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DISSEMINATION OF SCIENTIFIC INFORMATION

THE well-deserved tributes which have been paid to the achievements of British and other men of science in war-time almost inevitably tend to encourage in the public mind the belief that war stimulates scientific advance. That notion was exposed in "The Frustration of Science" (published by Allen and Unwin, 1935); but it is well to be reminded that, despite certain gains, on balance war tends to retard rather than to promote general advance. The advances occur in limited fields where the prosecution of the war effort is directly served, and although such advances may be turned to account in peace-time, the scientific effort expended is sometimes out of proportion to that which might have achieved the same result in peace-time. Moreover, fundamental research tends to be suspended entirely, or at best is pursued with inadequate means.

The positive achievements of scientific effort in war-time should not, therefore, be allowed to obscure the fact that a heavy price has been paid, that important fields have been neglected, and that development at best has been lopsided. It might be exaggeration to speak in the present war of the frustration of science; but there can be no denial that advance generally has been impeded, and a main cause of this has been the interruption of communications between scientific workers, both within and across national boundaries. The interruption of internal communications has already been the subject of some discussion in regard to the organization and development of scientific and industrial research in Great Britain. The international aspect is discussed by Dr. Joseph Needham in an article appearing on p. 657 of this issue.

It is, of course, to remedy the position which arises from the interruption of free scientific intercourse across national frontiers, with all that such intercourse means in the exchange of knowledge and ideas and the stimulation of creative thought, that there have been established in war-time such organizations as the British Central Scientific Office in Washington, the American Scientific Office in London, the scientific liaison officers of the various Dominions with the United Kingdom, the Anglo-Soviet Science Collaboration Committee and the Scientific Co-operation Office of the British Council in China, the organization and work of which Dr. Needham describes in some detail. It is no disparagement of the services of such liaison organizations to point out that some at least of their work in war-time is due to the interruption of normal channels of communication and the operation of the censorship. No such organizations, however efficient, can entirely compensate for the effects of withholding a scientific or technical paper either from publication entirely or from communication abroad.

In considering any new proposals for the organization of co-operation or the exchange of information in science, it is well to recall that the progress of science depends first and foremost upon full freedom of investigation and expression, and the first step must be the removal of the constraints of war-time at the earliest possible moment consistent with world order and security. Organization, in fact, should be not a substitute for such intercourse, as in war-time it tends to be, but a supplement and a stimulant.

As to the need for such supplementing, there is little room for doubt. The report issued last year by the British Commonwealth Science Committee (see *Nature*, 152, 29 ; 1943) showed how much remains to be done to improve the collection and dissemination of information and collaboration in research within the Empire, while the necessity for extending such collaboration to the United States, the U.S.S.R., China and other countries or regions was clearly indicated by the Committee. The report recommended specifically the maintenance in London by the Governments of the English-speaking countries of permanent scientific and technical representation, and that such representatives of the Dominions and India and of the United Kingdom and the Colonies should constitute a British Commonwealth Scientific Collaboration Committee, to act with the Royal Society in the discussion of topics of common interest, to keep in touch with all agencies and organizations for the collection and dissemination of scientific information, to further schemes for co-operation in research, and to make recommendations and proposals for common action. Arrangements to secure the co-operation of similar representatives in London of the United States and of other countries outside the British Commonwealth were also recommended.

Already the Council for Scientific and Industrial Research in New Zealand, the National Research Council of Canada and the National Research Board of South Africa are prepared to support such collaboration, and Prof. A. V. Hill has expressed the hope that such co-operation will lead in due course to more general collaboration. There is thus in being a movement which promises to retain the science co-operation offices already established for war purposes, and to use for post-war purposes at least their 'post-office' functions. Much more than this is clearly contemplated by the British Commonwealth Science Committee, which in its report has boldly indicated some of the possible developments in the collection and dissemination of scientific information, such as collaboration in the production of scientific abstracts for the common use of the English-speaking world.

These tendencies, to which Dr. Needham directs attention in outlining his proposals, are reinforced by others, the importance of which has been enhanced since the appearance of the British Commonwealth Science Committee's report. If the value of the various agencies for co-operation in science set up under the stress of war in the capitals of the United Nations is becoming more generally appreciated, the importance of utilizing such machinery for peace purposes has also been generally emphasized. There is now general agreement as to the mistake which was made in 1918–19 in scrapping too easily and without examination the similar organizations established then for our war purposes. Furthermore, as Dr. Needham notes, the whole trend towards the establishment of functional bodies such as the United Nations Relief and Rehabilitation Administration and the Food and Agricultural Organization enforces the need for more effective co-operation in science across national boundaries. Unless that is established, the functional bodies can scarcely achieve full success.

Whether the structure of the new world order is essentially functional or regional, such scientific collaboration will be essential, and its value has been proved by the work of such bodies as the Middle East Supply Centre and the Anglo-American Caribbean Commission. It is also in line with the school of thought which, inspired by the achievements of the Tennessee Valley Authority, looks to the development of Europe's public utilities or such regional projects as a Danube Valley Authority. There is, moreover, all the experience of the League of Nations' technical committees to testify to the feasibility of such co-operation in matters like health, the opium traffic, communications and transit.

But there is a further reason why the organization of such co-operation is important, which is well brought out in a recent article on "Intellectual Co-operation" by Dr. Gilbert Murray in *Agenda*. Whatever form the world organization for peace tentatively outlined in the Dumbarton Oaks proposals may ultimately take, whether its basis is regional, functional or whether ultimately it develops into a federal system, there must be some community of thought, some general understanding of the unexpressed assumptions, attitudes of mind, characteristic of each national tradition and taken for granted by those who share that tradition. To discover and interpret such assumptions is the primary task and function in international intellectual co-operation, which in this way by encouraging the artistic, scientific and imaginative links between the nations, promotes continuous co-operation and has a powerful, though unseen, influence for good.

By and large, much of this intellectual co-operation must be by personal intercourse and conversation between the people concerned. On that fact rests part of the case for an international university, put forward, for example, by Prof. G. W. Keeton in "The Case for an International University" (Watts, 1941), with its twin functions of the organization of research into all those problems which arise in the achievement of a world-order and publication of the results of such investigations, and the teaching of the adult communities and of youth so as to develop an ordered nationalism, seeking to establish the place of individual national cultures within the general pattern. But such co-operation must not be limited to the university level ; it should permeate all aspects of national culture if it is to provide the broad basis of goodwill for world order.

When all allowance is made for the limitations of space, the most striking impression which Gilbert Murray's survey makes is the comparative neglect of the scientific field. This statement that the agreement made in 1937 between the Committee of Intellectual Co-operation and the Council of Scientific Unions bore particularly good fruit might be disputed. In the scientific field, intellectual co-operation appears to have been largely sterile, and this conclusion is supported by the paper which Dr. Arnold Raestad contributed to the British Association Conference on Science and the Citizen last year (see *Advancement of Science*, 2, No. 8, 289 ; 1943). At the session on the exposition of science, Dr. Raestad, to whose paper Dr. Needham refers, reviewed generally the work of the Institute of Intellectual Co-operation leading to the appointment in 1938 of a committee to consider the means of improving the organization for presenting the results and methods of science to the general public ; and then described the main objectives of an international centre for scientific information, the creation of which was recommended by that committee.

These objectives were, first, the continuous recording of the progress of science, and, secondly, the mobilization, as need and demand arose, of information on any scientific point of current interest. With a modest central secretariat and regional representatives, it was proposed to work through the appropriate academy of science or other scientific body in each country that respected freedom of scientific thought and expression. Nations which subordinated scientific research to racial or other prejudices were to be excluded. The functioning of one such national centre of information, started in Paris in 1939 by the French Government's National Centre for Scientific Research, was described by Mr. J. G. Crowther at the annual conference last year of the Association of Special Libraries and Information Bureaux, based on information supplied by M. Louis Rapkine. This centre, directed by Prof. Pierre Auger, was essentially concerned with the provision of information by the expert, while the proposed international centre for scientific information was intended, at least in part, though not exclusively as Dr. Needham seems to think, with the education of the general public. The latter is, of course, the prime purpose of the institute of scientific information suggested by Mr. Ritchie Calder at the same British Association Conference. The very successful work of the British Council in this field is apparent from its latest annual report, and such work is of vital importance to the stability of a new world order or organization for peace. Such an order must rest on a greater readiness, and even habit, to submit one's own judgment to the control of facts, and to respect in others the supreme freedom to ascertain and assess facts, as Dr. Raestad emphasized.

That is a prime reason why implementation of international co-operation in the exposition and interpretation of science is of such importance to the establishment of world peace. The experience of the International Unions and of the Committee on Intellectual Co-operation suggests that the more effective organization of scientific co-operation may have equally important results in scientific circles themselves. It at least offers the prospect of breaking down some of the insularity and rigidity to which national professional organizations are inevitably prone, of stimulating that fundamental and creative thinking about their functions for which Prof. A. M. Carr-Saunders and Mr. P. A. Wilson pleaded in their study of the professions. Scientific workers, at least collectively in their professional associations, have been singularly blind to the possibilities which technical developments such as the microfilm or air transport hold for the improvement of their own ancillary services such as abstracting and publication, and the picture Mr. Crowther gave at the Conference of the Association of Special Libraries and Information Bureaux of the work of the French National Centre was most suggestive.

This, then, is the broad background against which Dr. Needham's proposals for the establishment by the United Nations of an international science co-operation service, as a functional body parallel with the International Labour Office and the Food and Agricultural Office, have to be considered. This would presumably fit in under the Economic and Social Council of the Dumbarton Oaks proposals, and could possibly be financed on similar lines. The permanent headquarters of the service would probably be determined by the centre selected as the headquarters of the general international organization, though, apart from the central and peripheral permanent secretariat, a considerable proportion of the officials of the service should, in Dr. Needham's scheme, be working men of science, selected to ensure that the organization always preserves the true atmosphere and understanding of research.

The functions of this international science co-operation service are to be the promotion of all aspects of scientific co-operation, the collection and dissemination of scientific information, the furtherance of schemes of research collaboration, facilitation of the movement of scientific workers across national boundaries, provision of advice on scientific matters to government and diplomatic personnel of individual States when desired and the provision of scientific assistance to all international organizations. Dr. Needham gives no clear idea as to how the new organization is to be developed from existing organizations, although he indicates some which might be linked up with it at a later date. His suggestion that the service should have permanent representatives in all countries or regions might be taken to indicate that he visualizes it as developing out of the scientific offices at present maintained in London, Washington and Chungking. This further proposal that such representatives should have diplomatic or 'League official' status and guaranteed government facilities for communication and transport reflects the suggestion made by Lord Samuel in the House of Lords last year regarding the appointment of scientific attachés to the principal British embassies abroad, or that Great Britain may have liaison officers who can bring to the notice of those interested at home the progress and methods which have been achieved or established in other countries.

The question of diplomatic status is a detail that requires somewhat fuller consideration when the proposals have reached the stage of a definite scheme. It is true that, as current criticism of the Foreign Service has emphasized, the basis of recruitment of that service requires widening, that it is important it should include those qualified to recognize important scientific and technical developments abroad and to advise authoritatively on problems of science and technology. There is, however, also the question of loyalties, and in conveying science and technology from the industrially advanced Western countries to the less advanced Eastern ones, confidence in such advisers as genuinely unbiased and disinterested may best be fostered if their first loyalty is seen to be unmistakably to science. Diplomatic facilities might be too dearly bought if they involved any compromise in that fundamental loyalty to the pursuit of science.

The proposals that Dr. Needham has advanced merit the serious attention of scientific workers. The case for some substantial improvement in what may be termed the 'communications of science', both inside its own special field and in its exposition to the public generally, is unchallengeable. That development must be a vital part in the new world organization to be established and for the success of new functional or regional institutions. Moreover, the proposals represent a challenge to existing professional associations, which, if accepted, may have invaluable consequences for the advance of science itself by the improvement of contacts, the stimulation of creative thought, the adoption of new techniques of communication and the facilitation of co-operation across and within national frontiers in the attack on the many problems the solution of which is imperative if mankind is to enjoy the bounty which science has put within our power to command. How great are those possibilities can be glimpsed from the stimulating survey of the study of land settlement to which Dr. Isaiah Bowman devoted the greater part of his presidential address, "Commanding our Wealth", to the American Association for the Advancement of Science last September (*Science*, **100**, 229; 1944). One of the roots of the tree of peace, he urged, is science; but if a true science of land settlement is to emerge, if we are to harness to the affairs of peace, as the Prime Minister said in his broadcast from Quebec last year, science, good sense and experience as well as hope, there must come first the removal of barriers of regulation or misunderstanding, tradition or prejudices hindering the free communication of information and interchange of men of science or of ideas throughout national and international life. After that will come new organizations, on the evolution of which in appropriate forms fresh, critical and unprejudiced thought and sound judgment must be brought to bear.

A SURGEON LOOKS AT MEDICAL EDUCATION

Rational Medicine

Comments on Social Medicine, Surgery and Education. By Basil Graves. Pp. xi+292. (London: Nicholson and Watson, Ltd., 1944.) 12*s*. 6*d*. net.

THE author of this book is an ophthalmic surgeon. His original purpose, he states, "was to describe and suggest the reform of certain anomalies that exist in present-day educational and surgical practice". As he proceeded in this enterprise, he encountered other lions in the way, in pursuit of which he has wandered down side-paths far removed from the beaten track. These digressions, in spite of a fluent style and much erudition, make the book difficult reading and involve much repetition.

In discussing the question of specialism, Mr. Graves draws chiefly on his own experience. He cites several unhappy examples of men who, despite high professional qualifications, have bungled operations on the eye. He avers, and no doubt with truth, that some surgeons are unfitted by training or experience for the specialty they profess. He rightly castigates the pseudo-specialist and the fetish of a brass plate in some particular street; and barbs the arrows of his attack with anecdotes and quotations. This criticism of his professional brethren is not vindictive. He remembers that most of them do excellent work, have a high sense of their calling and endeavour to mitigate the lot of human suffering. He holds that often incompetency results from unsuitable training, which has comprised general surgery and memory tests bearing little relation to future specialized work.

The truth of the matter is that medical examinations, qualifications and postgraduate diplomas testify to a man's reading and intellectual capacities, but to a considerable extent they also assess a candidate's clinical competence in diagnosis and treatment. The wealth of new knowledge that has enriched medicine during the past fifty years has greatly over-burdened the student of medicine with theoretical data; but all experienced examiners will agree that final and postgraduate students who fail do so chiefly in the clinical part of their examinations.

No man should presume to engage in specialism on academic qualifications alone and without a prolonged period of practical experience in hospital under the direction of recognized authorities. Only a minority have departed from this usual procedure, and those who have done so have usually regretted it. The incompetent surgeon, even if he buries his failures, gets weeded out and betakes himself to some other branch of the profession.

Mr. Graves considers that few important individual contributions to general knowledge have come from famous surgeons, though he admits Wilfred Trotter was an exception. But one could compile a long list of surgeons who have made such contributions. Sir James Paget and his son, Stephen Paget, Sir Frederick Treves, Sir D'Arcy Power, Sir Rickman Godlee, Prof. Grey Turner and many others. Sir Victor Horsley was not only a great cerebral surgeon and physiologist, but he was also a social reformer. The examinations for the fellowship of the Royal College of Surgeons of England cannot always cripple reflective thought as Prof. Tonks supposed (p. 23). Indeed, being himself a holder of that diploma, his own career as an artist refuted the statement.

The author rightly considers that there should be no social distinction between intellectual and manual work, and he extols the beauty of craftsmanship. The pity of it is that mass production and modern industrial processes are gradually eliminating the craftsman, with his appreciation of beauty and love for the work which grew under his hands. The medical profession itself is a blend of intellectual and manual labour, for the medical student from his pre-clinical days is trained how to use his hands, as is the student of science in physical, chemical and biological studies. He or she must be both thinker and craftsman.

Mr. Graves's views on the defects in the system of general education are specially endorsed by Sir John Graham Kerr in an appreciative foreword to the book. There is the waste of time devoted to rote-memorizing "with its disastrous interference with the development of originality and character, and with other things that really matter: as in the case of hospital nurses whose training in the very human and womanly art of nursing suffers from the amount of time demanded for the memorizing of masses of detail relating to anatomy and physiology; and the greatly exaggerated importance attached to written examinations as a means of testing ability". The main aim of education should be to develop the biological worth of the individual. With these arguments, which are reinforced by quotations from the educational experiences of Winston Churchill, H. E. Gorst, William James, Herbert Spencer, A. J. Balfour, Bernard Shaw and Thomas Huxley, most readers will be in agreement.

Mr. Graves also deals with a most important point. Boys and girls have to prepare for examinations at a time when they are already exposed to the strain of adolescence. This combination of physical and mental strain is most unfortunate, and occasionally leads to disastrous results. Examinations are possibly necessary evils, but because some children develop intellectually early, others late, they are imperfect tests of future mental ability. We must resist the educational 'gradgrinds' who, on the result of examination tests, would put every child into permanent intellectual pigeon-holes at the age of fourteen or sixteen years.

Mr. Graves admits he is on less firm ground when he comes to remedies for his present discontents. His suggestion, for example, for evaluation of a surgeon's operative skill—even by slit-lamp examination in ophthalmology—will scarcely prove acceptable in practice. As the author himself points out (on p. 50), the surgeon deals with living tissues the reactions of which cannot by any means always be determined or controlled, so that a case may prove disappointing even though the patient has received most competent specialized attention and the most skilful operating procurable.

Reform is, however, on the way, and in many directions. The Royal College of Surgeons is considering the practicability of instituting a special F.R.C.S. diploma in ophthalmology, which should go a long way to meeting the author's criticisms of the present examination. Furthermore, since this book was written, Sir William Goodenough's Inter-departmental Committee has reported on medical education: in its recommendations more attention is to be paid to clinical experience, less to rote-memorizing, while every candidate, it is proposed, should have a compulsory period of hospital appointments after passing the final medical examination before being admitted to the medical register.

Concerning a State medical service, Mr. Graves advocates an intermediate attitude, and his views seem likely to receive much general support from the profession.

This is a controversial treatise, and not all the writer's contentions will be acceptable. Enough has been said to indicate the book's earnest purpose and its provocative and challenging character. Its appearance is timely, for many of the questions it propounds are now being discussed by the medical profession and by all those who are interested in health and social reform.

Arthur S. MacNalty.

SCIENTIFIC METHOD IN ECONOMIC PROBLEMS

The Future of Economic Society

A Study in Group Organisation. By Roy Glenday. Pp. viii+320. (London: Macmillan and Co., Ltd., 1944.) 16*s.* net.

THIS book claims in its first sentence to be an "attempt to apply the scientific method to the study of economic problems", and to readers of *Nature* the question of prime importance must be how far Mr. Glenday has succeeded in this difficult task.

The early biological chapters, the constant reference to statistical data, the obvious wide reading of the author create a favourable impression. Here obviously is a scientific work, in so far as 'scientific' means both taking account of the conclusions of other sciences such as the natural sciences, and beginning with the observed and measured facts of your own science, in this case the facts of human society.

It is true that the author has the habit of attacking economists somewhat indiscriminately, even those like Colin Clark who have tried to pursue the same scientific method. It is true, too, that the author arrives at conclusions even more gloomy than those of the 'dismal science' itself. He finds that the high unemployment suffered in the inter-war years is not just a passing phase, but (p. 176–7) "the accepted index that a given organization is in process of breakdown", and that "superficiality of diagnosis seems to underlie the popular theory that the problem of persisting unemployment could have been solved either by the institution of public works, the equating of savings to investment—or, if all else failed, by setting those out of work to provide for their own needs". To quote Mr. Glenday's own summary, he foretells (p. 19) that "the days of the present economic society are numbered", meaning by this a society based (p. 20) on the ideal of the intrinsic uniqueness of individual man as against that of the subordination of the individual to the community. But however disputatious the attitude or gloomy the prophecies, a scientific critic must be put off neither by the incidental fireworks of controversy nor by the unpleasantness of the findings. He must inquire into the validity or otherwise of the *basic* conceptions and methods underlying the results.

At least two serious flaws appear to me in the structure of the argument. The first is the assumption that continuous geometrical progression must be expected; and if it is not attained, but merely arithmetic additions, that there is cause for despondency. Yet, as the series 1, 3, 6, 10, 15 exemplifies, it is quite possible for a continuous fall in growth-rates also to show a continuous rise in additional increments. Occasionally, indeed, Mr. Glenday must be accused of dressing up his graphs for the funeral pyre. There is a depressing diagram (Fig. 5, p. 78) showing the decline in growth-rate of five important items in American economic life between 1840 and 1930. In four of these—railroad mileage, steel tonnage, automobile registrations and electric power—the curves plunge downward catastrophically. But what are the facts of America? A continuous addition in all these items per head of population, compared to which the falling geometrical rate of growth is frankly just an academic abstraction.

The second flaw in Mr. Glenday's argument is his piecemeal approach. He takes a number of separate industries and shows statistically that their rate of growth is falling, and in some cases that they are arithmetically declining. But this does not allow for the fact that some industries are failing because more efficient methods of doing the same thing, or of doing better things, are taking their place. Railroad track mileage, for example, might well be declining absolutely because motor roads were substituted for purposes of transport. But there is no reason to be gloomy about it. On the whole, social progress has involved changes in consumption in the shape of substituting more intangible and variegated goods and services for easily measured staples, so that there is here a special risk that statistics, more easily obtained for the tangible output, may often be misleading for standards of consumption as a whole. In fact, attempts by economists such as Prof. A. L. Bowley, Mr. Seebohm Rowntree and Mr. Colin Clark to assess the total national real income by scientific methods of statistical computation show for Great Britain a continuous increase in goods and services per head of population during the twentieth century, with no sign of fading out.

The parts of the world where gloom may be scientifically justified are the 'have not' countries, where increasing production is simply allowing more and more population to stay alive and to keep down the *average* standard of living per head. These Malthusian conditions to-day affect countries containing at least four-fifths of the human race; but Mr. Glenday (p. 253) purposely omits them from his thesis.

Ancillary to Mr. Glenday's main thesis, many problems are discussed that arouse great interest. Notable among these are the satiation of wants (p. 204), where the author seems to under-estimate the possibilities of raising the consumption of the poor by those very social charges he deplores: and the problem of co-ordination (p. 186) arising from the distance separating the main food-producing areas from the industrial areas of the world.

Mr. Glenday writes clearly and without circumlocution. Though he does not prove his main thesis, and is handicapped in interpreting the facts by neglect of the useful apparatus of thought provided by economics, yet his book does at least tackle the essential dynamic problem of the trend of events, does start with the facts, and does present them forcibly.

P. SARGANT FLORENCE.

SOCIAL HUMANISM

The Humanities Look Ahead

Report of the First Annual Conference held by the Stanford School of Humanities, 'The Humanities in the War and Postwar World', May 7 and 8, 1943. Pp. ix+149. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1943.) 10*s.* 6*d.* net.

IN many ways the conference at Leland Stanford University, at which the seventeen papers collected in this volume were read, was characteristically American. It was as ready with self-criticism as with plans for action. Now that the arts, true science and philosophy are all "dislodged and beaten almost beyond surviving there in Europe and Asia", for the first time the United States of America, in the words of Prof. Paul Green, had leadership in this field thrust upon her. They met, however, "not to save the humanities" but to find the conditions "under which they would be worth saving". It was natural to begin the quest with an attempt to find out what was wrong with them now, and the speakers agreed on two main points. The humanistic field itself had become divided between, on one side, a few small groups living complacently a life of intellectual preciosity, who had forgotten that humanism had to serve humanity, and on the other side, a frightening array of people engaged on 'exact' research who had little sense for what Croce has called 'the feeling of the living soul'.

The second general cause of that decline was the growing gap between humanism and science. Prof. Frederick Koenig attributed that to the enormous growth and specialization of science, which had left the several disciplines high and dry as isolated islands, no longer fertilized by a common stream of philosophy; a separation accentuated by difference in temperament between the practitioners. The "scientists are unable to see that artists have brains, and artists are unable to see that scientists have souls". In such conditions humanism could not inspire the individual, in Symond's definition, with a "vital perception of the dignity of man as a rational being", or achieve its wider academic function, as defined by Dr. Leland, of "bringing understanding out of knowledge". The role of the humanities in their academic precincts and functions was indeed the central theme of the discussion; and while "Social Humanism" was the title of Prof. Borgese's paper, with its passionate generalities and its call for a 'Republic of the World', the British reader will find its substance rather in the papers which described American experience and experiments. Dr. Waldo Leland, the distinguished director of the American Council of Learned Societies, put the problem acutely when he said that it was "how to make human energy intelligible to itself". (Dr. Leland incidentally announced that his Council was about to publish a report on the part of the humanities in a liberal education.)

To the general causes for their decline, Dr. Leland added a more practical one, namely, the excess of students, with the resulting dilution in the qualifications of both students and teachers. Closely allied with over-specialization was the failure to keep up an active inter-relation with the sciences and, especially, with the social sciences; and last, but perhaps most serious, the failure of many scholars to "concern themselves actively with education". That was perhaps as true of men in the sciences, but for the humanist education was the very soil he had to till. The function of the humanist was so to inspire the learner that he may "develop for himself not a career but a character", said Mr. David Stevens, of the Rockefeller Foundation, who gave a survey of the Foundation's practical work in this field during the past ten years. Prof. Waldo Dunn described an experiment in humanistic education at Scripps College; and Prof. Linden Mander that of Washington University, where by various means the University is trying in characteristically practical ways to widen the range permeated by its educational work. All that corresponded to the two conditions which the conference seemed to think necessary for reclaiming the humanities: first, some unity of philosophical outlook in the world of thought and, secondly, the permeation with it of man's world of action. Two quotations from Mr. Lewis Mumford's final paper on "The Making of Men" may serve to round off an inevitably inadequate summary of this lively conference: "Our mistake consists in thinking that there is anything final or absolute in the present form and traditional methods of the university, and in not seeing that if only a profound change in all our cultural habits will save our civilization, we must plan and effect that change". "But here we must transcend the limitations of our own humanist tradition: for the first step toward world co-operation must rest on our realization that the humanities are not a special creation of Western civilization. . . . Unless we are humble enough to learn from all these sources", humanists will miss the opportunity of "carving out a much larger and much more significant place for themselves than they have ever occupied before". DAVID MITRANY.

THE EXPANDING LIBRARY

The Scholar and the Future of the Research Library

A Problem and its Solution. By Fremont Rider. Pp. xv+236. (New York: Hadham Press, 1944.) 4 dollars.

THE growth of American research libraries, averaged together, according to figures quoted by Mr. Fremont Rider, shows a doubling at almost exactly sixteen-year intervals, and there seems no good reason for believing that the rate of growth will be seriously checked for many years to come. If unchecked, the figures for some of America's largest libraries will become astronomical. Though, for a variety of reasons, the rate of growth of British libraries is not equally rapid, there is much of value and interest to be found in Mr. Rider's examination of the problems involved and in the suggested solution.

In the first part of the book, Mr. Rider recapitulates various current methods of reducing the growth of research libraries, and shows why they cannot be wholly satisfactory. He is entirely concerned with the problem of the research library serving the more advanced type of reader; comparable, in fact, to British national libraries such as the British Museum or the Bodleian. In such libraries it is an axiom that no class of material can be discarded with impunity. Even the trivia of to-day may prove valuable in relation to sociological or biographical research a century later. The scholar's needs are casual, but they are also urgent and unpredictable. In a satisfactory service he expects, within reason, to have his material available for quick consultation.

Mr. Fremont Rider's solution lies in 'micro-cards'. By this term he means the reproduction, in micro-print, of the text of the book or paper itself, on the back of a catalogue card. The face of the card would show the catalogue entry and an abstract of the work, in print of ordinary size. A careful choice of the form of the catalogue entry would enable the same cards to be used for author, title or subject catalogues, thus doing away with the need for further copying or additions by the subscribing libraries. Mr. Rider specifically suggests the use of the 'Readex' process, by which it is possible to print 100–250 pages of a book on a standard library card, but other adaptations of micro-photography are also possible. The resulting economy in space and cost is obvious.

The second half of the book deals with the micro-cards, their format, publication and uses, and with the problems of copyright. Mr. Rider stresses the fact that success in the use of micro-cards will depend largely upon an agreed format for the catalogue entry and subject headings, since interchangeability of cards among the subscribing libraries is an absolute necessity. It is therefore of great importance that the cards should be made, in the first place, by bibliographical experts. Mr. Rider recommends an extension of the division-of-fields suggestions already put forward by the Metcalf Committee. According to these proposals, each of the co-operating libraries would select its own particular sphere of interest and would endeavour to collect all research material pertaining to this field. Mr. Rider suggests that each of the co-operating libraries, thus having at hand all data relevant to its own field, would be in the best position to draw up the most accurate catalogue entry and subject classification for such material. Each library should therefore issue the micro-cards for works within its own field, receiving in turn micro-cards from other libraries specializing in other fields.

Objections to the schemes proposed by Mr. Rider could be immediately suggested, but much remains that is worthy of close attention. Micro-print, as distinct from micro-film, is still in the early stages of evolution, and reader-machines are in short supply. It may, however, reasonably be anticipated that supply will follow demand and that improved technique and equipment will rapidly be developed.

The method of combining the legible catalogue entry with the actual text of the original eliminates many of the disadvantages of micro-film and has much to recommend it as a self-contained and rapid means of access to reference works. Those who have felt that the potential value of micro-photography as an aid to the solution of library problems has not yet been fully utilized should draw inspiration from this book. E. M. R. DITMAS.

BRITISH PLANT DISEASES

List of Common British Plant Diseases

Compiled by the Plant Pathology Committee of the British Mycological Society. Pp. 61. (Cambridge: At the University Press, 1944.) 5*s.* net.

SO far back as 1928 the British Mycological Society decided to appoint a committee of men of science interested in plant diseases, their object being to compile a list of the more important diseases of British crop and ornamental plants and to suggest for each disease a single selected common name. It was hoped to encourage the use of these selected names so that uniformity in the naming of plant diseases could be achieved at least in the British Isles. Many people dealing with plants must be aware that the same disease of a particular plant may be known by several common names according to the locality, and furthermore that a name is often quite unsuitable for describing the disease to which it refers.

The Committee produced its first list in 1929 in the *Transactions of the British Mycological Society*, **14**, and further improved on this by publishing a second edition of the list in book form in 1935.

It has now produced in book form a third edition, with various emendations and additions, printed as before in two parallel columns, on the left the name of the host plant with, under it, the recommended common names of its diseases, and on the right the scientific name of the parasite causing the disease. In the case of diseases not caused by fungus or bacterial parasites the right-hand column gives the name of the causative agent, for example, mosaic virus, manganese deficiency, irregular water supply, etc. There is one important change in lay-out as compared with previous lists, this being the fact that the host plants instead of being arranged in groups, such as fruits, vegetables, etc., are now all placed in alphabetical order according to their names as ordinarily used. The result is that there is no need for a host-plant index.

In the case of the more important diseases which are also prevalent abroad, foreign common names from several countries are given in slightly smaller type under the selected British common names. There are an index of authors' names and abbreviations, one of the accepted scientific names of both host plants and parasites, and one of foreign common names of various diseases. Many readers will note and approve the separate index providing common names of diseases in Russian.

This attempt at uniformity in nomenclature of diseases is to be commended in a field where confusion is still too often met with. The fact that changes repeatedly occur in the scientific names of plant disease parasites makes this list doubly important to workers in this subject, and the Committee deserves the thanks of both research and advisory plant pathologists for providing such an up-to-date book of reference. There is no doubt that it will be welcomed by all concerned with plant diseases throughout the British Empire.

D. E. Green.

FOOD HABITS

The Origin of Food Habits

By H. D. Renner. Pp. 261. (London: Faber and Faber, Ltd., 1944.) 15*s*. net.

ALMOST the last habits anyone will give up are his food habits. So the average man is the despair of the dietitians and the Ministry of Food, who wish him to eat what is 'good for him' or what foods are available.

In the matter of food habits there are two sharply divided schools of thought: the one which we may call the 'Marie Lloyd school', which believes that food habits are based upon instinct and that what a man fancies does him good; and the other which considers all food habits conditioned reflexes due to upbringing. Most dietitians belong to the latter school. Any digestible substance which can provide calories, proteins, mineral elements and vitamins they call a food, whether the eater likes it or not. He can, they say, acquire a conditioned reflex for that food by practice, and quote illustrations from the War of 1914–18, when children brought up to eat margarine during the War refused butter when it became available after 1918. They also bring in observations made by explorers and anthropologists such as Stefánsson[1] and Margaret Mead[2]. The 'Marie Lloyd school' retort with Pavlov's own work on the psychic flow of gastric juice evoked by pleasant foods in dogs and the extension of Pavlov's work to man by Carlson. Moreover, there is Carl Richter[3], who has brought evidence to bear that Baltimore children behave towards cod liver oil as if guided by need rather than by conditioned reflexes.

The book under review collects evidence which will be used by both schools. The writer, who is rather heavily Teutonic in his handling of the problem, puts his emphasis on experimental psychology. For example, he thinks that people who are fond of food gobble it because they do not want to fatigue the sensory organs, and that when a food "goes round and round" in the mouth it is because the eater wishes to fatigue his gustatory apparatus for the unwanted food, so that he can swallow it without nausea. Surely simpler physiological explanations will cover both cases?

Though there is much in this book which every person interested in food, whether from gastronomic or dietetic reasons, will disagree with, it is one which every such person should read. It is difficult to sum up its attributes, and perhaps the best way to describe it is to borrow what Dr. Johnson is supposed to have said of the haggis: it is fine confused feeding.

V. H. Mottram.

[1] Stefánsson, "The Friendly Arctic" (Macmillan and Co., Ltd., 1921).
[2] Mead, "The American Character" (Penguin Books, Ltd., 1944).
[3] Richter, "The Harvey Lectures" (Science Press Printing Co., 1943).

PROF. THE SVEDBERG

The Svedberg, 1884–1944

Pp. 732. (Uppsala: Almquist and Wiksells Boktryckeri A.-B., 1944.) n.p.

IN universities, as in other walks of life, the personal expression of gratitude and appreciation is a rare event, and the means and opportunities of expression both difficult and infrequent. This volume was compiled by colleagues, friends and pupils to celebrate the sixtieth birthday of The Svedberg. If the limitation of war had not been imposed on the compilation, contributions would certainly have come in from all parts of the world.

Svedberg's original work lay in the field of colloid chemistry; but in 1923, as a result of a visit to Wisconsin, his interests were aroused in the possibilities of an ultra-centrifuge. While it is the development of this as an instrument of precision that gained for Svedberg his international reputation as well as a Nobel prize, his interests and activities are in fact much wider. Although he is by title professor of physical chemistry, it is significant that no less than thirty-one of the fifty-six communications in this volume lie in the field of what may now be termed biophysics. Another significant trend emerges in studying this volume—one which doubtless has been accentuated by the War, but which is a real part of the activities of the Institute—namely, the part played by Svedberg and his colleagues in the national economy of Sweden by co-operation with industries to the great advantage both of science and technology.

The volume contains a brief account of the Institute of Physical Chemistry at Uppsala, together with a number of original papers from the various departments of the University. Communications from other universities and high schools, notably the University of Lund, as well as from industrial laboratories are included. The topics dealt with cover a wide field of chemistry and biology, several of them naturally dealing with supercentrifugical, optical and electrophoretic measurements of biological material.

This collection of papers may be regarded as a cross-section of Swedish activities in chemical research during the war period, and any country might well be proud of such work and of The Svedberg, whose influence in and beyond the confines of Sweden has been so profound.

Eric K. Rideal.

AN INTERNATIONAL SCIENCE CO-OPERATION SERVICE

By DR. JOSEPH NEEDHAM, F.R.S.

ON the occasion of the recent meeting of the Royal Society in India, and the admission of several Indian fellows, Mr. Winston Churchill sent a message which included the following words: "It is the great tragedy of our time that the fruits of science should, by a monstrous perversion, have been turned on so vast a scale to evil ends. But that is no fault of science. Science has given to this generation the means of unlimited disaster or of unlimited progress. When this War is won we shall have averted disaster. There will remain the greater task of directing knowledge lastingly towards the purposes of peace and human good. In this task the scientists of the world, united by the bond of a single purpose which overrides all bounds of race and language, can play a leading and inspiring part"[1].

When, however, we come to the concrete necessity of implementing these truths, we see everywhere a growing conviction that after the War a much higher degree of international science co-operation must be attained. There are many who believe that the time has gone by when enough can be done by men of science working as individuals, or even in groups organized in universities or societies, within individual countries, and contacting each other as individuals, across national boundaries. Science and technology are now playing, and will in the future increasingly play, so predominant a part in all human civilization, that some means whereby science can effectually transcend national boundaries is urgently necessary. The various science co-operation offices which have already been set up under the stress of war in the capitals of the United Nations constitute a piece of machinery too precious to be allowed to disappear after the War.

The fundamental need for more intimate scientific contact among the nations might conceivably be met by a system of scientific attachés at the various embassies; but this might be found to harness the free movement of science in too much diplomatic formality. It is more likely to be partly met by sending from one country to another industrial scientists with loyalties limited to particular commercial interests; but this is very unsatisfactory, for their advice is unlikely to be truly unbiased and disinterested. What many of us would like to see would be an international science co-operation service, the representatives of which in all lands would have diplomatic status (or whatever status was accorded formerly to League of Nations officials) and full governmental facilities in communication and transportation, but who would be drawn from both government and academic laboratories, and hence would be free from commercial entanglements. One of the immediate aims of such an international service would be the conveyance of the most advanced applied and pure science from the highly industrialized Western countries to the less highly industrialized Eastern ones, though this is not to say that there would be no scope for westbound traffic too. In what follows, these ideas will be more fully worked out and concrete proposals made.

Existing Machinery

Many recent recommendations (for example, the Beveridge Report, the Unilever paper on unemployment, the Nuffield College Statement, and the Report of the League's Delegation on Economic Depressions[2]) have laid great emphasis on the desirability of utilizing whatever is possible among the international agencies established to further co-operation during the War. It is generally recognized that the similar organizations which grew up during the War of 1914–18 were scrapped much too lightheartedly in 1918.

At the present time, then, a number of offices have been established to further scientific co-operation. Working trans-Atlantically are the British Central Scientific Office in Washington, maintained by the British Ministries of Supply, Production and other British organizations; and the American Scientific Office in London, mainly connected with the Office of Scientific Research and Development. Through these two offices, an enormous amount of information, of first-class war importance, has passed. As between Great Britain and the Soviet Union, apart from the detailed co-operation of war technologists and important visits of specific missions, such as the Surgical and the Chemotherapeutical Missions, there is in London an Anglo-Soviet Science Collaboration Committee, with which Sir John Russell has been prominently associated.

In view of China's relative backwardness in the industrial and technological field, it was natural that scientific co-operation between Chungking and the other United Nations' capitals should have been rather slow in getting under way, but since the early part of 1942 a Sino-British Science Co-operation Office (British Council Scientific Office in China) has been working very actively there. Since this Office has been under my charge, and since its working, in spite of exceptionally severe difficulties, both material and linguistic, helps to indicate the kind of thing that a science co-operation office may do, a short description of it may be given.

The Sino-British Science Co-operation Office (British Council Scientific Office in China) is financed by the British Council (for cultural relations with other countries), but was also accepted into an organic relation with the Chinese Government through the Council for the Promotion of Science in the National Defence, which has the status of a subcommittee of the Executive Yuan. It has, at present, a staff of seven scientific men and women, four British, two Chinese and one Indian. Its head works closely with the British Ambassador and the Ministers of all departments of the Chinese Government concerned with science and technology. In matters of pure science he is in continuous contact with the Science Division of the British Council, and in matters of applied and war science with a China office in the British Ministry of Production.

The work of the Office is divided into three aspects, which may be called respectively contact, supply and output. Under the first, a channel is available whereby Chinese Departments, such as those of Health, Mining, Ordnance or Agriculture, can maintain contact with the corresponding organizations or any other agencies desired in London or Washington (in the latter case through the British Central Scientific Office there). Help is also made available from India, as, for example, in the printing of maps for the Chinese Geological Survey, or the provision of a list of edible and poisonous plants in North Burma and the Shan States for the Chinese Surgeon-General. All such dependence on India as the forward base for Chinese science and technology involves careful maintenance of contact.

In the field of supply the great task has been to do something towards breaking the blockade of China's scientific life after the planned destruction of her laboratories by the Japanese and their re-establishment in the non-industrial hinterland. The Office is available to supply, and has supplied in very substantial amounts: (*a*) already existing information on any question in either pure or applied science, (*b*) ideas and proposals from the West to meet specific problems arising in China, (*c*) scientific literature in all branches, including books, typescripts, offprints, microfilmed journals, microfilm reading-machines, etc., (*d*) actual essential research apparatus, instruments and chemicals. At the time of writing, some five hundred important scientific books have already reached China and some two thousand more are on the way; those from Great Britain are supplied on a kind of 'lend-lease' principle; but the Office also secures American scientific books when asked for. Nearly a hundred crates of scientific apparatus have arrived, for Government as well as university laboratories and for applied as well as for pure research.

In the field of output, the Office sends to the West (*a*) manuscript papers by Chinese men of science for publication, (*b*) current Chinese publications in science, (*c*) abstracts of Chinese work in Western languages, (*d*) articles and résumés describing the work of Chinese scientific workers and technologists, etc. The field of output is naturally smaller than that of supply, since even before an exhausting ten years of warfare China was not highly developed technically and scientifically; but even in questions of technical aid the Chinese have been not only willing but also able to help their Western Allies, as the examples of the use of bamboo in aeroplane construction, and the preparation of quartz crystals for stabilizing radio frequencies, may bear witness.

In addition to all this work, the Office is able to advise Chinese technical departments from time to time, and to give assistance to the Chinese Ministry of Education with problems of the sending of scientific personnel to the West for study.

The work of the Office has complemented in a fortunate way that of the technical experts sent to China by the Cultural Division of the American State Department. These experts, of whom some twenty-five have visited China during the past year and a half, and whose work has been in general markedly successful, have been attached to the relevant Chinese Ministries and have worked entirely, as it were, in the field. Such a system of procedure lacks a central clearing-house through which requests for scientific information and aid can be co-ordinated. The British Office, which has throughout maintained close contact with the American experts, has been able to fill this need.

It may be said that the functions of Science Co-operation Offices are largely of a 'post-office' character. There is some truth in this. The Chungking Office, in particular, has had the task of assuring contact between Chinese and Western men of science and technologists in circumstances of special difficulty, including a blockade such that communication with the outside world is only possible by air. In post-war conditions, with the resumption of normal mail communications and the disappearance of censorships, the purely post-office work of such a bureau must necessarily be expected to decrease. The post-office aspect of a Science Co-operation Bureau, however, is really only a part of its work. In order to be successful it must spontaneously collect and disseminate scientific information. Without being able to answer all scientific queries themselves, its staff must know where the answers can be obtained. They must familiarize themselves with the conditions of scientific and technical life and thought in the country where they are stationed. They must have the confidence of the resident diplomatic personnel and be able to advise them authoritatively on problems relating to science and technology. They must be unfailingly at the service of the ministers of the Government Departments concerned with science.

Even for peace-time, however, the post-office aspect of such agencies is not to be despised. In all ages, exceptional scholars have acted as clearing-houses for science and learning, and the more so the worse the political chaos of the age. In the Middle Ages the monastic houses and the Arabic translators in Spain fulfilled such functions, or the Sung Confucians in China, or, in the seventeenth century, the tireless Comenius (Bishop Komensky). Exiled from his native Bohemia, Komensky kept together through years of wanderings not only his Church, the *Unitas Fratum*, but also the band of adherents of the "new, or experimental", philosophy, whose later great achievement was the foundation of the Royal Society, suggested by Komensky himself. And when the Royal Society was founded, what a post-office did Oldenburg, its first foreign secretary, keep! He it was who opened the series of letters from the microscopist, Leeuwenhoek, in which for the first time the new world lying beyond the limits of ordinary vision was described. A scientific post-office, indeed, requires the qualities of a "department of insufficient addresses", for its aim should be to ensure that a communication reaches its proper destination, a destination that the author himself may only vaguely know.

It was said above that Science Co-operation Offices should be in a position to give unbiased advice to Governments. It was also said in the preamble that they should aid in conveying the most up-to-date science and technology from the industrially advanced Western countries to the less-advanced Eastern ones. Here is a machinery for assisting the Eastern Governments, under strictly international auspices, with genuinely unbiased and disinterested information on their problems of industrialization. It would be a substantial improvement on the scramble of advisers with relatively narrow loyalties which is otherwise only too likely to be seen.

Besides the Washington, London and Chungking offices which have already been mentioned, steps have recently been taken in London towards a much higher degree of scientific co-operation among the constituent States of the British Commonwealth than heretofore. The British Commonwealth Science Committee was set up under the chairmanship of the President of the Royal Society in October 1941 in order to secure scientific co-operation in tackling the emergency problems of the immediate post-war period, to ensure that the most should be made of common scientific resources for improving scientific knowledge and the life of the people throughout the Commonwealth, and to consider means of promoting research co-operation in pure and applied science. In an Indian article[3], Prof. A. V. Hill wrote: "The British Commonwealth Science Committee has suggested the desirability of maintaining permanent scientific and technical representation in London and possibly *also in other capital cities of the English-speak-*

ing world. It is further of the opinion that if scientific and technical representatives of the Dominions and India are permanently established in London, these, together with official representatives of science in the United Kingdom and the Colonies, should be constituted into a British Commonwealth Science Collaboration Committee, to act with the Royal Society in the discussion of topics of common interest, to keep in touch with all agencies for the collection and dissemination of scientific information, to further schemes for co-operation in research and to make such recommendations and proposals for common action as seem fit". Prof. Hill went on to express the hope that such co-operation would lead in due course to a more general collaboration.

The interim committee's report has been published[4]. Its discussions so far seem to have centred mostly on the extension and rationalization of the existing means of broadcasting scientific information (for example, the abstracts journals), on research collaboration schemes, and on schemes for facilitating readier movement of scientific men from one country to another. But the extension of such schemes to the United States has been discussed. The interim committee has stressed that the implications of the Atlantic Charter point inevitably to the need for closer political, social and technical collaboration with the United States, the U.S.S.R., China and other countries or regions, such as Africa. It has accordingly expressed its hope that arrangements will be made to seek the co-operation, so far as may be practicable and appropriate, of scientific and technical representatives of *the United States, the Soviet Union, China and other countries outside the British Commonwealth,* permanently established in London. The editorial in *Nature* goes on to say that "the wisdom of this last recommendation is so patent that the support of all scientific workers is assured", but urges that concrete support should be manifested by scientific men through their professional organizations. This has no doubt since been done.

The foregoing remarks will have sufficed to show that the nucleus of a British Commonwealth Science Co-operation Service has been forming in London for some time past. Since it would lack, by itself, the vigour and influence of a truly international organization, its sponsors are clearly willing and anxious to enter such an organization if it can be brought into being.

At this point the question arises as to what would be the relationship of an International Science Co-operation Service to the activities of the scientific divisions of such organizations as the British Council and the Cultural Division of the American State Department. There certainly need be no conflict. Such organizations exist to demonstrate the cultural goodwill of their respective States towards the countries receiving the scholars and experts they send, and to bring to the notice of these other countries the scientific achievements of their past, in which they take a legitimate pride. The International Service would only have to keep in close contact with all such activities.

Existing International Bodies

For the success of an International Science Co-operation Service, it would be essential that it should come under the aegis of whatever instrument of world organization the United Nations agree to set up at the end of the War. No doubt this will be centred on the 'big four' among the Allied Powers.

The International Science Co-operation Service could thus take its place among a number of international organizations, some with broad frames of reference, others with more restricted ones, which exist already or are in process of formation. The International Health Organization and the International Labour Office, two of the most successful agencies of the League, have never died, and are now in process of re-organization. The status of the International Institute of Intellectual Co-operation seems at present indeterminate. The International Institute of Agriculture, the World Power Conference, and the International Locust Control Commission, would all, it is believed, need little or no reviving.

Among the new organizations, the United Nations Relief and Rehabilitation Administration is at present most in the public eye; but the Food Conference at Hot Springs[5] ordered the creation of an Interim Commission on Food and Agriculture which is now drawing up plans for a permanent Commission for submission to the United Nations. All such organizations must be expected to have a good deal of concern with scientific research as applied to nutrition, agronomy, etc. The International Science Co-operation Service would have to keep in close touch with that side of their activities, and since its scientific frame of reference would be broader, would probably be able to offer them considerable help. It would be expected to outlast some of them, however, such as U.N.R.R.A., the existence of which has always been regarded as probably limited.

Current Trends

To-day one has only to open any book or paper dealing with world affairs in any relation to science and technology to find writers expressing views closely related to those here put forward. Thus Prof. D. Mitrany, in a paper recently issued by the Royal Institute of International Affairs[6], argues for what he calls the 'functional' development of international organization. International government should be organized along the line of services to meet specific ends and needs. "A different complexion would be put on the problem of security if frontier lines became overlaid with a natural growth of common activities and common administrative agencies. Moreover, functional organization offers some prospect of mitigating the difficulties which arise out of State claims to equality by evolving arrangements which show a measurable and acceptable relation between authority and responsibility, relating authority not to sheer power but to the weight of responsibility carried by the several members." Precedents here are the European Danube Commission, the North Atlantic International Ice Patrol, the North Sea International Fisheries Board and the International Astronomical Union, so important for navigation. New organizations which should on no account be scrapped are the Combined Production and Resources Board, the Combined Raw Materials Board and perhaps the Allied Supplies Executive Secretariat. An International Science Co-operation Service has not yet originated; but no field could be more suitable than science for such a type of organization.

Allied to such conceptions is that of Dr. Arnold Raestad's International Centre of Scientific Information[7]. This proposal, however, relates rather to the extremely important subject of popular education in science. Such a centre would be continually receiving and digesting reports of scientific progress throughout the world, and producing data suitable for elaboration by the journalist, the radio speaker, the film producer and the organizer of exhibitions. It would be a projection on a world scale of agencies such as the successful American Science News Service. It might ultimately be very suitably associated with the International Science Co-operation Service.

Allied also is the proposal of the British Association's Committee on Post-War University Education that some kind of world council of universities should be set up, sponsored perhaps by the Association of Professors and Lecturers of Allied Countries in Great Britain, and the Conference of Allied Ministers of Education[8].

In quite another sphere, the changing face of the modern world has necessitated proposals for the reform of the British Foreign Service[9]. Attachés and counsellors trained in economics are expected to play a greater part in embassies after the War than hitherto. The question has often been raised whether men with a scientific training should not also be included on embassy staffs. It was debated in Parliament in July 1943[10] and the proposal strongly recommended by Lord Samuel. In the course of the discussion great emphasis was laid on the Government's post-war plan for science, including arrangements for consultation and co-operation with the Dominions and the other United Nations.

Lastly, with regard specifically to West and East, Sir Henry Dale, in his message to the President of the Indian Science Congress Association[11], said: "There is a general desire among men of science in Britain for more intimate collaboration with those in India who are working for the advancement of knowledge in the same fields of research". Similarly, Minister Chu Chia-Hua, president of Academia Sinica, thanking the foreign secretary of the Royal Society, Sir Henry Tizard, for the gift of a facsimile of the Charter Book, wrote: "We believe it is our task to help to evolve and carry into practice some guiding principles of rational education for the world as a whole. Our first step in that direction must be to encourage and start widespread intellectual cross-fertilization. The Sino-British Science Co-operation Office has already done much in that direction in this country, and we hope that it may form part one day, in the not too far distant future, of an Office of World Science Co-operation. Compared with the Royal Society, the Academia Sinica is young, and not only in age; but as an organization of intellectual pursuit, we pledge to contribute our 'widow's mite' to the general wealth and strength that will some day bring about the supremacy of the intellect and reason". This interest on the part of the Chinese in the establishment of international organization appears again in the summary of proposals issued by the Commission for the Study of Post-war World Peace, of the Chinese People's Foreign Relations Association[12]. The summary stresses the importance of "international cultural and social co-operation". It is suggested that a cultural co-operation committee be established to undertake the work of changing the mentality of the people of the aggressor nations, and of strengthening cultural contacts. As regards social co-operation, the International Labour Office should extend its activities, including the improvement of social welfare and public health administration.

Proposals

For the purpose of discussion, the following concrete proposals emerge from the arguments of this memorandum. It is proposed:

(1) That an International Science Co-operation Service should be set up by the United Nations at the conclusion of the War under the aegis of whatever supreme international organization is devised, parallel with the International Labour Office, the International (Permanent) Commission on Food and Agriculture, and other similar bodies.

(2) That the functions of the International Science Co-operation Service should be (*a*) the promotion of scientific co-operation in all its aspects, (*b*) the collection and dissemination of scientific information, (*c*) the furtherance of schemes of collaboration in research, (*d*) the facilitation of the movement of scientific men across national boundaries, (*e*) the provision of advice on scientific matters to government and diplomatic personnel of individual States when desired, (*f*) the provision of scientific assistance to all other international organizations.

(3) That the International Science Co-operation Service be supported by funds, which relatively to those required for other purposes would, of course, be small, subscribed by the Governments of the United Nations on some agreed income-tax basis.

(4) That the International Science Co-operation Service should have permanent representatives in all countries or regions, with diplomatic or 'League-official' status, and guaranteed Governmental facilities for communication and transportation.

(5) That the International Science Co-operation Service should have permanent headquarters in some centre to be later decided on; but that apart from a central and peripheral permanent secretariat, a considerable proportion of the total number of its officials should be working scientists of every nationality serving on a temporary leave-of-absence basis, that is, seconded from governmental, academic and possibly industrial, laboratories; in order to ensure that the organization shall always preserve the true atmosphere and understanding of research.

[1] *Nature*, **153**, 63 (1944).
[2] *Nature*, **152**, 365 (1943).
[3] *Indian Information* (May 1, 1944).
[4] *Nature*, **152**, 29 (1943).
[5] *Nature*, **152**, 67 (1943).
[6] *Nature*, **152**, 309 (1943).
[7] *Advancement of Science* (British Association), **2**, No. 8, 290 (1943).
[8] *The Times* (April 3, 1944).
[9] *Indian Statesman* (February 1, 1943). *Nature*, **153**, 91 (1944).
[10] *Nature*, **152**, 129 (1943).
[11] *Nature*, **153**, 63 (1943).
[12] *Chungking Daily News* (July 5, 1944).

WATER SUPPLY AND HEALTH

IN his Chadwick Lecture, delivered on October 3, on the "Treatment of Water in Peace and War", Lord Amulree gave a history of water supply, discussed its effect on the health of the community and described the various processes of purification which are applied to a water supply in order to render it epidemiologically safe and acceptable to the consumer, and the special precautions that have been taken during the War to protect it against war hazards.

Lord Amulree began by pointing out that water is one of the necessities of life, and stressed the importance of ensuring its freedom from harmful impurities.

So long ago as 1832, during a cholera epidemic in Glasgow, the idea arose that the infection might have been carried by water. In this case Gorbals Parish furnished comparatively few cases of cholera, whereas in the rest of the city the epidemic was very severe. As Gorbals was provided with a soft water and the rest of Glasgow with a very hard one, the suggestion was made that the comparative freedom from cases in the Gorbals area was due to the soft water. Although this was by no means a full explanation, it was an important step forward in the epidemiology of cholera.

Next came the remarkable work of Dr. John Snow in connexion with epidemics of cholera in London in 1853 and 1854. At that time London was supplied by seven companies with water taken from the Thames and Lee and in many cases not filtered. One area was supplied by two companies, the Southwark and Vauxhall Water Company and the Lambeth Water Company, and by painstaking investigation Snow showed that whereas in the houses supplied by the Southwark and Vauxhall Water Company there were 286 deaths from cholera between July 8 and August 5, in those supplied by the Lambeth Water Company there were only 14 deaths. The former company derived its water from the Thames at Battersea, where contamination from London sewage was very heavy, whereas the Lambeth Company had, the previous year, moved its intake up to Ditton, which was free from such contamination. This convinced Snow that there was some connexion between the relative purity of the Lambeth Water Company's water and the low mortality from cholera of its consumers; but it was not until the following year, when another outbreak of cholera occurred in the neighbourhood of Broad Street, Golden Square, that he was able to provide definite proof that cholera was a water-borne disease. He found that nearly all the cases had drunk water from a pump in Broad Street, and at the end of the first week he persuaded the authorities to remove the handle of the pump so that it could not be used. As this was followed by a remarkable decrease in the number of cases of cholera, his proof was complete.

The observations of Snow have been amply confirmed since the discovery that bacteria were the causes of many diseases including cholera; but the interest lies in the fact that he reached the right conclusion by observation and deduction without any laboratory aid.

Typhoid fever is another of the great water-borne diseases. Prior to 1871, it was not differentiated in the Registrar General's returns from other diseases such as typhus and fevers of unknown origin, so that a true comparison cannot be made with what occurred in the first part of the nineteenth century; but these returns show a steady decline in the death-rate from typhoid fever from the five-year period 1871–75, when it was 374 per million living, to 4 in the last recorded period in 1936–40. "This," said Lord Amulree, "is a very remarkable and gratifying fall and must to a very large extent be attributed to a consciousness of the importance of water supplies to the public health of the country."

From what has been said, it is obvious that the most satisfactory kind of water supply is one that does not require any treatment and is drawn from an unpolluted source. Unfortunately, in a small and overcrowded island like Great Britain, it is difficult to find sufficient uncontaminated sources to supply the whole country, and many sources which in the past may have been quite wholesome have, by changing conditions, become liable to pollution.

Lord Amulree gave a warning that too much reliance should not be placed on bacteriological examination of the water, but that results obtained should be checked and used as a guide in investigating the possible sources of pollution. A word of warning was also given about the meaning of an unsatisfactory bacteriological analysis. Such a report does not necessarily mean that the whole of the consumers are immediately to be plunged into a large and serious epidemic. The presence of *Bact. coli* in the water means that the supply is liable to pollution, and that it is therefore possible that dangerous pathogenic organisms may at any moment gain access to the supply. Immediate steps should be taken to discover and remove or exclude the source of pollution, and at the same time special forms of treatment such as chlorination should be applied.

Unfortunately, a large number of water supplies in Great Britain come from rivers or other surface supplies. Rivers and streams are quite properly used in many places for the discharge of sewage effluents, and it must be remembered that no sewage treatment is aimed at making the effluent sterile, or even approaching a sterile condition, and for this reason treatment becomes necessary before the water is safe to be given to the consumers.

Proper treatment for water is complex and difficult, and requires supervision by expert staff who have laboratory facilities at their disposal. There are three stages of purification: storage, filtration and sterilization. In the early part of the twentieth century, Sir Alexander Houston, director of water examination at the Metropolitan Water Board, showed that polluted water is capable, to a very large degree, of purifying itself, if it be stored for long enough. Filtration may be done by slow or rapid sand filters. Sand filters act in two ways, by physical straining and by the biological destruction of the bacteria in the water by the saprophytic organisms in the 'skin' of the filter bed. Slow sand filters are worked at a rate of one to three million gallons per acre per day. Rapid filters work at much higher rates, and it is usual to add some chemical coagulant such as alumina to the water before filtration. Sterilization consists of adding chlorine or some other bactericide such as ozone to the water. Chlorine was first used as a sterilizer for a piped supply at Maidstone in 1897, following a serious outbreak of typhoid fever. It was extensively used by the armies in the field during the War of 1914–18 and has been widely employed since then, both in Great Britain and America, for treating water.

Like all measures which in modern times are hailed as panaceas, the treatment of water by chlorination has very definite limits. There is, for example, the danger of imparting an unpleasant taste to the water by an excess of chlorine, and there is also the fact that chlorine is only fully effective when applied to water which is free from any appreciable quantity of suspended organic matter. The adjustment of the dose to the varying condition of the water requires skilled supervision and laboratory control: it is a significant fact that of the water-borne outbreaks of typhoid fever which have occurred in recent years, most have taken place in areas where the water supply was supposed to have been treated with chlorine. During the War, instructions were given to all water undertakings in Great Britain to chlorinate the water under their care. Lord Amulree said that this was done as a protection against sabotage by enemy agents, and has led to the erroneous idea that so long as a certain amount of chlorine is put into the water, the water is automatically safe for consumption and that very little or no care need be paid to other forms of treatment or to care of the source. This easy and fatal attitude of mind is one which it is going to be very difficult to eradicate. The fact that chlorination should be under skilled and intelligent supervision, with laboratory control, makes the process difficult to provide for in small rural supplies; hence it becomes more and more important for them to acquire a source free from pollution and to take steps to keep it so.

Some waters are corrosive to lead, and require treatment to protect the consumers from lead poisoning. This is due to the acidity of the water, and is usually corrected by the addition of lime.

Much discussion has taken place during the last hundred years on the relative merits of hard and soft water, and it has been contended that the use of a soft water not only results in a saving of soap but also that food cooked in soft water is more wholesome and more palatable, and that there is a saving in the wear and tear of garments washed in soft water. There are two processes used for water softening. One is based on the process evolved by Prof. Clark, and consists of adding lime to the water and precipitating the calcium bicarbonate as calcium carbonate. The other is called the base-exchange or zeolite method. When hard water is passed through a bed of natural zeolite or artificial base-exchange material, the sodium ions of the zeolite pass into the water and are replaced by the calcium and magnesium ions of the water which combine with the zeolite. By this means a completely softened water is obtained, and when the water issuing from the apparatus is no longer soft the material is regenerated by passing sodium chloride through it and thus reversing the exchange. In particular cases treatment has to be given for the removal of iron, which imparts an unpleasant taste to the water and stains clothing in the laundry. The treatment consists of aeration and sedimentation or filtration. Algæ which interfere with filtration and sometimes give rise to obnoxious tastes in the water may be controlled by treatment with copper sulphate or by coagulation.

Lord Amulree pointed out that the War has brought many new difficulties to water undertakings. In the first place, there was the establishment of camps and training grounds for troops, which led to the possibility of contamination of gathering grounds as well as the necessity for providing largely increased supplies of water. A further danger was the possibility of sabotage or the dropping of chemical or bacterial poisons into reservoirs from enemy aircraft. So far as is known, no attempt to poison water supplies has been made by the enemy.

The bombing of towns brought another danger, when water mains were broken in the same street as sewers. Owing to the great care that has been taken to isolate all sections of damaged mains and to sterilize them with chlorine after they have been repaired and before being put back to service, this danger has been successfully overcome.

DENISON B. BYLES.

PROSPECTS OF CIVIL AVIATION

ON November 4 the Royal Aeronautical Society held at the Institution of Mechanical Engineers a discussion on civil aviation, and I agreed to preside. The time was appropriate in that a British Empire technical conference on the subject had just been held at Ottawa and one was going on on international aviation at Chicago. True, there is this difference in that, whereas agreement was required at the conferences, disagreement was required at the Royal Aeronautical Society's meeting in order to get real discussion.

The conduct of a meeting of this kind is always difficult: technicians are retiring, shy people as a rule, with the result that if you wait for someone to get up, it looks as if the meeting is slow, while if you call on people it appears to be pre-arranged and not spontaneous.

The canvas is very large that contains the picture of civil aviation, and it was certainly not our province to discuss any portion of it that brought in political prejudices or differences. How training or the economics of civil air transport comes within the ambit of a purely scientific society is not very clear, except on the basis that there is no one else to deal with it. I do not know whether a Saturday is a good day for such a gathering, starting at 10.30 a.m. and continuing until 6 p.m., but such was the demand to attend that tickets for admission were hard to come by and the place was full.

Brigadier-General Critchley, the director-general of British Overseas Airways Corporation, opened the discussion, speaking on training for civil purposes. He showed that much thought has been given to the subject. A pilot's career starts at twenty, for example; he must go anywhere until he is thirty-five, after which he can choose his route by virtue of his domestic ties until he is forty-five, when he comes off flying; but meanwhile he is to have training in administrative work, to see if he would be suitable for further employment in that line. It was interesting to note that one aircraft should average 3,000 hours a year and requires three crews to fly it. Accidents have been shown throughout the world to be at least 85 per cent pilot's errors.

Training for the R.A.F. and civil flying were said to be very different, a point disputed by Air Marshal Longmore as to engineers aboard. Altogether, chosen instrument or not, the personnel training of British Overseas Airways looked good, and General Critchley certainly impressed the meeting.

Major Thornton, a shipping director of Holts, an amateur flyer, a member of the Air Registration Board and a most treasured member of my Committee on Civil Aviation, dealt with the economics of flying, and startled everyone by saying he was surprised at being asked to speak on such a theme as the two subjects had never met! Coming from one who has dealt all his life with the running of tramp ships, his was a most enjoyable and instructive talk. He discussed frequency versus big machines, and showed a preference for frequency; but no one pointed out that the tiresome route London–New York non-stop compels at present a big machine on technical grounds. Major Thornton poured scorn, very rightly, on the aeroplane as a rival to ordinary freight carriers, but said it would create a new type of freight which is only of value if carried from place to place quickly.

Dr. Roxbee Cox pleaded for non-commercial routes to be run to open up areas, an important side of this subject.

Sir Frederick Handley Page wanted to know if the jet would jump us from the speed of 200 m.p.h. to 300 m.p.h. without much difference in economy.

Mr. Peter Masefield made the curious point that 100 per cent load factor is uneconomical in view of the waste of money consumed in the organization necessary to reserve places, allot priorities, etc.; 60 per cent load factor, arrive and take your seat, would seem better! This particular subject is very large and requires and deserves much more attention than it got during a morning's discussion.

In the afternoon, Mr. Roy Chadwick, chief designer to A. V. Roe's of Manchester, who was responsible for the most remarkable of all bombers—the Lancaster—started the proceedings, but with war-time caution would only talk of conventional aircraft, whereas everyone, I believe, wanted to be done with them and dream of the next step. Along the lines of the conventional, however, he wanted a general purpose machine of about 100,000–150,000 lb. weight, 1,000 miles range, carrying thirty people, to cruise if needed at 300 m.p.h.

The great Hives followed him, the soul of Rolls Royce, and what a lot we owe to him for his own genius and the teams under him, unequalled in the world. He started by making the interesting point that whereas a locomotive does 100,000 miles between overhauls, an aero engine, although universally cursed, does 150,000 miles between overhauls. He would not admit that design for war engines is different from that of engines for civil use, except in minor points. He stressed the importance for maintenance of the whole power plant being interchangeable. Petter did not like this, but I do not think Hives meant that all power plants should be the same, as that would restrict design; but that in many machines you should be able to take out and replace the whole plant. Air Commodore Banks agreed that peace and war engines were similar.

Here I must state candidly that although both Chadwick's and Hives' contributions were most valuable and interesting, the fact that we are at war and unable for security reasons to speak of so much that is interesting, made the whole discussion rather flat; but that was not their fault.

Mr. Ogston pointed out that the cost of fuel for a year equalled the cost of the aeroplane. Hives countered with the *Queen Mary*, and worked it out in his head at more than half the cost a year!

Mr. C. G. Grey, comparing the difference in form of the Fortress and Liberator, which have identical performances, drew the startling deduction that both must be wrong and that aeronautics was not a science at all!

Mr. F. F. Crocombe put the size of a tail-less machine at 260,000 lb. before showing advantage over the conventional type. Wings, I suppose, get deep enough then to carry useful load and human beings. No trouble in landing gear in big machines was anticipated, the flexing of large spars not being mentioned.

Dr. Roxbee Cox described the jet engine well and pleaded for speed so as to get his engines to give more real horse-power. He was surprisingly optimistic on fuel consumption relative to ground covered, and I hope he is right.

Hives, in replying, admitted that Rolls Royce are in the jet business. He did not say whole-heartedly, but if this was not known before, some engine manufacturers will feel a cold douche down their backs.

Mr. W. P. Hildred, director general of civil aviation and another member of my Committee, spoke well and with great knowledge on route facilities. He put some difficult questions to us, such as what regularity of service is wanted; is ground organization spoiling pilots, what radio aids are really needed, etc., and even asked if aircraft should be self-navigating. It was noble of him to come along, bombarded and harassed as he was by the representatives at the conference in Chicago, asking for loads of information from his broad shoulders.

After tea—for the meeting went on until 6 p.m.—Mr. J. P. Jeffcock made the point that aircraft operators should compel the radio world to give them what they want rather than to take ready-made goods. After the War, radio aids should be on the ground, not all in the aircraft as war demands.

Sir Roy Fedden, president of the Royal Aeronautical Society, to whom the Society owes so much, was the last speaker, and told us what we had all realized, namely, that in spite of the hours spent, we had only touched the surface of many problems; and that once the conferences in the United States are finished, we are to have another day of discussion. The Society's secretary, Captain Pritchard, was expected to gasp, but in fact he suggested it, so in the New Year we shall be at it again.

BRABAZON OF TARA.

NEWS and VIEWS

Teaching and Research in Industrial Health

THE announcement by the Nuffield Trust of grants totalling £150,000 for teaching and research in industrial health is a reminder of the importance of this hitherto neglected aspect of the nation's well-being. In the early eighteenth century, Ramazzini, in his famous "Diseases of Tradesmen", emphasized the risks to health associated with certain occupations; yet it was not until the War of 1914–18 that official interest, apart from a few industrial hazards, was aroused in industrial health. In 1915 it was realized in Britain that munition workers suffering from ill-health were a serious liability to the safety of the country, since their absence affected production. The Health of Munition Workers' Committee, formed in 1915, found that few organizations kept health records, and that the need for preserving the health of those who work with hands or brain was but feebly recognized. Since 1918 progress has been made, and the recognition of the need for industrial medical officers, industrial nurses, welfare workers and labour managers has become more widely spread. It is, however, chiefly the firms with the best conditions who do the most to safeguard the health of their employees in all ways. There are numerous organizations still existing where health is nobody's concern. There are two aspects to be considered: (*a*) the need for systematic research into the actual incidence of sickness absence from various causes; (*b*) the means of expressing the results of this research in such a way that it can be applied easily. Before the outbreak of the present War, much research had been done by the Industrial Health Research Board, but the results were only partially utilized.

Research in industrial health is not merely making an inquiry after something untoward has happened; yet this conception of research is found at times even in government departments. Research calls for much time and patient work, and should be done by people trained in its techniques. Then its initial application should be taken as seriously as the initial research: the attitude of mind of the research worker who prides himself on indifference to the application is out of place in these health problems. Finally, the results should be expressed not only for the research worker but also in a form that can be understood by people who are not specialists. In 1939, the lamentable lack of knowledge on the subject of industrial health had the same results as in 1914, though with less excuse. Medical men had little if any knowledge of the industrial conditions they were expected to understand. This should not be attributed to them as a fault, but as throwing into relief a defect in their training. We know that the total working environment, the social environment and the personalities of the people in authority, quite apart from home conditions, all play a part in determining the sickness absence of workers. It is therefore a definite move in the right direction that the trustees of the Nuffield Foundation have offered the Universities of Durham, Glasgow and Manchester, centres of large industrial populations, the financial means for the furtherance of teaching and research. It is also noteworthy that co-operation is suggested between the new departments and other departments such as science and engineering, the relevant Ministries and trades union officials, and the Industrial Health Research Board. Nor should research be limited to those technically called workers, that is, workers at the bench, but should include all those engaged in work of any kind. The grants, which are to be spread over a period of ten years, have been allocated as follows: £70,000 to the University of Manchester for a chair of industrial health; and £40,000 each to the Universities of Durham and Glasgow, at the former for the establishment of a new department under a university reader, and at the latter for a Sub-Department of Industrial Health in the present Department of Social Medicine.

Joint Council of Professional Scientists

THE Joint Council of Professional Scientists was established for the period of the national emergency, to voice the collective opinion of qualified men of science. It was originally a joint committee of representatives of the Royal Institute of Chemistry and of the Institute of Physics, which was set up for the purpose of fostering co-ordinated action in matters of common interest, and was developed by the co-option of a botanist, a geologist, a mathematician and a zoologist, there being no corresponding professional bodies to represent those branches of science. One of the representatives of the Royal Institute of Chemistry is a metallurgist of similar standing. The Council has now been working for two years. Among matters which have received, or are receiving, its attention are the proposal to urge the Government to establish a central scientific and technical board; the Ministry of Labour's announcement regarding the minimum number of hours to be worked in laboratories and factories; the influence, on professional standards, of war-time university regulations governing the award of degrees; the conditions of service of professional men of science in the Colonial service; and the national policy regarding research and development work.

In June 1943 the Council was responsible for the issue of a statement on "The Place of Scientists in the Community". The views expressed were generally supported and given wide publicity, in the lay and technical Press, not only in Great Britain but also abroad. The Council has specially concerned itself with the resettlement of professionally qualified men of science after the War and with the various proposals which have been put forward for the proper utilization of their services. At the invitation of the Ministry of Labour and National Service, representatives of the Council gave evidence before the Ministry's Committees on "Higher Appointments" and on "The Further Education and Training of Demobilized Persons". Through the Joint Council, also, the Royal Institute of Chemistry and the Institute of Physics offered their continued co-operation with the Ministry in the resettlement period. The Council is also prepared to assist in the general resettlement of all who earn their living through their knowledge of any branch of natural science. Whether the Joint Council will continue in being when the national emergency no longer exists must depend on prevailing circumstances, and how far there may still be a need for professionally qualified men of science as such to voice their collective opinion on matters which concern the community in general, but especially themselves.

Fuel and Power Advisory Council

A Fuel and Power Advisory Council has been constituted as follows: Sir Ernest Simon (*chairman*), Mr. Geoffrey Crowther, Sir John Greenly, Dr. E. S. Grumell, Sir Harold Hartley, Prof. C. N. Hinshelwood, Prof. John Jewkes, Viscount Ridley, Sir Robert Robinson, Mr. Geoffrey Summers and Mr. R. N. Quirk (*secretary*). The terms of reference are: "To consider and advise upon questions, referred from time to time by the Minister to the Council, concerning the development and utilization of the fuel and power resources of the country in the national interest."

Higher Technical Education in Great Britain

IN a paper on "The Status of Higher Technical Education" published by the Association of Technical Institutions (Hon. Secretary, Loughborough College, Leics. 6*d*.), Dr. T. J. Drakeley, principal of the Northern Polytechnic, London, states that while on the Continent, "technical university studies are accorded the same status as university studies and both lead to the award of degrees, here, most of our best students, in fact most students have been discouraged from taking higher technical courses because of their apparent inferior nature"; consequently industry has received few trained men and has suffered the decline foretold by Lyon Playfair in 1852. Dr. Drakeley strenuously combats the foreign view (which is supported even by some British chemists) that "we do not possess the right temperament to maintain industrial progress", and claims that our ineffectiveness in the industrial field is due to our lack of appreciation of "the vast importance of technical training in the development of an industry—whereas we state that trade cannot be taught *within* a school, our foreign competitors realise that trade cannot be taught *without* a school".

In discussing the relation between the universities and technical colleges of Great Britain, Dr. Drakeley directs attention to the fact that some of our major technological studies are not recognized for the award of degrees, and he suggests four ways in which the British problems of higher technological education might be solved, namely: (1) by transferring all existing technological studies to the universities and inaugurating new degree courses; (2) by conferring university rank on the major technical colleges; (3) by creating a national technological university with existing major technical colleges as the core; and (4) by establishing a non-university institution awarding the equivalent of a degree (for example, a diploma in technology) in approved technical colleges. He appears to favour the fourth of these alternatives owing to the time factor involved; "we must raise the status of technical education to that of university education . . . immediately, not only for the students coming forward now to study a technology but for the men on return from the Services". Readers of *Nature* will recall that the problem was discussed in some detail in these columns towards the end of last year and again in *Nature* of June 3, 1944, p. 663.

Skiagram

MR. W. McADAM ECCLES, consulting surgeon to St. Bartholomew's Hospital, London, has prepared a statement urging that an international effort should be made to agree on a standard term to be used for the photogram produced by X-rays. He quotes no less than nineteen words which have been used in connexion with "a negative produced upon a film sensitive to the action of X-rays". Chronologically they are:

1. X-ray.
2. X-rays.
3. X-ray picture.
4. X-ray photograph.
5. X-ray plate.
6. X-ray film.
7. Röntgen photograph.
8. Roentgenogram.
9. Actinograph.
10. Actinogram.
11. Radiograph.
12. Radiogram.
13. Sciagraph.
14. Sciagram.
15. Shadowgraph.
16. Shadowgram.
17. Skiogram.
18. Skiagraph.
19. Skiagram.

Mr. Eccles believes that two only of this collection of terms will bear scrutiny: they are 'skiagram' and 'X-ray film'. The latter is dismissed as being cumbersome and because one of the words used has alternative meanings. On the other hand, skiagram is etymologically sound (from the Greek 'skia' a shadow, and 'gramma' writing). It implies a 'shadow writing', which is a negative produced by X-rays. For some time it has been used in the scientific meaning, and it has never been used for any other purpose. Mr. Eccles therefore urges that the word 'skiagram' should be officially adopted as the standard term, so that it would be generally used in text-books, courts-of-law, medical reports, etc.

This is, of course, not the first time that reference has been made to the slipshod use of scientific terms generally and to the anomalies arising from the word 'radiogram' (see *Nature*, February 19, p. 218). The fundamental difficulty is that no body exists in Great Britain which is acknowledged as the authority on the use of scientific, or indeed other, words. Perhaps, indeed, it is foreign to the fluid character of the English language to accept direction in this manner. In the case of the word 'skiagram', however, with its relatively narrow field of use, it might well be considered by, say, the Physical Society, the British Institute of Radiology and the appropriate section of the Royal Society of Medicine, whether agreement might not be reached on the adequacy and appropriateness of the term, with the view of using it in these Societies' publications. Should it be adopted, no doubt its general acceptance would quickly follow.

Mechanical Properties of Matter

Two recent papers (*Proc. I. Mech. E.*, 151, No. 2; 1944) deal with the properties of materials, and are of particular interest. "A Renaissance of Mechanical Properties", by Sq.-Leader A. C. Vivian, is a plea for clarity in the terms describing the mechanical properties of metals, and demonstrates the fallacy of calculating stresses on a nominal basis instead of actual cross-sectional areas. The fundamental relationship between the factors stress, strain, temperature and loading-rate is discussed in detail, and a system of symbols is suggested for defining exactly the various properties of metals. "The Significance of Tensile and other Mechanical Test Properties of Metals", by Dr. H. O. Neill, is a critical consideration of the conventional quantities obtained from the tensile test, dealing particularly with the measurement of work-hardening capacity and plasticity. Attention is given to the various methods of plotting the results of tensile tests which enable these properties to be evaluated, and numerical data are given. The discussions on both these papers are included.

Earthquakes during July

DURING July 1944, twenty-seven earthquakes and earth tremors were registered by the seismographs at the observatory at Toledo, Spain. Those on July 17 (epicentral distance 112·5°), 19 (epicentral distance 119·1°), and 27 registered the greatest amplitudes at Toledo, whereas the shock on July 18 may have been a local tremor. At Wellington, New Zealand, during the same month, five strong shocks were registered. On July 10 the shock is thought to have originated south of the Kermedecs. On a basis of instrumental evidence received from thirteen other stations, the United States Coast and Geodetic Survey has estimated the epicentre of the shock of July 27 at 0h. 04·2m. G.M.T. to have been near 54·5° N., 166·5° W., which is in the Aleutian Islands, and the depth of focus to have been rather greater than normal. In New Zealand during July fourteen shocks were reported as having been felt. The greatest of these were of intensity 4 on the Modified Mercalli scale, and occurred on July 1 at Opotiki and Whakatane, and on July 11 at Karamea and Westport.

American Telephone and Telegraph Co.: Fellowships

THE American Telephone and Telegraph Company has established a trust fund to finance post-doctorate fellowships in physical science in honour of Dr. Frank B. Jewett, president of the U.S. National Academy of Sciences and vice-president of the Company in charge of development and research, who has just retired, having reached the Company's retirement age. Five fellowships will be awarded annually. The object is to stimulate and assist research in the fundamental physical sciences, and particularly to provide the holders with opportunities for individual development as creative workers. The fellowships provide an annual honorarium of 3,000 dollars to the holder and 1,500 dollars to the institution at which the recipient elects to do research. The fellowships will enable their recipients to devote themselves to research in pure science for a year or two following their doctorates. Since the purpose is to provide for the full-time continuation of academic research, awards will normally be made to those who have obtained the doctorate within the preceding year, or are expected to receive that degree not later than the beginning of the next fellowship term which starts on July 1 each year. The committee of award will consist of seven members of the scientific staff of Bell Telephone Laboratories who are actively and creatively engaged in research in the respective fields of physics, mathematics and chemistry. In making the selection for awards, the primary criteria will be demonstrated research ability of the applicant, the fundamental importance of the problem he proposes to attack, and the likelihood of his development as a scientific man. Selection for a fellowship award and its acceptance will involve no implication or commitment on the part of Bell Telephone Laboratories or on the part of the recipient as to later employment in the Laboratories.

National Physical Laboratory : Appointments

THE Secretary of the Department of Scientific and Industrial Research has announced the following appointments at the National Physical Laboratory: Mr. W. F. Higgins, secretary of the National Physical Laboratory, has been appointed superintendent of the Physics Division of the Laboratory, following a considerable period in which he had been acting in that capacity after the death of the late Dr. G. W. C. Kaye; Dr. G. A. Hankins, of the National Physical Laboratory, has been promoted superintendent of the Engineering Division of the Laboratory to fill the vacancy caused by the resignation of Dr. S. L. Smith; Mr. E. S. Hiscocks, of the Raw Materials Department, Ministry of Supply, and previously of the Department of the Government Chemist, has been appointed secretary of the National Physical Laboratory in succession to Mr. W. F. Higgins.

London School of Economics : Appointments

THE following appointments have been made in the University of London: Dr. R. W. Firth has been appointed as from October 1 to the University chair of anthropology tenable at the London School of Economics. Since 1941 he has been in Government employment at the Admiralty, and in July 1944 he was appointed secretary to the Colonial Social Science Research Council. Dr. R. G. D. Allen has been appointed as from October 1 to the University chair of statistics tenable at the School. Since 1940 he has been in the United States on government service, and is at present British director of statistics to the Combined Production and Resources Board at Washington.

The Night Sky in December

FULL moon occurs on Nov. 30d. 00h. 52m. U.T. and also on Dec. 29d. 14h. 38m.; new moon occurs on Dec. 15d. 14h. 34m. The following conjunctions with the moon take place: Dec. 2d. 08h., Saturn 0·1° N.; Dec. 8d. 09h., Jupiter 4° S.; Dec. 16d. 17h., Mercury 1° S.; Dec. 19d. 00h., Venus 0·2° S.; Dec. 29d. 14h., Saturn 0·3° N. In addition to these occultations, Mercury is in conjunction with Mars, Mercury 3·6° N., on Dec. 29d. 05h. The following occultations of stars brighter than magnitude 6 take place: Dec. 3d. 2h. 53·9m., 63 Gemi. (*R*); Dec. 27d. 17h. 40·2m., *i* Taur. (*D*). The times refer to the latitude of Greenwich and *D* and *R* refer to disappearance and reappearance, respectively. Mercury sets about an hour after the sun at the beginning and middle of the month and is in inferior conjunction on December 23. Venus sets at 18h. 20m., 18h. 58m., and 19h. 46m. at the beginning, middle and end of the month respectively. Mars is too close to the sun for favourable observation, rising 16m. before the sun on December 1 and 46m. before the sun on December 31. Jupiter rises at midnight in the middle of the month and is a conspicuous object during the morning hours. Saturn rises at 17h. 57m., 16h. 53m., and 15h. 43m. at the beginning, middle and end of the month respectively and can be seen south of ε Geminorum. Winter solstice is on Dec. 21d. 23h. The Geminid meteors are active in the early part of the month.

Announcements

WE regret to announce the death of Sir Arthur Eddington, O.M., F.R.S., Plumian professor of astronomy and experimental philosophy in the University of Cambridge, on November 21, aged sixty-one.

DR. F. W. LANCHESTER, the inventor and pioneer in the development of the motor-car and the aeroplane, has been awarded the 1945 James Watt International Medal. The medal is awarded by the Council of the Institution of Mechanical Engineers, with the collaboration of the major engineering institutions of the world. He is only the fourth recipient of the James Watt Medal; the others were Henry Ford, Orville Wright and M. Michel.

DR. J. A. FLEMING, general secretary of the American Geophysical Union of the U.S. National Research Council, announces that Mr. Waldo E. Smith has been appointed to the newly created post of executive secretary of the Union. Mr. Smith has recently been engaged on hydraulic engineering and hydrological studies with the Public Roads Administration, Washington, D.C.

SIX popular lectures on astronomy will be given on Fridays at 6.30, beginning on December 1, at the rooms of the Royal Astronomical Society in Burlington House, Piccadilly, London, W.1. The lectures are for members of the British and Allied Forces and admission is by ticket only, obtainable from Service organizations or from the Assistant Secretary, Royal Astronomical Society.

THE Conference on the "Nutritional Role of the Micro-flora in the Alimentary Tract", arranged by the Nutrition Society (English Group), which was to have been held last July and had to be postponed, will, it is now announced, take place on December 30, beginning at 11 a.m. Further details can be obtained from the Honorary Secretary, Dr. Leslie J. Harris, Nutritional Laboratory, Milton Road, Cambridge.

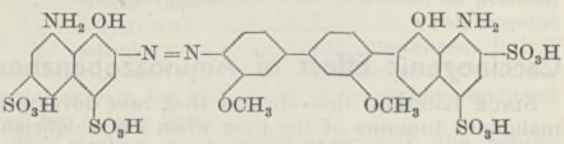
THE Conference of the Association of Special Libraries and Information Bureaux which had to be postponed in September will now be held on December 9 and 10 at the rooms of the Royal Society, London, W.1. The opening address will be given by the president, Sir Frederic Kenyon, on "Organised Knowledge in the World of the Future". There will be a symposium on "The Empire Contribution to the Flow of World Information" and a discussion on the status and education of special librarians and information officers, together with several shorter papers. Particulars can be obtained from the ASLIB Office, 31 Museum Street, London, W.C.1.

LETTERS TO THE EDITORS

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

Wharton's Jelly Considered as a Conducting Path

During the course of experiments conducted on the sheep fœtus, dyes were injected into the umbilical cord with the object of exploring movements of substances in the cord along non-vascular pathways. The dyes used were a dis-azo dye,



related to trypan blue, and the same dye linked to serum albumin by a diazo linkage. The dye, when linked to protein in this way, cannot dissociate from the albumin, and hence acts as a tag to the protein. These substances were prepared by one of us (P.D.M.).

Fœtuses of different age periods were delivered by Cæsarean section and kept alive, with the placental site intact, and the mother alive, for periods up to five hours. The fœtuses were not allowed to breathe. 2–5 ml. of the dye solution was injected under low pressure into Wharton's jelly (avoiding the main umbilical vessels) four to five inches from the abdominal wall of the fœtus. The injection occupied approximately one minute. The injection mass passed slowly along the cord into the abdomen of the fœtus. At the end of three hours, the blue colour of the dye was well marked throughout the whole substance of the cord on the fœtal side of the injection site, over the allantois, the upper portion of the bladder, the umbilical arteries and the adjacent peritoneal reflexions. No coloration was observed along the pathway to the liver or any other site. It is clear, therefore, that the dye did not find its way into either of the three other escape routes from the cord, namely, (1) the vascular system (there are small vessels in the Wharton's jelly of the sheep as was shown by Tait); (2) the allantoic duct, in which case the dye would have appeared in the bladder; (3) the extra embryonic cœlom leading to the *inside* of the peritoneal cavity.

It is therefore evident that molecules as large as serum albumin may pass from the cord into the embryo by a pathway which is functionally and embryologically distinct from routes (1), (2) and (3) above. The molecules of albumin move at a much greater rate than could be accounted for by diffusion. There must, therefore, under the conditions of these experiments, be a bulk flow of fluid from the cord into the embryo. As the pressure available cannot have been large, the resistance to flow through the connective tissue must be small.

Tait[1] reported results of injection into the cord which are different from the results we obtained. It is possible that the differences are due to his dyes being much more coarsely particulate than those used here.

The interest in the above observations lies in the fact that the Wharton's jelly in the umbilical cord of the sheep is continuous with similar material in the cotyledons of the placenta (Barcroft and Barron), implying a path from the placenta to the fœtus other than the purely vascular one. It has yet to be discovered whether material can pass in the fœtus further than the restricted area which we have described. Clearly, if there is a continuous flow of fluid, the water at least must do so, but what sized molecules it can take with it is another question.

Further research is required to ascertain how far this non-vascular pathway in the cord is of importance in the fœtus.

We are deeply indebted to Dr. D. V. Davies for his kind advice on the anatomical problems involved.

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Production of Gliotoxin by *Trichoderma viride*

Gliotoxin was first described by Weindling and Emerson[1] as a metabolic product of *Trichoderma lignorum* (Tode) Harz [= *T. viride* Pers. ex Fries]. Weindling afterwards[2], on the advice of C. Thom and M. Timonin, reported that he had described the fungus incorrectly, and that instead it should be identified as a *Gliocladium*, similar to *Gliocladium fimbriatum* Gilman and Abbott. I have found that strains of *Trichoderma viride* produce gliotoxin, and I suggest that it is extremely probable that the fungus used by Weindling was not *G. fimbriatum*, but was a *Trichoderma* as he originally supposed.

In 1942 I received from Prof. H. Raistrick a culture which had been supplied to him as Weindling's strain of *G. fimbriatum*. Using the culture medium recommended by Weindling and Emerson[1], I have found this to produce gliotoxin in 4-day still cultures at the rate of about 50 mgm. per litre. Afterwards, in the course of examination of a number of isolates of *T. viride*, one isolated from a local soil (No. 211) was found to possess marked powers of antagonism to a number of bacteria and fungi. This organism was then found to produce gliotoxin in yields of about 95 mgm. per litre, that is, at twice the rate of 'Weindling's strain' under similar conditions.

Analyses (Weiler and Strauss) of the products from both fungi agree with $C_{13}H_{14}N_2S_2O_4$ as found for gliotoxin by Dutcher[3], not with $C_{14}H_{16}N_2S_2O_4$ as originally suggested by Weindling and Emerson. Data are given in Table 1.

Table 1.

%	Calc. for $C_{13}H_{14}N_2S_2O_4$	Gliotoxin from Strain No. 211	Gliotoxin from 'Weindling's strain'
C	47·8	47·8	47·8
H	4·3	4·4	4·4
S	19·7	19·9	19·8
N	8·6	8·3	8·6

Until I discovered the production of gliotoxin by a fungus which I considered to be an obvious *Trichoderma*, I accepted the nomenclature of 'Weindling's strain' as *G. fimbriatum* Gilman and Abbott. Since these two fungi appeared very similar in macroscopic cultural characteristics, a more detailed examination of the two isolates was made. Apart from minor cultural differences, such as the relative amounts of sporulation on different media, the two were very similar morphologically. Fortunately, I was able at the same time to obtain another culture of *Gliocladium fimbriatum* Gilman and Abbott from the National Collection of Type Cultures (*NCTC*. No. 6599). This was clearly different from the two isolates mentioned above, and I have not been able to demonstrate the production of gliotoxin by this fungus. In Table 2 certain morphological features of these three fungi are compared with the original description of *G fimbriatum* by Gilman and Abbott[4].

TABLE 2.

	G. fimbriatum (data from Gilman and Abbott[4])	*G. fimbriatum. NCTC.* 6599	*G. fimbriatum.* 'Weindling's strain'	*T. viride* No. 211
Conidia	6·5–9·5 × 2·5–4 μ	5·5–7·5 × 3–3·5 μ	4·4–5·2 × 3·5–4·5 μ	4·5–5·5 × 3·5–4·5 μ
Phialides	10–20 μ	14–20 μ	7–11 μ	7–10 μ
Chlamydospores	Not recorded	None	Abundant	Abundant

It will be seen that 'Weindling's strain' and my isolate of *T. viride* are similar, and that both differ from *G. fimbriatum* (*NCTC*. 6599) and from Gilman and Abbott's description of *G. fimbriatum* in having shorter phialides, smaller and less markedly elliptical conidia, and in possessing chlamydospores of a type invariably found in *Trichoderma*. The conidia of *G. fimbriatum* (*NCTC*. 6599) are borne in slime-balls on a polyverticillate penicillus typical of the genus, usually more complex than that figured by Gilman and Abbott. The spore-balls of 'Weindling's strain' and *T. viride* No. 211 are borne at times on single phialides, or on two to three phialides, arising from the conidiophores in a manner typical of *T. viride*, but a high proportion are borne on phialides arising from a group of branches or metulæ produced terminally on the conidiophores, giving a rather *Gliocladium*-like appearance. Nevertheless, the characters already mentioned, the formation of 'tufts' of conidiophores, the rapid growth, and general colony characteristics all point to 'Weindling's strain' and my isolate No. 211 being strains of *T. viride*. They are aberrant strains in so far as the formation of a rather complex conidiophore is concerned; but, as Bisby[5] has shown, *T. viride* exhibits considerable strain variation in several directions.

It seems clear, from the evidence given above, that the fungus obtained as Weindling's strain of *Gliocladium fimbriatum* is really a strain of *Trichoderma viride*. Moreover, Weindling[2] himself mentions that the conidia of his organism were smaller than those recorded for *G. fimbriatum* Gilman and Abbott, and that it produced chlamydospores similar to those of *Trichoderma*, which had not been recorded by Gilman and Abbott for *G. fimbriatum.*

Antagonism based on the production of antibiotics is probably of great importance in determining the balance between various micro-organisms in such habitats as soil. It seems probable that the well-known antagonistic powers of *T. viride* are due, at least in part, to the production of gliotoxin. The natural biological role of gliotoxin can now be regarded as much greater than was heretofore imagined, since *T. viride* is widespread and abundant in soil, unlike the relatively rare *G. fimbriatum.*

Thanks are due to Dr. G. R. Bisby for help in the nomenclature of some of the organisms studied, and to Mr. J. C. McGowan for the chemical identification of gliotoxin.

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Carcinogenic Effect of Aminoazobenzene

SINCE Kinosita[1] first showed that rats developed malignant tumours of the liver when fed a deficient diet containing N,N-dimethyl-*p*-aminoazobenzene (butter-yellow), much work has been done in an attempt to elucidate the mechanism whereby this azo-dye brings about neoplastic changes in liver tissue. One aspect studied has been the metabolism of the dye itself; Stevenson, Dobriner and Rhoads[2] were able to isolate *p*-aminophenol and *p*-phenylenediamine, and also their N-acetylation products, from the urine of rats receiving the dye orally. Thus the azo-link is split as in the case of *o*-aminoazotoluene[3] and other azo-compounds in the animal body. However, the absence of N,N-dimethyl-*p*-phenylenediamine from fractions prepared without addition of sodium hydrosulphite suggested that complete demethylation occurs at some stage prior to the acetylation of the *p*-phenylenediamine. This lability of the N-methyl groups has been neatly demonstrated by Jacobi and Baumann[4], who found butter-yellow could function like other methyl-donors in protecting young rats against kidney lesions when on a choline-free diet.

Jacobi and Baumann[4] also suggested that the protection afforded by high-protein and high-riboflavin diets against butter-yellow carcinogenesis was due, at least in part, to the demethylation of the dye to *p*-aminoazobenzene, which they quote Kinosita as stating is non-carcinogenic. Kensler, Dexter and Rhoads also state that "Aminoazobenzene . . . does not produce liver cancer in the rat". This would attribute to the methyl groups a dominant role in the process of carcinogenesis. However, the methyl groups in *o*-aminoazotoluene (which is more carcinogenic for mice than is butter-yellow[6]) are attached to carbon atoms and presumably are not labile. Hence, it seemed unlikely that the N-methyl groups of butter-yellow were so essential as these workers suggested, and that *p*-aminoazobenzene itself might really be carcinogenic.

Miller, Miner, Rusch and Baumann[7] evolved a low-protein basal diet which enabled them to induce hepatomas in 90–100 per cent of rats receiving a butter-yellow supplement for four months; the incidence on a full diet was only 80 per cent at eight months. A group of fifteen albino rats of Wistar origin were placed on a similar diet in this Department, except that starch was replaced by boiled potatoes as a war-time modification. This modified diet, supplemented with butter-yellow (0·06 per cent of diet), induced malignant liver tumours after seven months, that is, it caused no marked acceleration in the production of tumours, compared with a full diet. However, sixteen similar rats have been fed on this modified diet, supplemented with *p*-aminoazobenzene (at first 300 mgm. per 100 gm. diet, and, later, 200 mgm. per 100 gm. diet), for more than eighteen months, so far. Of eight rats now dead, one (dying at thirteen months) had a few whitish spots visible to the naked eye, in the liver, and these proved on microscopic examination by Dr. P. R. Peacock to be small hepatomas. Two other rats died at seventeen months, both having very large tumours in one lobe and smaller tumours in the other lobes of the liver; in one case, the liver weight (including tumours) was 47·8 gm. These tumours were liver-cell carcinomas which were metastasizing via blood-vessels to the mesentery. It is hoped to publish, in conjunction with Dr. P. R. Peacock, a full account of the pathology of these lesions elsewhere; but it may now be said that *p*-aminoazobenzene is carcinogenic for rats fed the dye in a somewhat restricted diet for a long time.

This finding is in accordance with the results obtained by Kensler *et al.*[5,8] and Potter[9], who found various enzyme systems to be inhibited by the *p*-diamines which are liberated from butter-yellow and related azo-dyes when the azo-link is reduced. Thus N,N-dimethyl-*p*-phenylenediamine caused 64 per cent inhibition of urease at a molarity of 1×10^{-3}. *p*-Phenylenediamine at the same concentration caused 45 per cent inhibition[9]. Similarly, in the cases of succinoxidase, yeast carboxylase and coenzyme-I, *p*-phenylenediamine caused a significant degree of inhibition. If this effect on enzymes plays a part in the process of liver carcinogenesis, then it would be reasonable to expect that aminoazobenzene would be carcinogenic, though less so than the fully methylated compound. This is what we have found to be the case. It is, moreover, clear that the butter-yellow split-product must have its effect prior to the demethylation process, that is, reduction of the azo-link must precede demethylation; otherwise the two dyes would eventually yield the same split-product, *p*-phenylenediamine, and have the same degree of carcinogenic power.

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Taste of Thiouracil and Phenylthiocarbamide

TWELVE years ago, Fox[1] discovered a curious property of phenylthiocarbamide. He was putting some of the substance into a bottle when a colleague complained of the extremely bitter taste, which Fox himself was unable to confirm. The question was investigated by Blakeslee[2], who found that a sample of the American population contained 40 per cent of individuals who were non-tasters. Furthermore, it was found that if two non-tasters married, their children were also non-tasters. The ability to taste (*T*) is dominant to non-tasting (*t*), so that parents having the constitution *Tt* may have non-tasting children; but if one of them is homozygous, *TT*, then all the children will be tasters of phenylthiocarbamide. The test has been used as a genetic marker in the investigation of human pedigrees[3,4,5].

As the chemical constitution of thiouracil and phenylthiocarbamide indicate a common origin, it was considered desirable to investigate the taste of the former. Sixty volunteers submitted to the tests. Approximately one half of a 0·2 gm. tablet of thiouracil was chewed, and the subject was asked to state what taste it had. The responses varied from intensely bitter to a chalky taste, but there was no difficulty in identifying the tasters from the non-tasters. A solution of phenylthiocarbamide was prepared containing 0·005 per cent, and the subjects were given a teaspoonful each. This solution divided the group into two, tasters and non-tasters, in the same manner as the thiouracil, with one exception. This was a male who considered that thiouracil was intensely bitter, but was unable to taste 0·005 per cent phenylthiocarbamide although a 0·01 per cent solution was tasted. He was considered to be a taster.

	Tasters	Non-tasters	Total
Males	23	10	33
Females	20	7	27
Total	43	17	60

The proportion of tasters to non-tasters is shown in the accompanying table. The numbers were too small to establish the excess of non-tasting males which is known to occur. The material included a female taster who had a non-tasting husband. They have two children, a non-tasting boy and a tasting girl. It follows that the woman is probably heterozygous (*Tt*) for the factor concerned in controlling the taste of both thiouracil and phenylthiocarbamide. Two identical twins were both tasters.

It would appear that the ability to taste thiouracil is inherited in the same manner as that of phenylthiocarbamide. A few subjects taking thiouracil therapeutically showed nothing to suggest that their response differed in any way from the majority. So far as our knowledge goes, this peculiar property has only genetic significance.

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Apparent Vitamin C as a Possible Precursor of True Vitamin C in Walnuts

UNRIPE walnuts have previously been reported[1,2] to contain considerable amounts of apparent vitamin C, the provisional term suggested[3] for substances which so closely resemble true vitamin C in chemical and physical properties that they may be confused with the latter when it is being estimated by the usual dye titration method, though they may be distinguished from it by modifications[4,5] of Lugg's formaldehyde method[6]. A detailed study (on some hundreds of samples) has now been made of the relative proportions of true and apparent vitamin C in different tissues of the walnut throughout the period of growth and ripening.

The fruit in the earliest stages may contain practically no true vitamin C but very high concentrations (more than 1,000 mgm. per 100 gm.) of apparent vitamin C. As growth and maturation proceed, the proportion of true vitamin C in the total vitamin C gradually increases until in the nearly ripe nuts it approaches 100 per cent. An explanation is thus provided of the lower proportions of apparent vitamin C found by other workers[4,7,8] who examined more mature nuts. Moreover, the apparent vitamin C also occurs in high concentration in buds and leaves, and the concentration gradients suggest that a steady flow occurs from these centres of photosynthetic activity to the tissues of the nut in which it may be converted into true vitamin C. The most striking results have been obtained with samples of *Juglans regia*. With *J. nigra* the results were similar but less marked, and with *J. rupestris* and *Carya ovalis* var. *obcordata* the part played by apparent vitamin C is more obscure. This season no specimens were available of *J. cinerea*, in which we found last year that 73 per cent of the total vitamin C was apparent vitamin C.

Our results in the 1943 season had already indicated the possibility that apparent vitamin C might be a precursor of true vitamin C in walnuts[9], and our results in 1944 have provided further evidence in favour of this hypothesis. Attempts to establish the identity of the apparent vitamin C in walnuts are meeting with certain difficulties, and until these are overcome it appears premature to discuss various interesting possibilities arising from our findings. However, we think it desirable to publish this preliminary note and thus afford other workers the opportunity of checking our results.

The possible presence in apples of a vitamin C precursor has recently been mentioned by West and Zilva[10] when describing the results of several years work in which clear evidence was obtained that the true vitamin C content may increase during storage. It would be of interest to discover whether their apples contain any apparent vitamin C and, if so, whether the proportion of this decreased as the proportion of true vitamin C increased, as should occur if the former is a precursor of the latter. Unripe walnuts do not withstand storage so readily as apples do, and we have not yet been able to duplicate with our walnuts West and Zilva's lengthy storage experiments on apples. Over short periods (of a few weeks) we have obtained evidence with walnuts of decreases in the concentration of apparent vitamin C in parallel with increases in concentration of true vitamin C which were of the order to be expected from West and Zilva's results; but so far there has not been a high degree of significance in the differences observed.

Whether further work succeeds or fails in proving apparent vitamin C to be a precursor of true vitamin C, there already seems to be clear evidence that, in walnuts at least, apparent vitamin C is not a mere degradation product such as might be formed during the processing of foods, but rather a substance playing an important part in plant metabolism. The question of the part, if any, which it plays in animal metabolism, and of its possible physiological activity, has still to be decided.

We are indebted to Dr. E. J. Salisbury, director of the Royal Botanic Gardens, Kew, for material, to Prof. R. A. Morton for advice and for spectrographic examination of our extracts, to Dr. Bergel of Messrs. Roche Products, Ltd., for specimens of reductone, reductic acid and hydroxytetronic acid which we have compared with the apparent vitamin C in walnuts, and to Miss Elaine Finnigan and Miss Valerie Pritchard for assistance in making the extracts.

Full details of this work will be published elsewhere.

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Thymol Turbidity Test: a New Indicator of Liver Dysfunction

IN the course of work on the serum colloidal gold reaction[1,2] it was noted that the thymol which was at first used to inhibit the growth of moulds in the barbitone buffer (pH 7·8) produced a marked turbidity or precipitate with certain sera. These sera were usually from patients with parenchymatous liver disease and also gave positive colloidal gold reactions, and it soon became evident that there was a close correlation between the thymol turbidity and the gold test. Phenol and many of its substitution products gave similar results in suitable concentrations, and there was a direct relationship between the molecular weight, the solubility and the precipitating power. Thus six typical compounds required the following concentrations to produce equal degrees of turbidity at pH 7·8, $\mu = 0{\cdot}01$, when added to serum from a case of infective hepatitis. In each case the same solutions produced negligible effects with normal serum.

Compound	Equivalent concentration	Molecular weight	Solubility (approx.)
Phenol	1·5 per cent	94	5·1 per cent
Cresols (*o*, *m* and *p*)	0·75 ,,	108	1·8–2·5 ,,
Xylenol (1, 2, 4) ..	0·4 ,,	122	0·79 ,,
Naphthol (*a*) ..	0·10 ,,	144	0·11 ,,
Thymol	0·11 ,,	150	0·11 ,,
Carvacrol	0·11 ,,	150	0·12 ,,

It is evident that in this series, with increasing molecular weight, the solubility falls off more rapidly than the concentration required for effective precipitation, so that higher homologues such as cholesterol are too insoluble to give a positive result. These considerations suggest analogies with the Pandy test for globulin in cerebrospinal fluid which uses saturated phenol solution, and with the cephalin-cholesterol flocculation test of liver function[3]. It seems extremely probable that both these tests depend upon the same principle, the function of the cephalin being to keep the cholesterol in solution. On this basis thymol occupies a convenient intermediate position for use with serum, as it is just soluble enough to produce a satisfactory result in saturated solution. Being effective in low concentration, it has the additional merit of simplifying the analysis of the precipitate. No other compound tested was superior to thymol.

As with the gold reaction, changes in the pH and in the ionic strength of the medium exerted a marked influence on the result, so that at pH 5 turbidity was increased but the test lost all specificity. After numerous trials the following technique was finally adopted and has now been used in some 450 cases.

Thymol buffer, pH 7·8, $\mu = 0{\cdot}01$. Add 500 ml. of water to 1·03 gm. of sodium barbitone, 1·38 gm. of barbitone, and approximately 3 gm. of thymol. Heat just to boiling point, shake well and cool thoroughly. The mixture should now be turbid. Seed with a small amount of powdered thymol crystals, shake and allow to stand overnight at a temperature of 20–25° C. Finally shake again and filter the clear solution from the crystalline deposit.

Method. Add 60 volumes of buffer to 1 volume of serum, allow to stand for half to one hour and compare in a comparator with the turbidity standards of Kingsbury *et al.*[4]. 3 ml. of buffer and 0·05 ml. of serum are convenient volumes to use. The standards are those in common use for urine protein estimation and can be obtained commercially[5]. If the turbidity exceeds the 100 mgm. per cent standard, dilute with a further measured volume of buffer as required. When the test is positive, flocculation frequently occurs on standing overnight, but this is not an essential part of the test. The result is recorded in arbitrary units equal to the appropriate standard divided by ten with allowance for dilution. Thus if the final dilution is 1 in 120 and the mixture then matches the 70 mgm. per cent tube, the result is 14 units. Normal sera give values from 0 to 4 units.

The precipitate in typically positive cases contained 6·0 per cent N, 0·33 per cent P, 32 per cent thymol, and 11·8 per cent cholesterol (average figures). It could be redissolved in weak alkali and was then completely precipitated with one-third saturated ammonium sulphate. It therefore appears to be a globulin-thymol-lipoid complex with the following average composition: protein 37·5 per cent, thymol 32 per cent, cholesterol (half esterified) 16·5 per cent, and phospho-lipid calculated as lecithin 8·0 per cent. The protein is probably mainly the gamma globulin which is known to be concerned with the cephalin-cholesterol test and with the gold reaction[6]. The chemistry of the test is not understood; but it appears that the phenolic grouping has a special affinity for gamma globulin under the conditions employed, although other proteins are precipitated at more acid reactions or with higher concentrations of precipitant. The total serum globulin is above normal in about half the cases with positive thymol tests.

A fuller account will appear elsewhere. In general, the results have been similar to those obtained with the serum colloidal gold reaction[1,2], being positive in 120 out of 130 cases of infective hepatitis (mean 10·3 units, standard error 0·44), in 13 out of 13 cases of cirrhosis (14·2 ± 2·0), and only weakly positive in 3 out of 38 cases of obstructive jaundice (1·2 ± 0·27). The thymol test was more often positive than the gold test in Weil's disease and was less often positive in chronic infections. It is therefore rather more specifically related to liver disease than is the gold test, and should be of value in the differential diagnosis of jaundice and as a general indicator of liver dysfunction.

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Barotaxis in Diptera, and its Possible Significance to Economic Entomology

VARIOUS authors have noted an apparent correlation between the degree of activity of insects and the barometric pressure. I have recently completed an investigation of the conditions governing the aerial distribution of insects. The completed work is to be published elsewhere, but it has been thought advisable to direct attention to a phenomenon which came to light during laboratory experiments on the effects of decreased pressure upon insects.

It was noted that certain insects, particularly Diptera, consistently reacted to slight decreases in pressure with a marked increase in flight activity. This increase in activity occurred within the pressure range corresponding to the height interval between sea-level and about 1·5 km. The activity again became normal at still lower pressures.

It must be stressed that this increasing activity is not a distress reaction. The increase occurs regardless of the rate of decrease in pressure, within a zone of reasonable temperature. It occurs when ample time is allowed for acclimatization at given pressure levels.

Not all orders of insects exhibit such a response. In the case of the Diptera, the response is so marked that it should be considered of barotaxic origin. At the present time, the underlying physiology is not clear. However, Glick[1], in commenting on the results of his aircraft collections, notes that Diptera were taken in the first 1·5 km. of the atmosphere in consistently greater numbers than were any other orders. Since the collections were made under a variety of weather conditions, it does not seem reasonable to account for the above simply by assuming numerical superiority. Moreover, species of Coleoptera and Hymenoptera were the next most abundant within this height-interval. It may be significant that these three orders possess highly developed nervous systems. It is probable that their consistent occurrence at higher elevations arises from a favourable response to lowered pressure rather than from sheer weight of numbers.

Although the above observations are chiefly related to the distribution of insects in the upper air, they may be of value when applied to the bionomics of dipterous species at the surface. Underhill[2] noted that certain Simuliids fed more actively at low pressures, or during periods of rapidly falling pressures. It is likely that this is another manifestation of the general increase in activity.

I would suggest that, in future, more attention be given to the correlation of surface pressures with field observations of dipterous species, particularly in those problems related to variations in the activity of Diptera attacking man and animals. By a consideration of the surface pressure distribution, it may be possible to forecast changes in the activities of adults in the field, provided the temperature and other factors are favourable to activity. In this regard, the effect of the winds around areas of low pressure should be considered.

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Phase Difference Microscopy

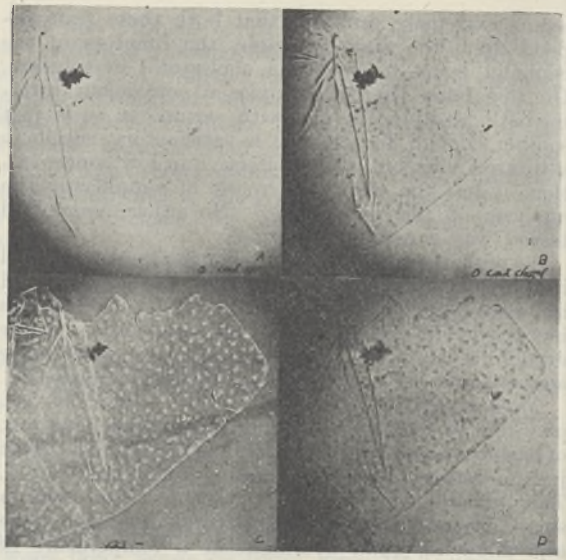
The microscope does not reveal detail in uncoloured, transparent specimens even though it is known to be present and of sufficient size to be resolvable. When the detail includes regions of different refractive index, phase differences will be involved in light passing through the specimen, and if these phase differences are changed into intensity differences, the detail may be seen since the eye is sensitive to the latter although not to the former.

This change can be accomplished by inserting an annular stop into the condenser of the microscope and inserting a phase plate into the objective at its back focal plane. The phase plate consists of an annulus having a different transparency from the rest of the plate and of proper size to intercept the light coming directly from the opening in the condenser. The plates can be made so that the detail in the specimen may be seen either brighter or darker than its surroundings.

Abbe considered phase differences, but made little practical use of them. Conrady and Rheinberg[1] used phase difference microscopy to show and photograph a grating. Zernike[2] extended the treatment of these differences and urged their use in microscopy. Köhler and Loos[3] used his method with an annular plate and described some of the advantages of this kind of microscopy. The general theory and optical design have been extended in our Research Division by Dr. Harold Osterberg and Dr. R. K. Luneberg, coating methods for the phase plates have been developed by Dr. Helen Jupnik and practical tests and applications have been made by me, all working under Mr. A. H. Bennett, director of research.

The Spencer equipment includes a variety of phase plates having *both* retarding and absorbing properties of improved thin-film coatings. Both positive and negative plates are available for a range of 0–0·4 λ retardation and 0–100 per cent transmission. *Absorption differences* have been found by us to be as important as retardation differences in making some specimens visible under the microscope. The microscope exhibited at the Cleveland meetings of the American Association for the Advancement of Science had the phase plates mounted in a disk so that they could be rotated successively into place within the objective.

Phase difference microscopy has been found useful with unstained, transparent tissues, both plant and animal. Fig. 1 shows the appearance of epithelial tissue, living and unstained, from the nictitating



Frog nictitating membrane epithelium. × 40 approx. *A*, ordinary microscope, aperture filled. *B*, same, aperture half filled, detail largely diffraction patterns. *C*, bright-, and *D*, dark-phase with phase-difference microscope.

membrane of the frog eye. The fine detail in fibroblasts from a chick embryo should be seen, but is not seen with the usual microscope objective. (Stopping the condenser down to give a narrow illuminating cone loses the fine detail in a lot of diffraction patterns.) Bacteria, blood cells, mould and Protozoa can be made clearly visible against their background; this facilitates study and counting. The resolution of the lenses appears not to be reduced, and considerable time and material are saved by not staining the specimens. The 'visualization' of transparent cells will give an interesting check on previous information obtained from killed and stained cells and tissues.

Industrial applications may include the examination of transparent fibres, as glass and plastics, and surface detail on materials embedded in media of slightly different index. Small particles, within the limit of resolution of light microscopy, may be counted and measured, as in homogenized milk and in mayonnaise. The microscopic polishing marks on a transparent glass surface have been demonstrated and photographed in our laboratory.

The positive phase difference giving dark detail is more useful for measurement, and the negative phase showing bright particles is preferable for counting. Either appearance is possible with no damage to the specimen. When the particles are of differing size, as within a large *Paramecium*, they may selectively be made lighter or darker with respect to those of different size. Magnifications used range from 100 to 2,000 diameters and include dry and homogeneous immersion objectives. This development extends greatly the usefulness of the light microscope to include transparent materials of importance to several branches of science, medicine and industry.

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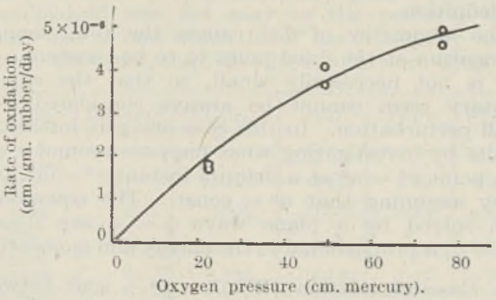
Reaction between Oxygen and Rubber

SEVERAL investigations[1,2,3,4] on the effect of pressure on the reaction between natural rubber and gaseous oxygen in its initial stages have been made by following the rate of disappearance of the oxygen in a closed system. In the experiments, the oxygen pressure decreased spontaneously as oxygen combined. Under these conditions, the results may be vitiated if time effects occur such as might arise from the rate of combination of oxygen dissolved in the rubber outpacing the rate of dissolution of fresh gas, or from the formation of unstable oxidation catalysts.

We have carried out oxygen absorption experiments under conditions of constant pressure, with rubber specimens for which we have evidence that their state of subdivision is such as to prevent any complication from diffusion effects, and have come to the following conclusions.

1. At constant pressure the rate of oxidation reaches a constant and reproducible value. (Our experiments have been confined to combined oxygen proportions not exceeding 1 per cent by weight.)

2. Contrary to earlier suggestions[4], the oxidation-rate is greater the greater the oxygen pressure (Fig. 1).



OXIDATION OF UNVULCANIZED SMOKED SHEET RUBBER AT 40° C.

3. The rate of oxidation using dry air free from carbon dioxide is greater than that using undiluted oxygen at the same partial pressure.

The following further conclusions are based on experiments involving alteration in oxygen pressure.

4. After storage in a vacuum, the rate of oxidation of rubber in oxygen under constant pressure slowly increases, for several hours, from zero to the 'equilibrium rate' for that oxygen pressure. This period is considerably greater than that required for solubility equilibrium.

5. If, after the rate of oxidation under constant pressure has become constant, the oxygen pressure is reduced to a new constant value, the rate of oxidation falls slowly for several hours from a high initial value to the new constant rate corresponding with the lower pressure. This high initial rate is sometimes greater than the constant rate at the higher pressure. These statements may also be true in strict converse for an increase in oxygen pressure.

6. The persistence of an oxidation-rate greater than the 'equilibrium rate' immediately succeeding a reduction in pressure (see 5) can invalidate conclusions from experiments involving a changing pressure, and may explain the lack of agreement between results of earlier workers.

A detailed account of this work will be published later.

We wish to thank the Dunlop Rubber Co. for permission to publish this work,

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[1] Williams and Neal, *Ind. Eng. Chem.*, **22**, 874 (1930).
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Ethereal Sulphate Content of Agar Specimens

IN 1942, through the kindness of Dr. A. P. Orr of the Marine Station, Millport, specimens of agars of known history were examined to see if evidence could be secured for the formulation of Jones and Peat[1], which demands a relatively high sulphur content (S, 1·8 per cent; that is, SO_4, 5·4 per cent).

The specimens had been extracted from the algæ with boiling water without any chemical treatment, and the agars purified by freezing and thawing; the results are tabulated below:

Plant	Source	Ash	SO_4 (in ash)	SO_4 (total)
Gracilaria confervoides	Plymouth	2·2%	0·9%	1·3%
Gelidium crinale	Dunure (Ayrshire)	3·6	0·7	1·4

These figures may be compared with those reported by Barry and Dillon[2] for an agar extracted from *Gelidium latifolium*, which gave ash, 2·6 per cent; S, 0·36 per cent. It is clear that none of the above specimens contain sufficient sulphate to account for the proportion of 2 : 4-dimethyl-3 : 6-anhydro-β-methyl-*l*-galactoside (9 per cent[1]; 11·5 per cent[3]) isolated from methylated agar, on the former of which the 'sulphate formula' proposed by Jones and Peat is based.

From their experiments with periodic acid, Barry and Dillon[2] concluded "that the 3 : 6-anhydro-*l*-galactose isolated from agar in the form of its 2 : 4-dimethyl derivative is not an artefact produced during the methylation process[1], but a constituent of the agar molecule". That this appears to be true for commercial samples of agar has been pointed out previously[3,4,5,6], but it is difficult to believe that there is no connexion between the 3 : 6-anhydro-*l*-galactose units and the sulphate groups, since the alkaline hydrolysis of methylhexoside sulphates gives rings of this type[6]. If, as Jones and Peat[1] suggest, all the galactose residues which ultimately become 3 : 6-anhydro-*l*-galactose residues carry sulphuric ester groups at the same time, the present evidence points to the conclusion that most of these sulphate residues are removed at some stage prior to the actual extraction of the polysaccharide from the plant. An alternative view would be a gradual removal of sulphate groups during the life of the plant with 3 : 6-anhydride formation, followed by the formation of ethereal sulphates on other galactose residues, the sulphur content remaining approximately constant throughout.

Finally, it should be stated that there is as yet no direct evidence that the sulphate groups remaining in the agar after isolation are located on C_6 of the *l*-galactose residues, although at the time of the publication by Jones and Peat[1] this was perhaps a natural assumption. The ethereal sulphate could indeed be situated on C_3, since recent experiments in this laboratory have shown that methylglucofuranoside-3-sulphates yield 3 : 6-anhydrides on alkaline hydrolysis. It may be added further that if the hydroxyl groups on C_3 were thus esterified, the agar would possess no α-glycol groupings, and would therefore not react with periodic acid, thus providing an alternative explanation for the results of Barry and Dillon[2]. It should be noted, however, that this suggestion that the sulphate residue might be found on C_3 is not put forward as a rival hypothesis to that of Jones and Peat[1], but as a possible alternative, to emphasize the fact that additional work on agar specimens of known history is needed before further progress can be made in determining the structure of this polysaccharide.

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[2] Barry and Dillon, *Chem. and Ind.*, **63**, 167 (1944).
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Non-conservative Fundamental Particles

IN view of certain possibilities, for example the still open possibility of the non-existence of the neutrino, it may be interesting to set up an equation for a fundamental particle which, in the restricted relativity approximation, does not obey the energy conservation law.

Such a non-conservation property is easily arrived at by taking a Lagrangian which depends explicitly on the four co-ordinates. It is remarkable, however, that such a Lagrangian, or alternatively the corresponding equations, are almost automatically obtained, in an elegant way, by starting from the Dirac form and merely taking full account of the Lorentz invariance. The simplest form of equation is obtained as follows. Let us start from the Dirac equation

$$\gamma^\mu \partial_\mu \psi + k \psi = 0 \quad (\partial_\mu = \partial/\partial x^\mu).$$

It is well known that the Lorentz invariance is not altered if one adds a term of the form $A_{\mu\nu}\gamma^\mu\gamma^\nu$, $A_{\mu\nu}$ being an antisymmetric tensor of second rank. The simplest tensor of this type attached to the particle is obviously $x_\mu \partial_\nu - x_\nu \partial_\mu$. In order to make it invariant also under a change of origin, we take $(x_\mu - b_\mu)\,\partial_\nu - (x_\nu - b_\nu)\,\partial_\mu$, b_μ representing the co-ordinates of a point in space-time, the simplest case again being b_μ = constant. Putting therefore $m^{\mu\nu} = i/2.(\gamma^\mu\gamma^\nu - \gamma^\nu\gamma^\mu)$, the new equation is, in the case of no field :

$$(1) \quad \gamma^\mu \partial_\mu \psi + i\lambda (x_\sigma - b_\sigma)\, m^{\sigma\mu}\, \partial_\mu \psi + k\psi = 0 \qquad (\lambda = \text{real constant}).$$

It is obvious that dual terms in $\gamma^\rho\gamma^\sigma\gamma^\tau$ and $\gamma^1\gamma^2\gamma^3\gamma^4$ could also be added without disturbing the invariance ; but as only the contribution of the $\gamma^\mu\gamma^\nu$ term brings something new, we shall leave them out at the present stage.

The particle defined by (1) has some remarkable properties close to those of Dirac's electron. It has a constant charge, and we may therefore call it a 'particle'. Its main feature is the spontaneous change of energy and momentum. The total amount of energy varies, even in the case of no field and even if the particle is 'at rest' and therefore has a vanishing kinetic energy. As the time passes, the particle loses or gains energy, even when resting, just like, for example, a living organism does. This change is connected with the existence of the new term in the equation and is proportional to the 'age' of the particle and to the constant λ. It can be computed from the expression of the symmetrical energy-momentum tensor[1] $T^{\mu\nu}$, which leads to :

$$\partial_\nu T^{\mu\nu} = 2\lambda (x^\mu - b^\mu)\,(\partial_\rho \psi^* i\gamma^4 m^{\sigma\rho}\, \partial_\sigma \psi),$$

giving thus a physical interpretation of the constant λ.

To define such a particle one must give, apart from its mass, a constant λ *and* a point in space-time b_μ, intrinsically defined as the (chosen) point around which the particle is almost conservative, behaving, in fact, like a classical Dirac electron. To achieve the definition of a particle by giving not only a mass and λ, but also a point in space-time, is most unfamiliar but by no means physically absurd. One can picture, for example, a conservative particle bound to some system and escaping from it at a given moment. If, when escaping from the nucleus (or in general when being created), the particle acquires the non-conservation character, the moment and place where this happens are indeed an essential feature of its definition.

The symmetry of $T^{\mu\nu}$ causes the total angular momentum at the fixed point b_μ to be constant.

λ is not necessarily small, so that the supplementary term cannot be always considered as a small perturbation. In this case one gets interesting results by investigating what happens around a certain point $x^k = a^k$ at a definite instant $x^4 = a^4$, that is by assuming that a^μ = const. The equation is then solved by a plane wave $\psi = A \exp i(p_\mu x^\mu)$, where p_μ is proportional to the energy and momentum.

The classical relation $(W/c)^2 = \vec{p}^{\,2} + w^2c^2$ between energy and momentum is no longer valid ; the new relation shows that, in the Newtonian approximation, the total energy is composed of the kinetic energy arising from the translation movement of the particle, plus a rotation energy, a fact which can be foreseen from the original form of the equation.

Unlike Dirac's case, the quantum mechanical treatment of this particle is essentially one which uses an indefinite metric in Hilbert space[2], as the normalization integral is

$$\int \psi^* [1 + \lambda (x_k - b_k)\, \gamma^k]\, \psi\, d\tau.$$

The Hamiltonian form $\partial\psi/\partial t + iH\psi = 0$ is easily obtained and brings to light the discontinuity sphere $1 - \lambda^2 \Sigma (x_\varkappa - b_\varkappa)^2 = 0$, which plays an important part in the discussion and gives a geometrical interpretation of the newly introduced constant λ.

The striking fact about the above equation is that it follows quite naturally from a straightforward application of restricted relativity to the problem of the electron. This does not mean that it necessarily fits the physical reality, but seems to point towards the fact that its study might be worth while.

I am indebted to Prof. P. A. M. Dirac for invaluable discussion.

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[1] Cf. *Portugaliæ Physica*, **1**, 159 (1943).
[2] Cf. Pauli, *Rev. Mod. Phys.*, **15**, 176 (1943).

'Coloured Anthers': a New Monofactorial Character in Wheat, *T. vulgare*, Host.

IN most bread wheats the anthers are yellow but in occasional lines they are a characteristic purplish-pink colour. During some experiments with hexaploid or *vulgare*-series wheats a cross was made between a yellow-anthered spelt wheat, *Triticum spelta*, L., and a coloured-anthered bread wheat, *T. vulgare*, Host. (*T. spelta* is simply a variety of *T. vulgare* with the '*spelta*' gene or gene block K^s on one of the pairs of chromosomes of the A or B sets instead of the allelomorph *k* for the round type of glume of *T. vulgare*). Of the F_2 plants examined at anthesis, 28 had coloured anthers (*CaCa* or *Caca*) and 13 had yellow (*caca*).

Anthers	Observed (O)	Calculated (C)	O–C	$(O-C)^2$	$\frac{(O-C)^2}{C}$
Coloured	28	30·75	—2·75	7·56	0·246
Yellow	13	10·25	2·75	7·56	0·735
Total	41	41·00	0·00	$\chi^2 = 0{\cdot}981$	

With $\chi^2 = 0{\cdot}981$, for 1 degree of freedom, $P = 0{\cdot}5–0{\cdot}3$, showing a good agreement with a 3 : 1 ratio.

After harvest, of the 41 plants classified, for various reasons only 34 remained which could be classified with respect to the spelta/round glume characters. Classification was not easy as the parental bread wheat line is one which itself has a slightly keeled glume. However, the following results were obtained :

Class	Observed (O)	Calculated (C)	O–C	$(O-C)^2$	$\frac{(O-C)^2}{C}$
Coloured keeled	17	19·125	—2·125	4·52	0·236
Coloured round	6	6·375	—0·375	0·141	0·022
Yellow keeled	10	6·375	3·625	13·14	2·062
Yellow round	1	2·125	—1·125	1·27	0·596
Total	34	34·00	0·000	$\chi^2 = 2{\cdot}916$	

With $\chi^2 = 2{\cdot}916$, for three degrees of freedom, $P = 0{\cdot}5–0{\cdot}3$, showing a good agreement with the assumption that the coloured/yellow anther alleles (*Ca*/*ca*) are monofactorial and independent of the keeled/round glume factors (*KS*/*k*), giving a 9 : 3 : 3 : 1 ratio in the F_2.

The number of simply inherited characters in wheat is remarkably small, so that the present one, which does not appear to have been described before, may prove useful as a marker gene. That other types of coloured anthers may give 15 : 1 or 63 : 1 ratios is quite possible since multiple factors are common in wheat : the character described might well be only one of two or three such allelomorphs.

Classification is good but inconvenient unless the plants can be grown where they may be examined every day. At anthesis there is little difficulty in classifying a plant, though sometimes (in heterozygotes ?) the colour is pale or restricted to the base of the anthers. After shedding pollen, the anther seems to continue drying and become a dirty white colour indistinguishable from that of an old dehisced yellow anther. Thus classification must be done during anthesis. The temperature during development seems to be rather important—all the F_1 plants were grown in a greenhouse, and they, as well as plants from similar crosses and plants from the line of the coloured parent, all had yellow anthers. The F_2 was grown outside, and the cool summer of 1944 was favourable for the expression of the character in these plants and in the parental and similar lines.

Thus the character 'coloured anthers' offers a new allele which, at least in this case, is easily classifiable, is monofactorial and is independent of the keeled/round glume allelomorphs.

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Shape of Sea-Urchins

IN the latest edition of "Growth and Form" (1942), Sir D'Arcy Thompson has directed attention to the analogy between the shapes of drops of such a liquid as *ortho*-toluidine when resting on the bottom of a vessel filled with water, and the shapes of sea-urchins. Thus a small drop remains practically spherical while a large drop spreads itself out, or more or less sags under its own weight (pp. 946–48).

In this way, Sir D'Arcy Thompson seeks to account for the pronounced flattening of some of the sea-urchins while he attributes the marked conical shape of others to the presence of masses of *fatty, oily eggs*, which have a density less than that of sea-water and thus raise the upper surface.

Some recent work carried out at Plymouth, however, would indicate that both these concepts require revision.

It is not denied that a sea-urchin with a very flexible shell might become flattened under its own weight, but flattening does not necessarily imply a non-resisting shell.

One of the sea-urchins recently studied was *Psammechinus miliaris* (Gmelin), which was found to have a density of 1·3457 at 14° C. and to contain 55·5 per cent water. The figures represent the mean of four determinations. One of the chief characteristics of this urchin is its marked flattening, its height seldom exceeding half the diameter. The urchin is, however, remarkably resistant to weight. This was proved by the very simple experiment of placing a specimen, after it had drained on filter-paper for a few seconds, under the right-hand pan of a 5 kilo Oertling balance. Weights equal to 4 kilos were placed on the left pan and two weights each of 2 kilos were placed on the right pan.

On removing the weights carefully from the left pan the right pan rested on the urchin, and it was found that the animal could support the whole 4 kilos without undergoing injury, and since the urchin in question only weighed 19 gm. it was thus supporting more than two hundred times its own weight.

The second concept, namely, that of the upper part of the shell being raised by the presence of ova lighter than sea-water, also requires moderation, for the ova of sea-urchins contain very little fat and at no period of their existence is their density less than that of sea-water. The whole concept of buoyancy by oil drops in sea-water requires revision, for though such oil drops are fairly common their density is usually about 0·9. Thus in marine invertebrates, if the density of calcite is 2·7 and that of silica 2·5, that of chitin 1·4 and of protoplasm itself 1·05, the presence of a small amount of oil or fat with a density of 0·9–0·8 can have very little buoyancy effect. It is very doubtful whether any appreciable buoyancy effect due to fats or oils is to be found except among the mammals. The ova of *Acanthias vulgaris* contain practically 30 per cent fat, but the ova still retain a density of 1·055.

It is true that the flattening might take place during the very early stages of development of the sea-urchins, but at this stage there would scarcely be any pronounced ovaries; and again if these supposedly light ova could lift the upper shell of the urchin, would it not occur in one sex only and thus impress marked sexual dimorphism, which appears to be so markedly lacking among the echinoids ?

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A New Type of the *Salmonella* Genus

IN a previous communication[1], as a matter of preliminary report, a few properties of *S. hormæchei* were described, the antigenic structure of which differed from those of all known types.

This *Salmonella* was isolated by means of Kauffmann's 'combined method' from the ovary of a hen the blood of which gave a positive reaction with the pullorum antigen coloured and dead.

S. hormæchei presents morphological, tinctorial and culture characters, which coincide, except for the slight variations described below, with the bacteria belonging to the *Salmonella* genus. It is mobile. It develops vigorously in the usual culture media. In agar, the culture is adherent. In liquid media, a noticeable turbidity can be observed, which later becomes intense, the sediment is abundant and does not easily disintegrate by agitation. It shows in the liquid mass, as well as in contact with the inner wall of the container, a fine granulation. The formation of a slight superficial veil can be noticed.

It ferments, with the production of acid and gases, dextrose, arabinose, dulcitol, galactose, rhamnose, lævulose, maltose, manitol, manose, sorbitol, trehalose and xylose. It does not attack starch, erithrite, inosite, inulin, lactose, raffinose, saccharose or salicine. It does not produce indol. It does not coagulate milk. It does not produce hydrogen sulphide. It does not liquefy gelatine. It gives a positive reaction with Stern's test; Bitter, Weigmann and Habs media, positive, with dextrose and arabinose; subpositive, with dulcitol and rhamnose; Simmons media, with arabinose, dextrose, dulcitol, rhamnose and citrate, all positive. Positive reaction opposite to *d*-tartrate, mucate, *l*-tartrate, *i*-tartrate and citrate. Reduces nitrates to nitrites; does not hydrolyse urea.

The antigenic structure, which has been studied by means of the 'mirror test', indicates that *S. hormæchei* possess the same antigenic '*O*' thermostable of *S. ballerup*; but on the other hand it has not been possible, at least thus far, to find antigen *Vi*.

The flagellar antigens present special interest, since they are considered to be an antigenic 'mosaic', constituted by two fractions not referred to hitherto, where one of them corresponds to '*H*' antigen specific, which we designate by the symbol Z^{30}, and the other is common with *S. ballerup*; we distinguish it by the symbol Z^{31}. Concerning the latter, researches are being continued. The abbreviated serological formula of *S. hormæchei* is represented in the following form, XXIX.Z^{30}.(Z^{31}).—., where Z^{31} is in brackets in order to show that in certain circumstances it may be lacking. Inoculations in mice, guinea pig and rabbits, by the oral, subcutaneous and intraperitoneal routes, have not caused death in any case.

S. hormæchei corresponds to the second new type of *Salmonella*, isolated and classified in Argentina by me, the first having been *S. bonariensis*.

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July 4.

[1] Monteverde, J. J., *Nature*, **149**, 472 (1942).

Collapse of Determinism

Now that this subject has been raised again in these columns[1] I should like to ask a question which puzzles the 'everyday' physicist who is paid to keep his feet on the ground.

In his Guthrie Lecture, Prof. Whittaker, after discussing hidden parameters in relation to the reflexion or transmission of light, says: "Thus the choice between the alternatives of transmission and reflexion at the Nicol is truly indeterminate, so far as individual photons are concerned, and is qualified only by a statistical regularity when great numbers of events are considered" (that is, $\cos^2 \varphi$ of the intensity is transmitted and $\sin^2 \varphi$ reflected).

My difficulty is that if the final result of, say, one million, or billion, photons is regular (that is, determined), then how can the choice of any (except the first few) be individually indeterminate ? Surely there must be some influence set up by the first 999,000 photons which will bias the indeterminate motion of the last 1,000 in order to balance the statistical result if the first arrivals have been a little too free with their indeterminacy. The introduction of a certain experimental error in measurement of the intensity does not affect the argument.

The difficulty is so obvious that I feel one has the right to demand a *simple* explanation to clear it up. It is independent of any particular knowledge of photons or of the mathematics of indeterminacy.

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Whiteleaf,
Via Aylesbury, Bucks. Oct. 11.

[1] *Nature*, **154**, 464 (1944).

FOR a profound study of the question of determinism in physics, reference may be made to Prof. J. von Neumann's "Mathematische Grundlagen der Quantenmechanik", p. 157 *et seq.* I doubt if any very simple treatment can be quite rigorous; but in connexion with Mr. Barkas's point, the following line of thought might be profitable. If a coin is tossed a thousand times and the number of occurrences of heads recorded, and if this experiment is repeated a very great number of times, there will be a statistical regularity in the records, which may be calculated by the ordinary theory of probability. Does the calculation at any stage involve the assumption that the tossing of coins is crypto-deterministic, or does it involve only the assumption (as regards the tossing) that there is symmetry in the system, so that there is no reason to expect heads rather than tails in a single trial ?

E. T. WHITTAKER.

PENICILLIN TREATMENT

A SPECIAL issue of the *British Journal of Surgery* (32, 105–224, 1944. 12*s.* 6*d.* net) is devoted to reports by British and United States medical men on the treatment with penicillin of battle casualties which has been carried out during the present War. Everybody who is at all interested in penicillin should read this valuable and beautifully produced record. It is only two years, Major-General L. T. Poole explains in his foreword, since Sir Howard Florey offered to the British War Office a small quantity of penicillin for trial in the Middle East. This was successfully flown out there, in spite of the difficulties of communications at that time. The strength of the first batches received by the Army varied from 30 to 40 Oxford units per mgm. Nowadays some of the preparations used have a strength of about 1,600 units per mgm. This is one measure of the progress made in this short period. The progress in production may be gauged by the fact that the Penicillin Team sent to North Africa in May 1943 was equipped with ten million units, whereas later it was possible to send by air regularly to Italy twenty million units a day.

Penicillin treatment is not, of course, to be lightly undertaken. Everywhere in this record of its use the necessity for the training of teams of workers for its application is emphasized. Sir Howard Florey and M. A. Jennings deal with the general principles of the treatment. They summarize the properties of penicillin, which Sir Howard Florey has already described in *Nature* (Jan. 8, p. 40, 1944). Modern methods of its administration are less well known and are here described by Sir Howard and M. A. Jennings and by other contributors. The rapid absorption and elimination of penicillin must always be borne in mind. Relatively large doses must be given and these must be frequently repeated. A continuous concentration of the drug must be maintained in contact with all the infected tissues. For systemic administration penicillin is usually given by intramuscular or subcutaneous injection. After intramuscular injection the maximum concentration in the blood is reached after fifteen minutes, so that little is gained by intravenous administration. Absorption from subcutaneous injection is somewhat slower. Excretion in the urine begins as soon as the penicillin reaches the blood. As a rule, in the fourth hour after a dose of 15,000 units, a bacteriostatic concentration no longer exists in the blood, so that the dose should be repeated every three hours. Excretion is so rapid that there is probably no advantage in increasing the dose of 15,000 units originally established by the Floreys as the generally effective dose. The same total dose can be given by a continuous intravenous or intramuscular drip or by continuous subcutaneous infusion. For local administration, penicillin in the form of a powder, a solution or in creams can be used. Brigadier R. W. Mackenna (*The Lancet*, 314, Sept. 2, 1944) has devised a dosimetric spray for the treatment of skin diseases.

Because penicillin must be brought into contact with every part of the infected tissues, all dead tissue must be removed. Penicillin is not, therefore, a substitute for surgery, and most of the surgeons contributing to this symposium emphasize this fact. For the same reason too much should not be expected from it when certain kinds of severe injury are being treated. Major R. Furlong and Major J. M. P. Clark, for example, reporting on the treatment of open fractures of the femur, conclude that the penicillin treatment given by them did not control sepsis fully; but this kind of battle casualty presents the surgeon with great difficulties. It may, for example, be difficult to obtain adequate drainage of all parts of such extensive and complex injuries as these, and, as the authors remark, "penicillin cannot be expected to clean Augean stables". Lieut.-Colonel Jeffrey, who succeeded Lieut.-Colonel Ian Fraser as penicillin surgical officer in North Africa and Italy when the latter was invalided home, reports, however, in his article on battle fractures in Italy, that penicillin, in his experience, very largely controlled the infection. Without the assurance that this would be so, the necessary radical surgical treatment would not have been justified in such cases as compound fractures more than twelve hours old. The authors of both these articles on battle fractures record a reduction of mortality and fewer losses of limbs as the result of the use of penicillin.

The hastening of healing by early closure of the wound and the instillation of penicillin through fine rubber tubes placed in the wound is discussed by Lieut.-Colonels F. H. Bentley and J. J. Mason Brown. Photographs illustrate the method of doing this. Penicillin may also be injected with a needle. Like some other substances, penicillin passes only slowly from the blood into the cerebro-spinal spaces, and into the pleural and probably the joint cavities also. For meningitis, Sir Howard Florey and M. A. Jennings state that intrathecal injection by the lumbar route or into the lateral ventricles of the brain is most effective. Fleming and others have shown that this method maintains a bacteriostatic concentration in the cerebro-spinal fluid. The article by Brigadier Hugh Cairns deals with this method for the treatment of wounds of the head and spine, to which penicillin can be applied either as a powder, as a solution instilled through rubber tubes in the wound, by systemic routes or by injection of it by the lumbar route or into the lateral ventricles of the brain. Sulphadiazine or sulphamezathine are, he says, useful additional means for the prevention or prophylaxis of meningitis. One is reminded here of the claims made by some Russian workers that tetanus can be successfully treated by a similar injection of tetanus antitoxin into the lateral ventricles of the brain and the cerebrospinal spaces, the so-called blood-brain barrier being thus overcome. Brigadier Cairns, like his colleagues, emphasizes the need for "careful surgical toilet" in addition to the penicillin. Two articles describe the use of penicillin for treatment of wounds of the chest, and the value of penicillin is agreed, although its value for cases of hæmothorax is less certain.

The two articles on the treatment of gas gangrene indicate that more work is required on the treatment of this condition with penicillin. In one of these articles, which is illustrated by photographs in colour of the progress of battle wounds, Col. Elliott C. Cutler and Major W. R. Sandusky, United States Army, record that penicillin did not prevent the development of gas gangrene in seven cases treated locally and parenterally. This number of cases is, they conclude, too small to enable them to assess the real influence of penicillin on gas gangrene, but they think that surgical treatment is the main factor in the prophylaxis and treatment. Lieut.-Colonel J. S. Jeffrey and Major Scott Thomson report on thirty-three cases of gas gangrene in Italy and conclude that penicillin was definitely useful. The causative organism in Italy was *Cl. welchii.*

The use of penicillin for the treatment of venereal disease is described in two articles. Major J. N. Robinson, United States Army, concludes that "penicillin is the most effective agent we have for treating all types of gonorrhœa. If the supply were unlimited, it would be the therapy of choice". Lieut.-Colonel D. M. Pillsbury and Major C. S. Wise, United States Army, report their confirmation of earlier work which showed that penicillin rapidly kills the spirochætes which cause syphilis and causes early regression of syphilitic symptoms; the immediate effects of penicillin are, they think, better than those of the arsenical preparations. The bibliography, which contains, the editors say, references to all the previous published work on penicillin, refers to work on other spirochætal infections, such as relapsing fever.

The low toxicity of penicillin, especially of the purer forms of it now available, is one of its most remarkable features. It is almost certain, say Sir Howard Florey and M. A. Jennings, that such clinical reactions as are seen in some cases are due to the impurities which are present in all preparations of penicillin. There is all the more reason for the warnings which have been issued against the use of 'home-made penicillin' and preparations of other fungi. One of the outstanding features of this symposium is, indeed, the insistence in more than one article of the need for careful technique, which should be carried out by specially trained teams, and for the control of the treatment by the bacteriologist. Penicillin has, moreover, certain definite limitations which are indicated by Sir Howard Florey and M. A. Jennings and by Lieut.-Colonel J. S. Jeffrey. Certain organisms are resistant to it, nor can penicillin act on organisms susceptible to it when these are in dead tissue or in the centre of abscesses or masses of pus; it cannot affect bacterial toxins either. Ignorance or neglect of these facts, inadequate dosage and lack of proper supervision of the technique may result in disappointment. There has, however, been little tendency to neglect adequate surgery or to rely too much upon penicillin. The bacteriological control necessary is well described by Prof. L. P. Garrod and N. G. Heatley in their account of the diagnosis of bacteria in wounds, of the standardization of the Oxford unit (the unit of potency) and the methods of assay of penicillin used for treatment or present in exudates or in the blood or other body fluids.

Major Scott Thomson describes the bacteriological examination of wounds treated with penicillin. "Exacting to handle and unstable though it may be," say Sir Howard Florey and M. A. Jennings, penicillin should not fail if it is given continuous contact with the tissues involved. This is the surgeon's problem and often it is not an easy one. The three main uses of penicillin, Lieut.-Colonel J. S. Jeffrey concludes, are to prevent infection soon after the infliction of the wound (in the forward areas), to control it during the first two weeks (at the forward base hospitals) and to combat infection in the later stages. The routine use of penicillin, he says, saves lives and minimizes functional disability and loss of man-power; it allows more rapid healing than has been possible before. It may therefore be especially useful, as Major-General L. T. Poole points out, to airborne troops, who may have to wait some time before the main forces fighting towards them can evacuate their wounded.

Future work, says Major-General Poole, will seek corroboration of the results already obtained and will tackle the problems which this work has raised. For this the continuation of the existing collaboration of chemists, pathologists, bacteriologists, clinicians and surgeons will be required. The collaboration here recorded between British and United States workers reminds us of the debt we also owe to others in the United States who have helped British workers to produce penicillin in such quantities that we can all now share its benefits. In Great Britain this debt is freely acknowledged. It is but one more instance of that co-operation of the English-speaking peoples which has done so much all over the world for the control of all kinds of human disease.

Since the above was written, a number of articles on penicillin have appeared which are related to several of the points mentioned.

The Lancet (348, Sept. 9, 1944), in a valuable annotation on penicillin, discusses the production of penicillin and the regulations which now control the manufacture of penicillin crude filtrate, dried crude filtrate and purified penicillin in the form of its sodium salt, and the good results which have been obtained with crude filtrates. The new regulations do not prevent any hospital from preparing penicillin for its own use. *The Lancet* refers to the full account of the preparation and properties of crude penicillin given by A. M. Fisher (*Bull. Johns Hopkins Hosp.*, **73**, 343; 1943). In the same issue (page 336), I. W. J. McAdam, J. P. Duguid and S. W. Challinor describe the types of apparatus for continuous or three-hourly administration of penicillin. G. V. Osborne (*The Lancet*, 407, Sept. 23, 1944) describes an apparatus for administration by continuous ultra-muscular drip. Dr. C. A. St. Hill (*Brit. Med. J.*, 631, Nov. 11, 1944) describes an apparatus, easily made from routine pathological equipment, for subcutaneous or intra-muscular administration of penicillin to infants and young children.

The 'mega unit' of penicillin, which represents a million Oxford units, is discussed in *The Lancet* (522, Oct. 21, 1944); it is used only for ordering supplies in order to obviate the necessity of writing out hundreds of thousands of Oxford units and confusion with the American billion, which is only a thousand million. The international uniform standard and unit of penicillin agreed upon at the recent conference of the Health Section of the League of Nations are described in the *British Medical Journal* (572, Oct. 28, 1944, and *The Lancet*, 574, Oct. 28, 1944).

Lieut.-Colonel J. W. Bigger (*The Lancet*, 497, Oct. 14, 1944; see also p. 508) has described a method of alternately giving and withholding penicillin for infections with *Staphylococcus pyogenes*, based on his view that penicillin acts on bacteria at the time of their division and also actually kills staphylococci. A. M. Fisher (*loc. cit.*; see also *The Lancet*, 348, Sept. 9, 1944) found that it is bactericidal to *S. aureus*. Lieut.-Colonel Bigger believes that the few staphylococci which survive the penicillin do so because they are in a non-dividing phase. He calls them 'persisters', and his method aims at killing them when the penicillin treatment is recommenced.

W. McKissock, V. Logue and I. Bartholomew (*Brit. Med. J.*, 551, Oct. 28, 1944), reporting on the local penicillin treatment of battle wounds of the head, emphasize the need for asepsis.

In view of the desirability of finding some method of slowing down the rapid excretion of penicillin, the work done by K. H. Beyer and his colleagues (*Science*, 100, 107; 1944; see *The Lancet*, 542, Oct. 21, 1944), which indicates that intravenous administration of *p*-amino-hippuric acid delays the renal excretion of penicillin, merits further trial.

Lieut.-Colonel Bigger (*The Lancet*, 400, Sept. 23, 1944) claims that penicillin is, contrary to the statement made about it by many writers, inactivated by human blood or serum. The degree of inactivation varies, however, considerably with different specimens of serum and is much greater at body temperature than at lower temperatures. It may lead the bacteriologist to under-estimate the amount of penicillin in the serum of a patient, particularly when the concentration is low. Inactivation *in vivo* is probably chiefly important in cases in which the excretion by the kidneys is slow. The author, discussing the fact that penicillin is excreted chiefly by the kidneys, refers to Sir Howard Florey's comparison of the struggle to maintain an adequate concentration of penicillin in the blood to efforts to fill a bath while the plug is out. If, Colonel Bigger says, penicillin is constantly being inactivated by the plasma, we should add to this comparison a running cold tap and, in view of the difficulties of supply, a boilerman highly conscious of the need for fuel economy. The author also discusses the work of C. H. Rammelkamp and S. E. Bradley (*Proc. Soc. Exp. Biol. and Med.*, 53, 30; 1943), who found that the administration of 'Diodrast' (B.P. diodone) delays the excretion of penicillin.

Marie Kalisova (*Brit. Med. J.*, 597, Nov. 4, 1944) describes "the dramatic effect of penicillin on what would otherwise have been a hopeless case of acute appendicitis" in a child aged four. The penicillin was introduced directly into the peritoneal cavity, and by repeated aspirations of exudate from this cavity and its replacement by penicillin the patient's condition improved and his life was saved.

G. LAPAGE.

ANTISEPTICS

THE first Lister Memorial Lecture of the Society of Chemical Industry was delivered on November 9 by Sir Alexander Fleming, of St. Mary's Hospital, London, at the University of Edinburgh; the title of Sir Alexander's address was "Antiseptics".

Lord Lister, in his epoch-making work, used carbolic acid as an antiseptic in surgery. This had the advantage of attacking all microbes equally, but the disadvantage of being poisonous to man and of destroying the leucocytes or white corpuscles of the blood which themselves act as the chief weapon in the body's own antiseptic armoury. The latest antiseptics, on the contrary, have a much greater effect against certain bacteria but are less destructive to leucocytes; the antibacterial to antileucocytic ratio of penicillin is 250,000, of sulphanilamide 1,000, but of carbolic acid only ½.

Sir Alexander Fleming described his discovery of penicillin in 1929. There had been nothing in the literature to make anyone suspect that a substance with the chemical constitution of penicillin would have antibacterial value. The discovery had to come by chance, and it was his good fortune that the chance had presented itself to him. While working on quite a different subject he noticed that a mould (later proved to be *Penicillium notatum*), growing as a contamination on a culture plate, made a noteworthy change in colonies of staphylococci on the plate. Thanks to his long interest in antiseptics and to his previous discovery of the natural antiseptic, lysozyme, Sir Alexander kept the plate for examination instead of throwing it away as many bacteriologists must have done before. The lapse of ten years between his discovery of penicillin and its preparation in a concentrated form suitable for therapeutic trial by the Oxford workers was due to the difficulty of concentrating and purifying it. This was a chemical problem. He himself was a bacteriologist.

It is calculated that pure penicillin, even if diluted to 1 in 50 million or more, will inhibit the growth of staphylococci, the common microbe of boils and carbuncles. On the other hand, it is so non-poisonous that, so far as Sir Alexander is aware, no one has yet had enough to poison a man. Like the sulphonamides, it is very specific, affecting certain microbes but having little or no action on others. It seems unlikely that we shall ever get an antiseptic which will affect all microbes without being poisonous to some human cells, but we shall have to arm ourselves with a series of chemicals covering the whole range of microbic growth. This will make it more difficult for the medical man; he will have to pay more attention to bacteriology than heretofore.

Penicillin is not perfect. For one thing, it is so rapidly destroyed in the stomach that it cannot be given by the mouth. There is still scope for the chemist to synthesize it, and then tinker with the molecule so that the imperfections can be remedied. There are thousands of other micro-organisms which may be capable of manufacturing even better antiseptics than penicillin, or ones which might give a clue to the chemical linkages responsible for the destruction of bacteria. The work is not finished—it is just beginning—and it is for the chemists now to carry it further.

THE SCOTS PINE (*Pinus sylvestris*)

By ALEXANDER L. HOWARD

I remember, I remember,
The Fir-tree dark and high.
I used to think their slender tops
Were close against the sky.

THOMAS HOOD.

THIS tree, which is often incorrectly called 'fir' or 'Scotch fir', is a native of Britain, and the most important of our coniferous trees. From earliest days magnificent pine forests have grown in the Scottish Highlands where, as the Rev. C. A. Johns says, the seeds have been carried far and wide by the violent winds which are prevalent in that country, and also by rooks who are "Nature's planters of Pine Woods".

Gerard (1545–1612) speaks of these trees as

"growing in Cheshire, Staffordshire, and Lancashire where they grow in great plentie, as is reported before Noah's floud, but then being overflowed and overwhelmed, have been since in the mosses and waterie moorish grounds, very sound and fresh until this day; and so full of resinous substance that they burn like a torch or linke, and the inhabitants of those countries do call it Firre Wood and Fire woode unto this day."

Some people consider the Scots pine an uninteresting tree, and it is true that when reared under modern conditions in regular rows the conventional habit of its growth is apt to destroy its decorative value.

When planted with other trees it stands out conspicuously; but probably to appreciate its beauty to the full it should be seen as so many famous artists loved to paint it, in a group standing on high ground, thus outlined against the sky.

Under good conditions the Scots pine grows with great rapidity, reaching a height of about 100 ft., a clean bole of 70–80 ft., with a girth of 10–11 ft.

The bark is tough and fissured; the lower part of a dark reddish-brown, and the upper smoother and bright red. In early life the thick bushy foliage grows in pyramidal form flattening out later into tiers of irregular shape.

Johns tells us that in the Highlands of Scotland

"almost every district bears the trace of the vast forest with which at no very distant period, the hills and heaths were covered . . . on the South of Ben Nevis a large Pine forest . . . was burned to expel the wolves."

One wonders whether Robert Bridges had made a study of scientific forestry when he wrote:

"His spear, to equal which the tallest pine hewn on Norwegian hills . . . were but a wand."

However that may be, it is a fact that in Norway, Sweden, Finland and Russia the Scots pine has played the most important part in the economic history of these countries; especially in Russia has the subject received intense study, and been given every scientific assistance, but unfortunately the same cannot be said of Great Britain, with the exception of some effort since the establishment of the Forestry Commission.

It is not surprising, therefore, that the quality of British-grown pine has been found generally very inferior to that imported from these other countries. Whereas in the U.S.S.R. an excellent system of grading has been adopted, in most other places either little attention has been paid to the question, or conditions do not allow of much variation, for the general quality of the timber is fairly uniform, and up to now could not be classed in a high grade. The variation in England, however, is considerable, some districts producing excellent timber while others only poor quality.

Lord Sackville told me that one of his ancestors three hundred years ago brought from Memel Scots pine planks to provide floors for the long galleries at Knowle Park, Sevenoaks, as the trees growing on his own land, though abundant, were of poor quality.

In the time of Samuel Pepys, Scots pine was only imported in one dimension—three inches by nine inches and 12 ft. in length. These were termed 'deals' in England; other sizes were termed 'planks', 'battens' and 'scantlings'. Curiously enough, whereas the other terms were never adopted except for their real meaning, the word 'deal' became known to describe any kind of coniferous wood regardless of size, the name being still used wherever English is spoken.

Samuel Pepys, under date of October 18, 1664, records in his Diary:

"Thence to the Exchange, and so home to dinner, and then to my office, where a full board, and busy all the afternoon, and among other things made a great contract with Sir W. Warren for 40,000 deals Swinsound, at £3.17/– per hundred."

One hundred deals of similar character would cost to-day £69 17*s*. Swinsound was a port of Norway, about a mile from Fredrikshald, close to Frederikstadt, and now called Halden. The deals were hand-sawn and of superior quality. Norwegian imports, under the name of 'Christiania', continued, and the name 'Christiania deals' was still in use up to 1939. Probably the last shipment into England was in 1878, after which Norwegian supplies failed. From this time forward importations from Sweden, Finland and Russia increased in volume year by year; later supplies were received from Canada, America, southern Europe and Poland. All these revealed an ever-growing destruction of the larger trees. For several years after 1878 shipments consisted of more than 75 per cent of sizes 3 in. by 9 in. and larger, with only 25 per cent of smaller dimensions, but by the year 1939, except for the U.S.S.R., only 15–20 per cent could be obtained of the larger sizes. While with the Russian a better average of large sizes was maintained, not more than one piece in five was free of the centre, whereas in earlier years only one centre piece would be found with four or five quite free. Throughout, the inclusion of sap wood has greatly increased, and scantling sizes are almost all sap wood. The foregoing is a clear indication of the manner in which the forests are being exhausted.

In 1937–38 we expended the immense sum of £51 million on importations from Sweden, Norway, Finland, the U.S.S.R., Esthonia, Latvia, Lithuania, Poland, Yugoslavia and Rumania, the principal of which was Scots pine. This was used for joists, beams, rafters, flooring, etc., and the better qualities for joinery work, doors, window-frames, shelves and cupboards, etc. Prior to this War (1939) trees grown in Great Britain were used only for rough work such as gates and fences, and for estate purposes, but lately so great has been the demand that what was once considered inferior is now regarded of great value. Bearing in mind the vast building operations which will be necessary for many years after the War, Scots pine will be more than ever in demand, and should be planted freely in all suitable areas where the climate and soil are congenial, and reared on the most scientific principles of forestry, in order that the quality may be improved.

PRINCIPLE AND PRACTICE IN VEGETATIVE PROPAGATION

PRACTICES of vegetative propagation of plants, originated in antiquity, and used without change for many centuries, have probably received a greater inspiration from modern science than any other of man's ancient occupations. The discovery of plant hormones made it possible to propagate species which had previously defied the greatest horticultural skill. There are, however, many other factors which have recently been passed in masterly review by R. J. Garner*.

Although the title of the pamphlet places special emphasis on pome and stone fruits, the work includes consideration of a wide variety of plant species, and certain generalizations are possible. New growth is a better source of cuttings than older material, and the presence of abundant stored carbohydrate food also assists this form of propagation. Indeed, soaking cuttings in sugar solution has often induced rooting. Lateral shoots are superior to terminals, and basal

* Imp. Bur. of Hort. and Plantation Crops. (Tech. Comm. No. 14.) Pp. 1–79. (I.A.B. Central Sales Branch, Agricultural Research Building, Penglais, Aberystwyth, Jan. 1944.) 3*s*. 6*d*. net.

cuttings root best. "The time of taking cuttings should be governed by the condition of the material rather than by the calendar." Various methods of application of synthetic hormone substances are described and, although these still give varying results, they represent by far the greatest single advance in technique. The effects of temperature, moisture and light form an interrelated complex, which should be determined for each species. Wound stimulation can increase rooting response; leaves are generally necessary, but flowers are a hindrance to regeneration.

Rooting media must be well aerated, but must also hold sufficient moisture; peat is considered to provide rooting stimulants, possibly of hormone nature. Some stem cuttings root better after an initial period of inversion, while some root cuttings regenerate better if the proximal end is above the compost. The presence of nitrogen hinders the rooting of normal plants, but nitrogen-starved growth may occasionally be stimulated to root by treatment with suitable nutrient solutions. Layering and marcotting (aerial layering) appear to depend for their full success upon some form of constriction or ringing which presumably increases the carbohydrate in the parts which are to root. Mr. Garner finally discusses the application of principles revealed by his survey to the practices of propagating fruit trees in use at the East Malling Research Station. Many orchards and nurseries are at present in bad condition because of the War, and Mr. Garner's publication has the objective aim of demonstrating the best methods for their restoration when peace returns.

GROWTH OF CEREAL EMBRYOS

SINCE the pericarp in a cereal such as barley is semi-permeable, during the first period of germination the embryo is exposed to a low level of water and oxygen availability (0·1 atm.) and a relatively high carbon dioxide concentration (0·1 atm.) (R. Brown, *Ann. Bot.*, N.S., 93 and 275; 1943). In contrast, when excised embryos are being cultured, as in attempts to elucidate some of the problems of vernalization and kindred phenomena, the young plants are being started under conditions of high water and oxygen availability. Whether grown on water or culture solutions, such isolated embryos always show an immediate drop in dry weight, followed by a slower loss over at least the first twelve hours, suggesting a leaching effect followed by a rather higher rate of respiration than in the embryos of intact grains.

The change-over from a dormant embryo with dense non-vacuolate cells to a seedling in a fully active state seems to occupy about the first seventy-two hours, since after that time the water content remains constant. Although the food reserves in the endosperm are not available to the young plant during the first twenty-four hours of germination, excision within the first twelve hours of germination affects the linear and dry-weight growth, suggesting either that some substance is being absorbed (a hormone?) or that the internal carbon dioxide concentration has a stimulating effect, either directly or by altering the acidity of the environment. When the carbon dioxide concentration is high, as in an intact grain, a low level of water-availability stimulates the linear and dry-weight growth of the embryo, either when attached or when growing on a nutritive medium. On the other hand, linear and dry-weight growth do not appear to be influenced by changes in oxygen concentration provided it is above about 15 per cent.

"Each of the factors considered above tends to be at a level inside the seed which, relative to the incident level of the same factor outside the seed, stimulates the subsequent growth of the seedling"; and there is probably "a high degree of instability in the metabolic pattern of the embryo . . . subject to modification according to the nature of the environment in which early development occurs".

FORTHCOMING EVENTS

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

Saturday, November 25

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (joint meeting with the SCIENTIFIC AND TECHNICAL GROUP OF THE ROYAL PHOTOGRAPHIC SOCIETY) (at 16 Princes Gate, South Kensington, London, S.W.7), at 3 p.m.—Mr. G. Parr: "The Electron Microscope"; Dr. E. M. Crook, Miss F. M. L. Sheffield and Mr. L. V. Chilton: "Photographic Materials for use in the Electron Microscope"; Dr. D. G. Drummond: "Electron Micrography of Textiles".

Monday, November 27

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. S. J. Folley: "Milk", (2) "The Hormonal Control of Lactation" (Cantor Lecture).

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, South Kensington, London, S.W.7), at 5 p.m.—Mr. C. Hope Gill: "The Hadhramaut" (Kodachrome Film).

BRITISH INSTITUTION OF RADIO ENGINEERS (LONDON SECTION) (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6 p.m.—Mr. E. R. Friedlander: "Magnetic Dust Cores".

INSTITUTION OF ELECTRICAL ENGINEERS (LONDON STUDENTS' SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 7 p.m.—Mr. W. A. Hatch: "Some Hydro-Electric Possibilities and Achievements".

IRON AND STEEL INSTITUTE (joint meeting with the SHEFFIELD BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN) (at the Royal Victoria Hotel, Sheffield), at 7 p.m.—Mr. B. Gray: "The Side Feeding of Steel Castings—a Note on the Influence of the Mechanism of Freezing".

Tuesday, November 28

BRITISH PSYCHOLOGICAL SOCIETY (INDUSTRIAL SECTION) (at the National Institute of Industrial Psychology, Aldwych House, Aldwych, London, W.C.2), at 12.45 p.m.—Prof. E. A. Bott: "Some Problems of Selection and Training in War and in Peace" (followed by Questions and Discussion).

ROYAL ANTHROPOLOGICAL INSTITUTE (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 1.30 p.m.—Prof. V. Gordon Childe: "Archæological Ages as Technological Stages" (Huxley Memorial Lecture).

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2 p.m.—Mr. C. Culpin: "Machinery for Crop Cultivation".

CHADWICK LECTURE (at the Sir Edward Meyerstein Lecture Theatre, Westminster Hospital Medical School, 17 Horseferry Road, Westminster, London, S.W.1), at 2.30 p.m.—Mr. J. A. H. Brincker: "Research in all its Various Aspects Essential for the Promotion of Health and the Prevention of Disease" (Malcolm Morris Memorial Lecture).*

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 5.15 p.m.—Mr. F. C. Bawden: "Plant Viruses and Virus Diseases", (ii) "The Properties of Purified Plant Viruses".

ROYAL STATISTICAL SOCIETY (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 5.15 p.m.—Sir William Elderton: "Cricket Scores and Some Skew Correlation Distributions (An Arithmetical Study)": Mr. George H. Wood: "Cricket Scores and Geometrical Progression".

INSTITUTE OF PETROLEUM (at 26 Portland Place, London, W.1), at 5.30 p.m.—Reception to the Visiting Indian Scientists, when addresses will be given by Sir Shanti S. Bhatnagar, F.R.S., and Prof. J. N. Mukherjee.

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Mr. A. Shaw Maclaren: "The Design of Land Airports for Medium and Long Distance Civil Air Transport".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. E. Leslie Champness: "University Education in Shipbuilding and Naval Architecture".

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield 1), at 6.30 p.m.—Mr. H. O. Howson: "The Formation of Banded Structures in Centrifugal Casting".

Wednesday, November 29

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Brigadier L. E. H. Whitby: "The Army Blood Transfusion Service".

BRITISH INSTITUTION OF RADIO ENGINEERS (MIDLANDS SECTION), (in the Latin Theatre, The University, Edmund Street, Birmingham), at 6 p.m.—Mr. G. F. Knewstub: "The Super-regenerative Detector".

INSTITUTE OF WELDING (at the Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1), at 6 p.m.—Mr. M. Riddihough: "Hardsurfacing by Welding".

OIL AND COLOUR CHEMISTS' ASSOCIATION (at the Grand Hotel, Manchester), at 7 p.m.—Mr. G. A. Campbell and Dr. T. F. West: "DDT, the New Insecticide—a General Survey and some possible Paint Applications".

Thursday, November 30

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 2.30 p.m.—Prof. James Gray, F.R.S.: "Locomotory Mechanisms in Vertebrate Animals", (ii) "Transition from Water to Land—Origin of the Limb with Five Digits, Its Development for Propulsion and Support".

INSTITUTION OF ELECTRICAL ENGINEERS (INSTALLATIONS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on (a) The Installation Section of the Report on "Electricity Supply, Distribution and Installation", and (b) The Report of the Electrical Installations Committee convened by the Institution on behalf of the Ministry of Works (to be opened by Mr. W. N. C. Clinch).

Friday, December 1

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 6 p.m.—Prof. Herbert Dingle: "Spectrum Analysis".

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. W. S. Graff-Baker: "Mechanical Engineering Problems of London Transport".

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Dr. G. C. McVittie: "The Spiral Nebulæ" (Lectures for the Forces, 1).

Saturday, December 2

INSTITUTE OF PHYSICS (LONDON AND HOME COUNTIES' BRANCH) (at the Royal Institution, Albemarle Street, London, W.1), at 2 p.m.—Conference on "The Selection and Training of Personnel for Industry" (to be opened by Major F. A. Freeth, F.R.S.).

GEOLOGISTS' ASSOCIATION (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. G. M. Lees: "The Geology of the Oilfields of the Middle East".

SHEFFIELD METALLURGICAL ASSOCIATION (joint meeting with the IRON AND STEEL INSTITUTE and the SHEFFIELD SOCIETY OF ENGINEERS AND METALLURGISTS) (at the Royal Victoria Station Hotel, Sheffield), at 2.30 p.m.—Discussion of Papers presented to the Iron and Steel Institute.

APPOINTMENTS VACANT

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

VISITING PROFESSOR OF PHYSICS and VISITING PROFESSOR OF ORGANIC CHEMISTRY in the Farouk I University, Alexandria—The First Secretary, Royal Egyptian Embassy, 75 South Audley Street, London, W.1 (November 30).

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING—The Registrar, College of Technology, Manchester 1 (November 30).

LECTURER (full-time) IN MECHANICAL ENGINEERING—The Principal, Battersea Polytechnic, Battersea, London, S.W.11 (November 30).

LECTURER (man or woman) IN MATHEMATICS—The Registrar, University College, Southampton (December 1).

LECTURER (full-time) IN MATHEMATICS in the Science Department—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham, Essex (December 4).

MECHANICAL ENGINEERS for the Government of Nigeria Public Works Department—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. C.K.2361.A) (December 5).

LOCATION ENGINEER by the Government of the Tanganyika Territory—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. E.1209.A) (December 5).

ENGINEERS (temporary staff) by the Government of Nigeria for the Public Works Department—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. E.1212A.) (December 5).

PHYSICISTS AND RADIO ENGINEERS for Hertfordshire Laboratory of large group of Companies engaged on Radio Telecommunications Research and Development Work—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. A.631.XA) (December 5).

PSYCHOLOGIST AND EDUCATIONAL ADVISER (man or woman)—The Secretary, County Buildings, Shrewsbury (December 6).

RESEARCH BIOCHEMIST in the Department of Pathology in association with the Sheffield Radium Centre—The Registrar, The University, Sheffield (December 8).

ASSISTANT CHIEF ENGINEER in the Chief Engineer's Department—The Clerk of the London County Council, The County Hall, Westminster Bridge, London, S.E.1 (December 9).

LECTURER (full-time) IN MATHEMATICS in the Medway Technical College, Gillingham—The District Education Office, Kent Education Committee, Fort Pitt House, Rochester (December 9).

LECTURER IN AGRICULTURAL ECONOMICS—The Acting Registrar, The University, Leeds (December 9).

SPEECH THERAPISTS (two) in the Hertfordshire School Medical Services—The County Medical Officer, County Hall, Hertford (December 11).

ENGINEER AND MANAGER of the Plymouth Water Undertaking—The Town Clerk, Pounds House, Peverell, Plymouth (endorsed 'Water Engineer') (December 12).

ELECTRO-PLATING CHEMIST for appointment with an established West London manufacturing concern—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. F.2409.XA) (December 20).

MATHEMATICAL PHYSICIST on the Staff of the Division of Radiophysics of the Council for Scientific and Industrial Research, Sydney—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2 (December 21).

LECTURER IN EXPERIMENTAL ZOOLOGY—The Registrar, The University, Liverpool (January 5).

LIBRARIANSHIP of the Bodleian Library—The Registrar, The University, Oxford (February 3).

RESEARCH CHEMIST, a RESEARCH ASSISTANT FOR MICROSCOPICAL DEPARTMENT, and one or more senior appointments and one junior appointment to the Liaison Department—The Director, British Leather Manufacturers' Research Association, 1–6 Nelson Square, London, S.E.1.

GRADUATE ASSISTANT MASTER qualified to teach Mathematics, Science and Engineering Drawing in the Junior Technical School and National Certificate Classes of the Ashton-under-Lyne Technical School—The Director of Education, 8 Warrington Street, Ashton-under-Lyne, Lancs.

TEACHER OF ENGINEERING DRAWING, with drawing office experience, in the Canterbury Technical Institute—The Director of Education, 78 London Road, Canterbury.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Re-Allocation of Man-Power between the Armed Forces and Civilian Employment during any Interim Period between the Defeat of Germany and the Defeat of Japan. (Cmd. 6548.) Pp. 4. (London: H.M. Stationery Office.) 1*d*. [410

Memorandum on Patent Law Reform. By Joint Chemical Committee. Part 1. Pp. 24. (London: Association of British Chemical Manufacturers.) 1*s*. [410

Institution of Professional Civil Servants. Post-War Reconstruction. Pp. 16. 6*d*. Post-War Reconstruction of the Technical Civil Service. Pp. 4. (London: Institution of Professional Civil Servants.) [510

The Status of Higher Technical Education. By Dr. T. J. Drakeley. Pp. 16. (Loughborough: Association of Technical Institutions.) 6*d*. [610

British Journal of Surgery. Special Issue: Penicillin in Warfare. Pp. 105–224+xxxii. (Bristol: J. Wright and Sons, Ltd.) 12*s*. 6*d*. net. [1110

Production Control in the Small Factory. (Office Aid to the Factory Series.) (B.S.1100: Part 2: 1944.) Pp. 26. (London: British Standards Institution.) 2*s*. [1110

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S.), No. 29: Studies in Peat, Part 13, Mona Wax and its Constituents as Emulsifying Agents. By J. C. Aherne and Dr. J. Reilly. Pp. 300–306. 1*s*. Vol. 23 (N.S.), No. 30: A Rapid Fermentation Method for the Production of Calcium Nitrate and Calcium Gluconate from Beet Molasses. By Oliver Roberts and Diarmuid Murphy. Pp. 307–314. 1*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [1210

Other Countries

Ministry of Public Works, Egypt: Physical Department. Physical Department Paper No. 45: A Short Account of the Nile Basin. By Dr. H. E. Hurst. Pp. iv+77+9 plates. (Cairo: Government Press.) P.T. 40. [59

Indian Lac Cess Committee. Annual Report for the Year 1st April 1942 to 31st March 1943. Pp. 34. (Ranchi: Indian Lac Cess Committee.) [129

Bericht über das Geobotanische Forschungsinstitut Rübel in Zürich für das Jahr 1943. Von E. Rübel und W. Lüdi. Pp. 124. (Zürich: Geobotanische Forschungsinstitut Rübel.) [129

Indian Forest Leaflet No. 63: Studies on Adhesives, Part 9, Tar-Acid-Formaldehyde Resin Adhesives. By D. Narayanamurti and Kartar Singh. Pp. ii+19. (Dehra Dun: Forest Research Institute.) 6 annas; 7*d*. [149

Indian Forest Records (New Series). Utilization, Vol. 3, No. 5: Suitability and Selection of Timbers for Different Uses, Parts 1 and 2. By V. D. Limaye. Pp. ii+34+2+x+15 plates. (Dehra Dun: Forest Research Institute.) 6 annas; 7*d*., each Part. [149

League of Nations: Advisory Committee on Social Questions. Prevention of Prostitution: a Study of Measures adopted or under consideration particularly with regard to Minors. (Official No.: C.26.M.26.1943.IV.) Pp. 182. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 6*s*. [149

Indian Forest Leaflet No. 62: Fireplaces. By J. L. Harrison. Pp. 8+4 plates. (Dehra Dun: Forest Research Institute.) 6 annas; 9*d*. [189

Bulletin of the American Museum of Natural History. Vol. 83, Art. 3: A New Fossil Whale from the Miocene of Peru. By Edwin H. Colbert. Pp. 195–216+plates 11–14. Vol. 83, Art. 4: A Collection of Fishes from the Panama Bight, Pacific Ocean. By John Treadwell Nichols and Robert Cushman Harvey. Pp. 217–260+plates 15–18. (New York: American Museum of Natural History.) [209