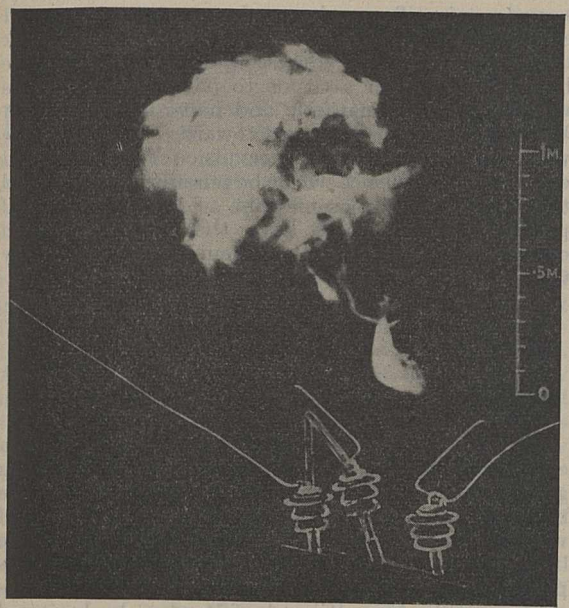
Department of Zoology,
University College of North Wales,
Bangor.
March 22.

[1] Parkes, A. S., NATURE, **153**, 245 (1944).
[2] Brambell, F. W. Rogers, *Proc. Roy. Soc.*, B, **130**, 462 (1942).
[3] Brambell, F. W. Rogers, *Proc. Zool. Soc. Lond.* (in the Press).

Diffusion Phenomena in Alternating Current Arcs

THE successful interruption of large currents at high voltages has been the subject of considerable research, the general aim being to bring about a low-energy release in the circuit breaker by having a short arcing period. During recent years, attention has been focused on the use of a high-velocity blast of gas to effect consistently rapid interruption and at the same time avoid setting up destructive voltage surges in the circuit. Numerous oscillograms have shown that final interruption takes place towards the end of a half-cycle, and for this reason great interest has been taken in the de-ionizing influences which are active immediately after current zero.

While it is generally agreed that diffusion enhances the recovery of dielectric strength during at least the first 10 microseconds after the recorded current zero, there are differences of opinion as to the mechanism which is mainly responsible for avoiding the re-striking of the arc. By suitable mechanical arrangements[1], a gas blast can be so directed that some time after current zero a wedge of cold gas is inserted in the arc trace. This wedge extends rapidly and can



EXTINCTION OF 10 KV., 280 AMP. ARC. EXPOSURE TIME, 1/400 SEC.

be thought of as a major factor in building up dielectric strength. Slepian[2] has strongly criticized this point of view, and has argued that diffusion rather than displacement is the vital factor in circuit interruptions.

Some information on the nature of the processes at work after current zero has been obtained by large-scale experiments with 50-cycle arcs in open air. By drawing arcs of 100–320 amp. at 10,000 volts, highly unstable conditions were obtained which gave rise to extinction in times of the order of 1 second.

Numerous photographs were taken to examine the progressive nature of arc instability and one of these, taken shortly after final interruption, is reproduced. This seems to indicate that interruption takes place at one pole earlier than the other and that the final current is a space-charge-limited discharge. Other photographs show that separate clouds of excited atoms or molecules can exist for appreciable times after current has been interrupted.

A fuller account is in course of preparation.

J. J. O'DOHERTY.

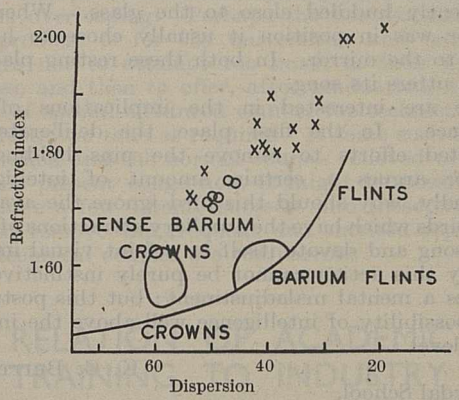
Science Buildings,
University College,
Dublin.
March 25.

[1] Kesselring and Kopplemann, *Arch. Elektrotech.*, **30**, 75 (1936).
[2] Slepian, *Trans. Amer. Inst. Elect. Eng.*, **60**, 162 (1941).

New Types of Optical Glass

THE communication[1] by Messrs. Hampton, Bastick and Wheat is timely in that it directs attention to recently developed forms of optical glass that depart markedly in properties from those previously available and so provide optical designers with increased scope. Two statements, however, need correction. The refractive index limits of the new Kodak glass[2] are 1·71–2·02 and not 1·71–1·97, as stated; while the reference to the Kodak glass (known as *EK*2), having $nD = 1{\cdot}745$ and $V = 45{\cdot}8$, should not be taken to imply that it is now generally available. This glass is being made in England in our laboratories under the ægis of the Government and can be supplied for war purposes only.

The full range of optical properties now capable of realization as a result of our researches in the manufacture of glass from rare earth elements, with little or no proportion of silica, is shown in the accompanying figure. In support of the suggestion, by Hampton *et al.*, that the availability of glasses of such outstanding properties should stimulate work in lens design, it may be mentioned that many patents on lens design have been granted since the publication of our patents[2]; for example, B.P. 517,271; 523,061; 523,062; 535,501; 548,254; 548,255; 548,256; 548,251; 547,691; 554,291; 555,464; 555,404, to mention but a few. Some stimulation of lens design has, therefore, already occurred. Indeed, the Eastman Kodak Company was supplying lenses using the new glass before the present War, and is now using it in air-camera lenses on a large scale.



COMPARISON OF NEW KODAK GLASSES WITH OLDER TYPES. × REFERS TO GLASSES DESCRIBED IN B.P. 462,304; ○ REFERS TO GLASSES DESCRIBED IN B.P. 534,680.

So far the chief demand has been for the *EK*2 type; but we shall welcome any expression of views that will assist us in deciding which of the other members of the series should be made available.

W. G. BENT.
(Chairman.)

Kodak, Ltd.,
Kingsway,
London, W.C.2.

[1] NATURE, **153**, 283 (1944).
[2] B.P. 462,304 and B.P. 534,680.

A Deluded Sparrow

WE have been much intrigued of late by the actions of a cock house sparrow which has apparently become permanently attracted by its own reflexion in a glass window. The window forms a transom over a door and we first noticed the bird flying at the glass and pecking it violently. When this was continued for a long period, closer observation was made and the available facts collected. At the time of writing, the observation period has extended over more than a fortnight, and the bird shows no sign of deserting its post. The facts are as follow:

(1) Although there are many windows available in the immediate neighbourhood, attention is confined to one piece of glass. (2) Although the bird sometimes

absents itself during the day and always at night, it returns to the same place. We have not been able to discover its night resting place. (3) A piece of mirror was fastened to the outside of the glass by means of two bright 3 in. optics pins stuck into the frame. The mirror was loose behind the pins and the nature of the restraining force would be clear to a creature with intelligence. The presence of the mirror much excited the bird, and it made violent efforts to get behind the mirror. To do this it seized the pins in its beak and pulled. On two occasions it managed to remove the pins. (4) Occasionally during the day, regularly at about 8.30 a.m., it fetches pieces of food and tries to push them through the glass. The food is obtained nearby, where tits and chaffinches are fed daily. There are not many house sparrows on this particular feeding ground. (5) The bird shows considerable boldness, for people are constantly passing within a few feet of it. It made attacking rushes towards me when I was fixing the mirror in position. (6) At times the bird becomes tired and rests, sometimes on a small projection above the window, more frequently huddled close to the glass. When the mirror was in position it usually chose to huddle close to the mirror. In both these resting places it often utters its song.

We are interested in the implications of this evidence. In the first place, the deliberate and repeated efforts to remove the pins holding the mirror argues a certain amount of intelligence. Secondly, why should this bird ignore the available real birds which have the auxiliary attractions of smell and song and devote itself to a faint visual image? Surely this action cannot be purely instinctive. It argues a mental maladjustment; but this postulates the possibility of intelligence well above the instinctive level.

K. G. BRITTON.

Rydal School,
Oakwood Park,
Conway.
April 3.

Wordsworth and Science

WORDSWORTH'S apparent antipathy to science, as revealed by the quotations which Dr. Wigglesworth has given in NATURE of March 25 from his poetical works, has always provoked adverse comment, not unnaturally, from scientific men, and the quotation which has so long adorned the front page of NATURE has always borne a somewhat ironical air.

Yet it would seem that Wordsworth once had high hopes of science, and those who have read his famous introduction to the "Lyrical Ballads" will find there a more sympathetic view of it and, incidentally, a statement of what Wordsworth conceived to be the relationship between science and poetry. That relationship touches the crux of the matter, however we view it, but I do not propose to discuss it here. But it may be pointed out that when Wordsworth was writing, science had elaborated few of those great generalizations with which we are now familiar and which have some claim to be regarded as imaginative efforts paralleling those of the poet and artist.

It would also appear that Wordsworth's strictures were provoked less by science itself than by a certain narrow-mindedness he had found in 'scientists' of a sort with whom he had come into contact. His animadversions may not have been altogether undeserved; scientific workers of a certain type and calibre do not always exhibit in their mental outlook the fruits of a liberal education, assuming they have had one, and their attitude to poetry and the arts may be as unsympathetic and naïve as that which Wordsworth often displayed towards science. There was some ground for his revulsion from the cold detachment of science when the pursuit of it deadened the wider sensibilities of some of its followers. If poetry and the poets have their vapourings on occasion, science and the scientists have equally their aridities and myopic crudities.

H. A. SCRUTON.

"The Ridings",
Riplingham Road,
Kirk Ella,
E. Yorks.

MR. SCRUTON'S comments, with which I am in entire agreement, afford me an opportunity of making good an omission from my article. I omitted to state that my notes were limited to Wordsworth's poetical writings. The omission is indefensible; but the limitation I think can be defended, for Wordsworth's prose writings are immeasurably inferior to his poetry—as he himself surely felt when he hesitated whether to reprint the prefaces, and decided to include them at the end of his last volume where they could be read or not as the reader might desire.

As Mr. Scruton rightly says, the references to science which the prefaces contain are certainly more sympathetic. "The knowledge both of the Poet and the Man of science is pleasure". But still "Poetry is the breath and finer spirit of all knowledge; it is the impassioned expression which is in the countenance of all Science." Wordsworth concedes that "the remotest discoveries of the Chemist" may be "proper objects of the Poet's art" and "if the time should ever come when what is now called science . . . shall be ready to put on, as it were, a form of flesh and blood, the Poet will lend his divine spirit to aid the transfiguration, and will welcome the Being thus produced, as a dear and genuine inmate of the household of man". As Mr. Scruton asks in effect, if Wordsworth were alive to-day, would he have judged that that time had now arrived?

V. B. WIGGLESWORTH.

The Rare Gene Rh_y in Mother and Son

Wiener[1], and Race *et al.*[2,3,4], have independently described allelomorphs of the *Rh* gene. In addition to the six common to both investigations, the possession of the *St* serum enabled Race *et al.*[3] to define a seventh rare allelomorph, Rh_y.

The first family evidence that Rh_y is allelomorphic has just been obtained from the examination of the parents of the first Rh_1Rh_y donor recognized. His mother was Rh_1Rh_y, and his father's blood gave the reactions of Rh_1Rh_2. Three different sera of the *St* type were used in testing this family.

R. R. RACE.
G. L. TAYLOR.

Medical Research Council,
Emergency Blood Transfusion Service.
April 11.

[1] Wiener, *Proc. Soc. Exp. Biol. and Med.*, **54**, 316 (1943).
[2] Race and Taylor, NATURE, **152**, 300 (1943).
[3] Race, Taylor, Boorman and Dodd, NATURE, **152**, 563 (1943).
[4] Race, Taylor, Cappell and McFarlane, NATURE, **153**, 52 (1944).

TECHNICAL EDUCATION OF THE FUTURE

DR. D. S. ANDERSON, principal of the Birmingham Technical College, recently addressed a meeting of the Birmingham General Branch of the Association of Scientific Workers, outlining his views on desirable changes in technical education in Great Britain.

Technical education, Dr. Anderson said, may be roughly defined as the education required by, and given to, personnel in industry, this personnel ranging from the skilled craftsman to the man doing laboratory development work of the highest character. At present the personnel of industry falls roughly into four groups : unskilled, semi-skilled, skilled and technical staff workers. Before examining the needs of the different groups, one should consider if any change in the grouping is to be expected in the post-war period. Dr. Anderson thinks such a change is to be expected. The increase of mechanization, of automatic processes and control, of scientific in place of empirical bases for much industrial practice, will all increase considerably the number of technical staff workers required. This development will be accompanied by the de-grading of many skilled operations to semi-skilled, and the net result is likely to be a decrease in the number of skilled workers and a corresponding increase in the number of technical staff workers and semi-skilled workers. While many may deplore the diminution in the number of skilled workers, the change really represents an advance.

The teaching institutions are concerned only with the skilled and technical staff workers. In Great Britain, apart from university degree courses, comparatively little special preparation or training is given before entering industry. Both the practical and theoretical training begin after entry, the theoretical training being taken, in the majority of cases, in the form of evening courses. This present system of training is unsatisfactory in three main respects : the system is slow, it is frequently unorganized at the works end, and the evening study imposes a very heavy burden on the young person. Students are frequently engaged on their technical studies right through their early twenties, and as a result of this prolonged period of technical study are prevented from developing an interest in cultural subjects and social affairs. One of the main post-war tasks in technical education should be an endeavour to shorten all forms of technical training. In the case of the skilled worker, this could be done by more systematic training in the works, and in the case of the technical staff worker it might be done by arranging some part of his technical course on a full-time basis, either at the beginning or end of the training period. On the Continent, full-time courses for technical staff workers prior to entering industry have been developed to a considerable extent and have proved of great value in supplying industry with a body of well-trained technicians.

Another post-war problem is concerned with teachers in universities and technical colleges. The quality of instruction in any teaching institution depends first on the teacher, secondly on the equipment, and thirdly on the building. While it is obvious that teachers must be carefully selected initially, very little has been given in the past for what one might call their 'care and maintenance'. The output of new knowledge in all branches of science and technology is so overwhelming that teachers have the greatest possible difficulty in keeping up to date. Technical teachers therefore require refresher courses to bring them up to date in their subjects, and periodical returns to industry to be brought up to date in industrial practice.

Two other points concerning teaching are that some subjects are best taught by practising specialists, and therefore firms should be prepared to allow senior members of their technical staff to act as part-time lecturers during the day. The other point concerns exchange of teachers. It would have a very stimulating effect if teachers could be exchanged between institutions such as universities and technical colleges, and also with American and Dominion institutions.

One of the problems which is ever present in a teaching institution is that of getting into a syllabus all the subject matter which is required. The boundaries of knowledge are advancing so rapidly in all directions that material has constantly to be added to all technical and scientific syllabuses, causing most serious overloading. Perhaps the best solution for this problem is for the universities and technical colleges not to attempt too much in their normal courses, and then to offer, after graduation, a wide range of special advanced courses for technical men in industry to take as required. If some such action were taken and the normal courses relieved of some of their present congestion, it might be possible to introduce a few 'liberal' subjects into these courses, and so remove the frequent and merited reproach that technical courses are too narrow.

RELATION OF ACADEMIC TRAINING TO INDUSTRY

THE Swiss university journal *Schweizerisch Hochschule Zeitung* of September 1943 contains some long extracts from a report by Dr. H. Erb which has attracted considerable interest in Switzerland, and may have some bearing on post-war educational problems in other countries. It deals with the old and recurring problem of too many with academic training, a matter which has also exercised the minds of leading educationists elsewhere, notably in Germany a few years ago, when it filled many columns in the *Chemische Zeitung*, and also in the United States. The pressing needs and special conditions of war have submerged the problem in most countries to-day; but it is likely to emerge with still greater insistence after the War. Dr. Erb, while analysing its special features under Swiss conditions with much detail, does not suggest any very new or striking remedial or preventive measures other than those which have already been frequently urged in Great Britain and America : such, for example, as the warning against excessive concentration on the vocational side of education, at all events in a too narrow or specialized sense ; the urgent need for raising the dignity of handiwork, of applying more thoroughly the doctrine of Morris and Kropotkin of mind-training through the hand ; and a few generalities briefly dealt with below. So far as Switzerland is concerned, it is thought that more complete statistics and better analytical interpretation thereof, together with a greatly improved central organization for the transfer of university men into suitable openings in industry, are urgently needed.

If the number of young people leaving school and college is much larger in recent years than at the beginning of the century, it would seem that this is less marked in Switzerland than in certain other countries. For example, it is pointed out that, in 1930–31, per 100,000 of population, Germany had 63 *Abiturienten* (holders of school-leaving certificates or equivalent) whereas Switzerland had only 34. Japan and Rumania in 1934 had more than six times as many with academic training as in 1913. In the same period those of Holland increased by 146 per cent, of France 112 per cent, of Great Britain 83 per cent, and of Switzerland 59 per cent. According to Dr. Erb, the most disturbing aspect of this increase in quantity is the serious decline in quality: he thinks the standard, however measured, is definitely lower. The real problem, therefore, is not necessarily 'too many', but 'too many of the wrong type'. Mediocrity is said to be very noticeable in the universities and secondary schools. There are far too many *Brodstudenten*, or those who concentrate too closely on the vocational side to the neglect of the broader cultural and intellectual aspect. They specialize too soon and aim at passing through the technical schools as quickly as possible. The sole business of education, in their view, is to enable one to earn a living in some narrowly specialized sphere. We are faced again with the dangers of specialization, which have been debated *ad nauseam* in recent years.

Dr. Erb may have put his finger on one of the main sources of the trouble when he admits that school-building accommodation and number of teachers have not kept pace with the increased number of entrants. Teaching has become less individualistic than ever, and tends to savour of mass-production methods. It is difficult, of course, to be precise on this matter of quality; but both in the universities and in industry there are complaints that, despite the large increase in number of those with academic training, there is serious lack of the right type for the needs of industry and trade. If sufficient school space is wanting; if there are too few teachers and these are underpaid, with inadequate status and insufficient knowledge of the needs of business and industry, then the quality of the students must necessarily suffer. Certain it is that many of them show signs of hurried and inadequate training, both of mind and character—especially the latter: they are incapable of adapting themselves readily to the realities of life, from which they expect too much.

Although Dr. Erb complains that educational, or at least academic, statistics are not so good as they might be, and those which are available are not intelligently used, he thinks there is little doubt that the number of entrants to schools and universities tends to increase considerably in periods of industrial prosperity; but by the time these new entrants have finished their scholastic career, the boom period has been succeeded by depression, and they are condemned to unemployment; so much harder to bear in proportion to their academic qualifications. This is one of the tragedies of unemployment, raising larger issues than can be dealt with here; nevertheless, it must be remembered that, as already indicated, chances of employment for those with academic training—even in lean times—would be increased if they were more adequately or properly trained.

Reference is made also to the impact of social conditions and changes on the relative numbers of students at secondary schools and universities. The rights of man and consequent social philosophy of the nineteenth century led to the emancipation of the lower classes and of women, and to increasing demands for improved social status and better education. Dr. Erb considers that, in Switzerland, the exaggerated importance imputed to academic learning of the more showy or superficial type was particularly marked, and was closely associated with the growing social prejudice for black-coated respectability. Those who had not themselves attained to this status were anxious and determined that their children should do so; and this delusion, says Dr. Erb, will continue until it is more generally realized that the harder one studies the more certainly will he miss the road to wealth. This may be often true, but scarcely attains the dignity of a general proposition; and in any event strikes a slightly discordant note in its present context.

Among remedial measures suggested are a more careful selection of candidates for the school-leaving examinations, and greater attention to the importance of test or observation periods rather than exclusive concentration on examination results. In other words, the examination system is again under criticism, as is frequently the case to-day. Dr. Erb is strongly of opinion that the path to the university should be more strictly reserved to those above the general average who can best profit by university training. Not only should the school-leaving examinations (*Maturitätsschule* and *Auslese*) be considerably tightened up and revised, but also they should be supplemented by a system of character tests and observation periods, so that the real abilities of the student, not necessarily brought out by the usual examination, could be much more clearly and thoroughly ascertained. The examinations themselves should not usually be made more difficult in the sense of book knowledge—they are already too overloaded—but rather should include tests of character and personality not generally provided for in the examination papers.

CORRELATION OF THIXOTROPIC SETTING WITH DENSITY IN SILVER AMALGAMS

By DR. D. R. HUDSON
Heriot-Watt College, Edinburgh

SILVER and mercury form, by peritectic reactions at 276° and 127° C. respectively, intermetallic compounds represented very nearly by the formulæ AgHg and Ag_3Hg_4. They exist in space lattices of the close-packed hexagonal type with $a = 2{\cdot}987$ A., $c/a = 1{\cdot}62$, and the body-centred cubic type with $a = 10 - 10{\cdot}1$ A., respectively; the latter resembles the well-known γ-brass structure, but is not identical with it. In synthesized amalgams the range of stability of both species is small, probably not exceeding $\pm \frac{1}{2}$ per cent. Ag_3Hg_4 exists as native amalgam (argental or landsbergite) often in very well-formed crystals in the cubic system, corresponding closely in composition to the artificial product; AgHg has not, so far, been reported in minerals, and Heide has suggested that this species does not occur native. Further, Ag_3Hg_4—known already to the alchemists as *Arbor Dianae*—can be obtained chemically by displacement of ions of either metal in solution by the action of the other. This is in accordance with the fact that the two standard

electrode potentials are almost identical: 0·799 v. for $Hg : Hg_2^{\cdot\cdot}$ and 0·798 v. for $Ag : Ag^{\cdot}$ at 25° C. In the hardening of plastic dental amalgams, Ag_3Hg_4 is formed by the reaction

$$\underset{\text{filings}}{Ag_3Sn} + \underset{\text{liquid}}{Hg} \rightleftarrows \underset{\text{dendrites}}{Ag_3Hg_4} + \underset{\substack{\text{solid solution}\\(\text{Black, Troiano})}}{Sn(Hg)}$$

Densities of heterogeneous silver amalgams. The variation of density with composition has been determined for the heterogeneous range. Although the solubility of silver in mercury is small—only about 0·03 per cent at room temperature—they are quite fluid up to about 8 per cent. Between about 8 per cent and about 20 per cent silver, they are plastic on formation but 'set' on standing overnight; above 20 per cent they resemble hard 'Plasticine' rather than a heterogeneous mass, becoming gradually harder as the composition of the solid amalgam is approached. This was found to be 27·43 and 27·72 per cent in two separate experiments, by expulsion of the liquid phase (argentiferous mercury) under severe compression. By very careful handling of the set amalgams, it was found possible to use Archimedes' method down to about 13½ per cent silver; below this a special midget (2½ ml.) specific gravity bottle was used with success. The results are in fair agreement with the older determinations of Maey (1905), but are more consistent among themselves and probably rather more accurate than these; the very erratic values reported by Joule (1863) and Duczko (1935) were not confirmed. The density/composition curve shows small but distinct peaks at about 15 and 28 per cent, about 13·61 and 13·60 respectively, with minima at about 13 and 25 per cent, that is, 13·47 and 13·37. Between these points the curve is made up of straight lines and the *density is invariably above that calculated for a conglomerate* by summation of volumes. The silver content (at the mercury boundary) lies about midway between $(Ag_3Hg_4)_4$ proposed by Weryha (28·74 per cent), and $(Ag_2Hg_3)_{10}$ proposed by Berman and Harcourt (26·4 per cent), but a Hume-Rothery constitution $(Ag_5Hg_8)_4$ is definitely excluded by present results as well as by *X*-radiological and metallographic data.

Setting and Thixotropy. The amalgams set like plaster of Paris when they contain more than 8 per cent silver, but the process is very different, being completely and repeatedly reversible by pressure alone. During setting, the hardness increases; above 20 per cent one can obtain a robust mass which becomes quite plastic on kneading. This process is thixotropic, being due to the formation of a well-defined *réseau* of acicular crystals, which is quickly degraded under local pressure. Surplus mercury is held in this spongy structure as a result of its high surface tension, and in the mercury-rich amalgams may be seen to liquate out, leaving the dry *réseau* intact. It is rare to find thixotropy displayed so perfectly as in these amalgams.

Effect of setting on density. With the incidence of setting there is also a fall in density of 1–1½ per cent in a few days. In an extreme case, a 15 per cent alloy, which had stood undisturbed for more than two years, segregated into hard discrete equi-axed lumps and argentiferous mercury. Hard grinding was required to restore this to the plastic state, when its density was found to be normal and as much as 4 per cent greater. This ('pea' plus liquid) state is regarded as the ultimate limit of thixotropic setting, equivalent to complete spheroidization of cementite in steel. Two explanations are suggested.

(1) That pressure causes Murphy's peritectic reaction at 127° C. to go leftward at room temperature. $\beta + Hg \rightleftarrows \gamma$, or very nearly $3AgHg + Hg \rightleftarrows Ag_3Hg_4$.

(2) That the *réseau* consists of another intermetallic species, formed on standing and restored on kneading to the Ag_3Hg_4 originally present. This species might be either the same phase (27·7 per cent silver) in another space lattice with different physical properties, or a new intermetallic compound, possibly of different composition. Unfortunately, the relative proportion of jagged crystals and argentiferous mercury in the 15 per cent amalgam was not determined accurately. It may be estimated to be about 1 : 2, which would give an approximate silver content of about 45 per cent, the solubility of silver in liquid mercury being very small at room temperature. One may recall Murphy's β-constituent containing about 40 per cent mercury, which we have denoted AgHg.

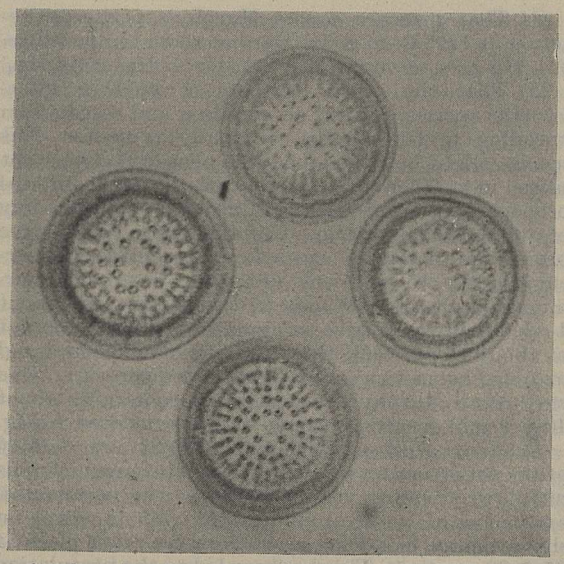
Dental amalgams. The unexpectedly low density of the set structure (spongy *réseau* plus argentiferous mercury) accounts very happily for the paradoxical expansion of tooth stoppings too rich in silver—a sharp change in setting characteristics takes place at 25·5–26 per cent. This bugbear led to the postulation of void formation by Gray, which *faute de mieux* has been accepted by Troiano and Gayler. However, in the specimen mentioned, in which the thixotropy had proceeded to the extreme limit, the measured difference of 4 per cent in density would require a void volume of as much as one eighth in the 'peas'. In view of their hardness and jagged nature, this is very difficult to accept. Moreover, it is somehow repugnant to scientific intuition to believe that voids can be formed on dendritic crystallization within a mother liquor with surface energy as high as mercury. Sullivan's amalgam of precipitated copper and mercury, now discarded in dentistry, is plastic but sets *hard* in a few hours, and can then be rolled or hammered. On kneading or heating, the mass recovers its plasticity.

Application to other physical properties. It is formally suggested that other anomalies in the physical properties of amalgams of alkalis and other metals, for example, viscosity, surface tension, electrical conductance, may also be due to thixotropy rather than to colloid formation.

A SIMPLE TECHNIQUE FOR PHOTOMICROGRAPHY

By DR. W. N. LEAK

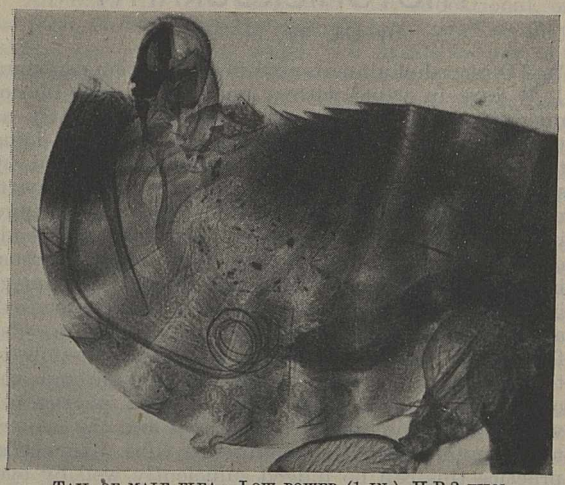
NO record of a microscopical preparation can compare in value with a photograph, yet photomicrographs are often not taken so frequently as workers might wish because of the difficulty of doing the work personally or the interruption caused by sending it to a special photomicrographical department. There is, however, a simple method of obtaining excellent photomicrographs. The method depends on the fact that a camera will photograph a virtual image as easily as it will a real object. The image in a microscope is a virtual one, and if this is focused, as it normally is, at infinity, and a camera, also focused at infinity, is placed as near as possible to the ocular, so that all the light coming through the ocular enters the camera lens, a good photograph will result if the exposure is correct and the camera truly in line with the microscope tube. In actual practice this can be judged sufficiently well by eye,



Cestodiscus superbus. MEDIUM POWER (⅛ IN.). F.P.2 FILM. × 600 APPROX.

and the actual taking of a photomicrograph by this method presents no real difficulty whatever. We can ensure that the microscope image is focused at infinity either by using a focusing screen or a reflex camera, but much more simply by viewing part of the image through a small telescope (a 4-in. lens with a spare eyepiece in a cardboard tube makes quite a satisfactory one) focused for infinity and altering the fine adjustment until the image is sharp. Even this simple procedure is not necessary if the observer's eye is quite normal.

The excellence of the results obtained by this method seems to be due to two factors. First, practically all microscopes are constructed to give their finest results when used visually with an eyepiece, etc., and these conditions do not obtain in the ordinary methods of photomicrography. In the present method, however, we make the microscope give the finest visual image of which it and we are capable, and then photograph this image with the best photographic equipment at hand. The second reason is that in the ordinary way there is a considerable distance between ocular and plate, and this is liable to give rise to serious diffraction phenomena.



TAIL OF MALE FLEA. LOW POWER (1 IN.). H.P.2 FILM.

In this method, however, the length of these narrow pencils of light is scarcely greater than the focal length of the camera lens, so that diffraction troubles almost cease to exist.

With a 10-in. camera lens, the image on the film will be the same size as that seen by the eye, and such a film should stand considerable enlargement; though actually I find that my Leica with a 2-in. Elmar lens will reproduce practically everything I can see if fine grain film is used and enlarged about eight times. To illustrate this the photograph of *Cestodiscus superbus* was deliberately taken at the lowest visual magnification to show the marginal striations comfortably and the film enlarged eight times. A 4-in. or 5-in. lens might be better for general use, though longer exposures would be required. Kodachrome or Agfacolor film have even finer resolution than fine-grain film. With this method there is nothing to prevent the use of high-power eyepieces, for the close eyepoint and the shadows on the retina of blood vessels and opacities, etc., which make them objectionable for visual use do not affect the camera lens. I do not imply that this will give resolution beyond the resolving power of the objective, but it may well show details on the enlarged print which many eyes would fail to see visually.

I hope this brief description of some of the practical and theoretical points involved will make the method better known, for it has great possibilities in industrial and academic research, as well as in teaching. The method can naturally also be used for obtaining a photograph through any other instrument which uses an eyepiece, such as telescope, spectroscope, etc. A fuller description of the method appeared in the *British Medical Journal* of December 18, 1943, p. 787.

SOME SOUTH AMERICAN TIMBERS

TWO Leaflets, Nos. 31 and 32 (September 1943), have been issued under the auspices of the Department of Scientific and Industrial Research by the Forest Products Research Laboratory on "Some Foreign Timbers (South America), 3 and 4" respectively. The leaflets deal with the tree, timber, seasoning and mechanical properties, natural durability, insect attack, preservative treatment, working qualities, uses, and supplies available.

In Leaflet No. 31 two trees, the parana pine, *Araucaria brasiliana* and louro vermelho, probably *Ocotea rubra*, are discussed. The parana pine is a sub-tropical conifer attaining a height of 110–130 ft. with an average diameter of 2 ft. and clear bole of 60–70 ft. It occurs in the Andean region of South America at varying altitudes above 1,600 ft. and preferably on sandy soils. The timber is not resistant to decay, and sapwood very liable to develop a blue stain; it is easily worked by hand and machine tools.

Louro vermelho attains a height of more than 100 ft. and a maximum diameter of 3 ft. in some parts of its range, which probably includes Brazil and British Guiana and may extend further. The timber is said to be resistant to decay, probably more resistant than the heartwood of English oak; a character which, should it be confirmed, is high praise indeed. It is said to be easily workable with hand and machine tools.

Leaflet No. 32 gives notes on peroba rosa, *Aspidosperma polyneuron* (syn. *A. peroba*); and mandio-

queira, Qualea spp. The peroba rosa tree is said to attain a height of 125 ft. and a diameter of 4–5 ft. in the San Paulo State in Brazil. In less favourable parts of its range, however, it is often less than half this size. It is highly resistant to decay and is easily worked by hand and machine tools.

The name 'mandioqueira' refers to several closely related species of Qualea in the Amazon region. In Central and Southern Brazil the same name is applied to species of Didymopanax, with timber of entirely different character. In Brazil mandioqueira occurs as a large tree mainly of the uplands and the banks of running streams. It probably averages about 100 ft. in height at maturity with a diameter of about 2 ft. About thirty species of this genus have been recorded from Brazil and the adjoining countries. The timber is moderately hard to work by hand or machine tools, being somewhat cane-like in its resistance to cutting. It is said to be like the African iroko (*Chlorophora excelsa*) in many respects.

A factor, not without importance in connexion with the research work undertaken by the Forest Products Research Laboratory on these foreign timbers, is in its application among other uses to their suitability or otherwise for plywood conversion.

PETROLEUM: PAST, PRESENT AND FUTURE

THE petroleum supply situation is causing considerable comment in the United States at the present time and no doubt there is the usual crop of rumours concerning imminent scarcity of this product, so necessary in peace-time, so indispensable at this critical period of warfare. Dr. Per K. Frolich has given (*Science*, Nov. 26 and Dec. 3, 1943) a candid picture of the present position, supported by data from a number of reliable sources. Unhesitatingly he states that eventually a shortage in natural petroleum will occur; but he is equally emphatic that when that time comes it should be possible to obtain all necessary hydrocarbon products from alternative sources. Moreover, there is nothing to indicate that there will be any break in continuity of supply of gasoline and other petroleum derivatives. Nothing more nor less is envisaged than the gradual introduction of synthetic products into the industry as the supply of natural hydrocarbons declines.

Methane, the major constituent of natural gas, can be converted into gasoline by the Fischer-Tropsch process, used commercially in Germany for some considerable time; the heavier constituents can be processed by cracking or dehydrogenation, followed by polymerization and alkylation. Oil can be recovered from shales by 'retorting' under suitable conditions of temperature and pressure. The Tertiary deposits of the Rocky Mountain Region, the Devonian black shales of Indiana and Kentucky, and the cannel shales of Pennsylvania and West Virginia represent a large potential supply of liquid hydrocarbons. In 1928 these deposits were estimated by Dean E. Winchester as capable of producing 92 billion barrels of oil. In addition, there are the Canadian deposits of tar sands which spread over thousands of square miles.

These potential reserves of liquid hydrocarbons are, however, insignificant when compared with the quantity which could be produced from coal deposits. H. L. Ickes, Petroleum Administrator of the United States, estimated in August 1943 that available coal reserves can provide all the synthetic fuel needed for a thousand years and still leave enough for present purposes.

So far these alternative sources of liquid hydrocarbons have scarcely been tapped in the United States, whence before the War came 63 per cent of the world's petroleum requirements. Indeed, it is unlikely that they will be exploited to any great extent for some time to come. The next phase of development in the petroleum industry, as envisaged by Dr. Frolich, will be characterized by further technological progress, increased drilling for oil on a world-wide basis and necessary adjustments in supply and demand. All these factors will tend to prolong the availability of natural resources and, when peace comes, fear of their imminent exhaustion will loom correspondingly less large.

BOMBAY ISLAND

THE president of the Section of Geology and Geography at the thirty-first session of the Indian Science Congress at Delhi last January was Dr. A. S. Kalapesi, of St. Xavier's College, Bombay. Appropriately, Dr. Kalapesi chose as the subject of his presidential address a review of the geographical and geological features of Bombay Island. His discourse on its geographical aspects is of much interest to those who know Bombay, especially because in describing the evolution of the present unitary island from the earlier seven separate islands (the *Heptanesia* of Ptolemy) Dr. Kalapesi mentions also the derivation of many of the well-known place names. The word Bombay itself, for example, is now generally accepted as derived from the name, 'Mumba Devi', of the tutelary goddess of the first known inhabitants of these islands, the Kolis.

Geologically, Bombay Island is a portion of the great spread of Deccan Trap lavas occupying so much of Western India, and is composed essentially of westerly dipping sheets of this basaltic formation with a freshwater intercalation, the whole being masked in places by recent sea and lagoon deposits. That there have been geologically recent changes of level is proved by the presence of a raised sea beach in the centre, and of a submerged forest on the east side of the island. The sedimentary bed mentioned above is of special interest as it contains numerous beautifully preserved fossil skeletons of small frogs. The lava sheets of Bombay are thought to be in part of extrusive origin, like the main mass of the Deccan Trap lava flows, and in part of slightly later intrusive origin.

It is evident from Dr. Kalapesi's address and the writings of some of his predecessors (Carter, Wynne and Fox) that what is now needed is a detailed geological study of Bombay Island, including a careful petrographical study of the various rock types, fortified by chemical analyses. At present views differ, for example, on whether the lava flow that constitutes Malabar Hill, whereon is situated Government House and many of the residences of the merchant princes of Bombay, is composed of basalt, andesite or trachyte. There should be no room for doubt on such a point as this. The task suggested seems a suitable one for geological residents of Bombay, such as Dr. Kalapesi and his students.

L. L. FERMOR.

FORTHCOMING EVENTS

Monday, May 8

SOCIETY OF CHEMICAL INDUSTRY (PLASTICS GROUP) (at the Waldorf Hotel, Aldwych, London, W.C.2), at 2.30 p.m.—Annual General Meeting. Mr. H. Langwell: "The Technique of the Scientific Lecture".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 8 p.m.—Mr. K. de B. Codrington: "Valleys of the Hindu Kush".

Tuesday, May 9

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Prof. H. J. Fleure: "Some Islamic Reactions to Modern Life around the Eastern Mediterranean".

ILLUMINATING ENGINEERING SOCIETY (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 5 p.m.—Annual General Meeting. At 5.30 p.m.—Sir Charles Darwin, K.B.E., F.R.S.: "Tolerances and their Effect on Physical Measurements".

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) (at 16 Princes Gate, South Kensington, London, S.W.7), at 6 p.m.—Mr. David Charles: "Practical Cure of Convergent Verticals".

Wednesday, May 10

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP) (at the Waldorf Hotel, Aldwych, London, W.C.2), at 12.15 p.m.—Twenty-fifth Annual General Meeting.

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir Richard Winn Livingstone: "Education, To-day and To-morrow", 9: "Adult Education".

INSTITUTION OF ELECTRICAL ENGINEERS (TRANSMISSION SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. J. L. Carr: "Remote Switching by Superimposed Currents".

Wednesday, May 10—Thursday, May 11

INSTITUTION OF NAVAL ARCHITECTS (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 2.30 each day.—Boiler Symposium on the Application of Water-Tube Boilers to Merchant Ships.

Thursday, May 11

IRON AND STEEL INSTITUTE (at 4 Grosvenor Gardens, London, S.W.1), at 10.45 a.m.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Annual General Meeting. Mr. R. J. Halsey: "Modern Submarine Cable Telephony and the Use of Submerged Repeaters".

INSTITUTION OF ELECTRICAL ENGINEERS (CAMBRIDGE AND DISTRICT WIRELESS GROUP) (at the University Engineering Department, Trumpington Street, Cambridge), at 8.15 p.m.—Dr. E. B. Moullin: "The Contribution of Cambridge to Radio Engineering".

Friday, May 12

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Mr. G. L. Camm: "An Analysis of the Motion of Cepheid Variable Stars, with reference to Galactic Rotation and Absorption"; Mr. E. H. Linfoot: "The Schmidt-Cassegrain Systems and their Application to Astronomical Photography".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Dr. W. T. Astbury, F.R.S.: "Fibres and Fabrics, Old and New—Their Chemical Structure and Physical Properties".

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

APPOINTMENTS VACANT

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

DISTRICT ENGINEER by the Ceylon Government Railway—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.926A) (May 10).

SENIOR POST under the AERONAUTICAL INSPECTION DIRECTORATE (applicants should possess a first-class Honours Degree in Physics or a recognized equivalent, have had industrial radiological experience, be conversant with the various modifications of the technique of X-ray crystal analysis, and be capable of carrying out independent *ad hoc* scientific investigations in electro-physics)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. A.499A) (May 10).

LECTURER (man or woman) IN GEOGRAPHY AND MATHEMATICS—The Principal, Dudley and Staffordshire Technical College, Dudley (May 12).

LECTURER IN PRODUCTION ENGINEERING at the Coventry Technical College—The Director of Education, Education Offices, Coventry (May 12).

LECTURE-ASSISTANT IN MATHEMATICS—The Registrar, The University, Manchester (May 13).

GRADUATE ASSISTANTS IN MECHANICAL ENGINEERING, ELECTRICAL ENGINEERING, and GRADUATE (or equivalent qualification) in BUILDING AND STRUCTURAL ENGINEERING, at the Darlington Technical College and Technical School—The Chief Education Officer, Education Office, Darlington (May 15).

SPEECH THERAPIST (female, full-time)—The Director of Education, Huntriss Row, Scarborough (May 15).

LECTURER IN MATHEMATICS—The Principal, Kingston Technical College, Kingston, Surrey (May 15).

ASSISTANT LECTURER IN SCIENCE—The Principal, Domestic Science College, Knighton Fields, Leicester (May 17).

ASSISTANT CIVIL ENGINEERS (temporary) on the Staff of the Ministry of Home Affairs, Government of Northern Ireland—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.940A) (May 17).

ASSISTANT CIVIL ENGINEER (temporary) on the Staff of the Ministry of Finance, Government of Northern Ireland—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.941A) (May 17).

DEPUTY ELECTRICAL ENGINEER AND MANAGER (temporary) or CHIEF ASSISTANT ELECTRICAL ENGINEER (temporary) (location, City of Chester)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. D.807XA) (May 17).

CHEMISTS for service with Petroleum Company in the Middle East—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. F.1843X) (May 17).

TWO DEMONSTRATORS IN PHYSIOLOGY (one for BIOCHEMISTRY)—The Secretary, King's College, Strand, London, W.C.2 (May 18).

ASSISTANT TECHNICAL OFFICER—The Executive Officer, Essex War Agricultural Executive Committee, Essex Institute of Agriculture, Writtle, Chelmsford (May 20).

LECTURER IN THE DEPARTMENT OF MATHEMATICS—The Registrar, University College, Singleton Park, Swansea (May 20).

DRAINAGE AND IRRIGATION ENGINEER by the Gambia Government—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E. 950 A) (May 24).

LECTURER in charge of the DEPARTMENT OF BOTANY—The Registrar, University College, Leicester (May 27).

DIRECTOR OF THE INSTITUTE OF MEDICAL AND VETERINARY SCIENCE, Adelaide—The Agent-General and Trade Commissioner for South Australia, South Australia House, Marble Arch, London, W.1 (May 31).

DEPUTY ENGINEER of the Sheffield Waterworks Undertaking—The General Manager and Engineer, Waterworks Office, Town Hall, Sheffield 1 (May 31).

CHAIRS OF PHILOSOPHY, ZOOLOGY and COMPARATIVE ANATOMY—The Registrar, University College, Cathays Park, Cardiff (May 31).

CHAIR OF BOTANY—The Registrar, The University, Sheffield (June 1).

CHAIR OF NATURAL PHILOSOPHY, United College, St. Andrews—The Secretary, The University, St. Andrews (June 15).

CHIEF ENGINEER AND GENERAL MANAGER of the Gloucester Electricity Undertaking—The Town Clerk, Guildhall, Gloucester.

ASSISTANT LECTURER IN SOCIAL PHILOSOPHY to assist in the teaching of the elements of Ethics and Social Philosophy, and an ASSISTANT LECTURER IN GEOGRAPHY to assist with the teaching of Geography—The Acting Secretary, London School of Economics, The Hostel, Peterhouse, Cambridge.

SCIENCE AND MATHEMATICS MASTER, for English High School for Boys, Istanbul—The British Council, 3 Hanover Street, London, W.1 (endorsed "Istanbul").

ASSISTANT LECTURER (Grade III) IN THE DEPARTMENT OF INORGANIC AND PHYSICAL CHEMISTRY—The Registrar, The University, Liverpool.

ASSISTANT MASTER FOR ENGINEERING SUBJECTS in the Burton-upon-Trent Technical Institute and Junior Technical School—The Secretary and Director of Education, Education Offices, Guild Street, Burton-upon-Trent.

DIRECTOR OF THE BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION—The Chairman of the Council, B.E.A.I.R.A., 15 Savoy Street, Strand, London, W.C.2.

RESEARCH ASSISTANT (BIOLOGY and/or PHYSICS) for Hospital Laboratory—The General Superintendent, Christie Hospital and Holt Radium Institute, Withington, Manchester 20.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

University of Leeds. Report of the Librarian for the Session 1942–43. Pp. 6. (Leeds: The University.) [114

Institution of Chemical Engineers. Annual Report of the Council for the Year ended December 1943. Pp. 4. (London: Institution of Chemical Engineers.) [134

Scientific Research and Development. (Cmd. 6514.) Pp. 12. (London: H.M. Stationery Office.) 2*d*. net. [134

Post-War Plans for Science. Pp. 8. (London: Association of Scientific Workers.) 3*d*. [144

Year Book of the Royal Society of Edinburgh, 1944. Pp. 54. (Edinburgh and London: Oliver and Boyd.) 6*s*. [174

Forty-first Annual Report, 1943–1944, of the Imperial Cancer Research Fund. Pp. 32. (London: Imperial Cancer Research Fund.) [174

Other Countries

Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation. Twentieth Annual Report, 1943. Pp. 4. (Boston, Massachusetts: Dr. J. C. Aub, Massachusetts General Hospital.) [54

U.S. Department of Agriculture. Technical Bulletin No. 858: Life History of the Wireworm *Melanotus Longulus* (Lec.) in Southern California. By M. W. Stone and A. F. Howland. Pp. 30. (Washington, D.C.: Government Printing Office.) 10 cents. [114

Smithsonian Miscellaneous Collections. Vol. 104, No. 3: A 27-day Period in Washington Precipitation. By C. G. Abbot. (Publication 3765.) Pp. ii+4. (Washington, D.C.: Smithsonian Institution.) [114

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1943. Pp. iii+108. (Washington, D.C.: Government Printing Office.) 20 cents. [114

Printed in Great Britain by FISHER, KNIGHT & Co., LTD., The Gainsborough Press, St. Albans, and published by MACMILLAN & Co., LIMITED, at St. Martin's Street, London, W.C.2, and THE MACMILLAN Co., 60 Fifth Avenue, New York 11, N.Y., U.S.A.—Saturday, May 6, 1944.