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MACHINERY FOR INTERNATIONAL ADMINISTRATION

ONE of the factors directing fresh attention to the Civil Service at the present time is the realization that much of the success of our plans for dealing with post-war problems will depend upon the way in which the Civil Service carries out its new duties and discharges the much more positive functions which are being demanded of it to-day. That was well brought out in the debate in the House of Commons on employment policy, and in the report of the Assheton Committee on the Training of Civil Servants. The machinery of government must be adapted to its new tasks. Some re-tooling may be necessary, and it is at least certain that a large part of the Civil Service will require training for its new functions.

While the machinery of government is being re-examined in this way, the administrative problems of international organization have received comparatively little attention. The effectiveness of any system of world co-operation which may be established will not depend, however, solely on the readiness of the nations to co-operate, and their willingness to ensure that the world organization has adequate force at its disposal. It will depend also on whether the system is administratively sound, not merely in point of theory, but also from the point of view of the men and women who will be called upon to make it work. If it makes demands on their loyalty and integrity that are impossibly severe, the system is doomed to failure as surely as if, for other reasons, it fails to command adequate support.

A modest little study has been issued this year by the Royal Institute of International Affairs which seeks to fill this gap. Under the title "The International Secretariat of the Future", it considers the lessons drawn from experience by a group of former officials of the League of Nations, and indicates concisely the problems which will have to be faced at the administrative level whatever form we may give to the policy-making organ or organs or to the committees advising them, especially in technical matters, in the world organization of to-morrow. It shows clearly how the formulation and execution of policy on an international scale require a machine which is capable of being rapidly extended for special purposes, and of being reduced again, without weakening the machine as a whole, when the special activity is completed. A central and permanent secretariat provides the necessary continuity and accumulation of experience and knowledge ; but the equally necessary power of expansion and contraction depends on the collaboration of Governments.

Discussing the main aspects of the work of an international secretariat and emphasizing that such a secretariat must develop to the full the technique of collecting and using material which is not likely to be generally available, but which, as a servant of many Governments, it has unique opportunities of securing, the question first asked is whether twenty years experience shows that efficient international

action on the service plane is possible. Without claiming perfection for the League's administrative machine, the writers submit it has been decisively proved by experience that an international Civil Service need not be hopelessly handicapped by the lack of a sufficient *esprit de corps*, and that the difficulty of mutual understanding, the clash of traditional systems and the inequalities of administrative experience, need not render the machine inefficient. If there is agreement on policy, an efficient international service can be organized to carry it out.

If an international service is properly instructed either to execute a particular decision or to study a particular question, or if it is performing a recognized routine of work, the fact of its being internationally staffed is no handicap to its complete efficiency. The importance of this conclusion scarcely needs to be stressed. It means that in our planning for world peace we can take it for granted that an efficient international administration can be set up to carry out our plans, provided that in this field, just as in the greater field of policy, we are prepared to create and maintain the necessary conditions.

The discussion of what those conditions are occupies the greater part of this report. Dealing first with the general framework, the statement postulates that the future international organization will be based largely on the concept of sovereign States. The immediate international issue will consequently continue to be how to promote better co-operation among sovereign entities, not how to abolish them. Success in voluntary co-operation may lead States gradually to transfer more aspects of their sovereignty to the international organization than they are at present prepared to do.

Secondly, the practical impossibility of separating the problems of peace and welfare into watertight regional compartments postulates, or at least points to, the need for a world-wide organization. The report admits, indeed, the value of regional organization for certain technical purposes, though no reference is made to such functional regional developments as the Anglo-American Caribbean Commission or the Middle East Supply Centre. It is concerned rather with the danger that crystallization on regional lines may create vested interests and thus obstruct further developments, apart from the more insidious dangers of isolationism and the doctrine of the *Herrenvolk* which regionalism might foster. A world-wide system, starting with the United Nations and expanding rapidly to include neutral countries and ultimately the ex-enemy countries, is regarded as the most probable and hopeful form of post-war international organization.

Thirdly, the report assumes that the international organization will cover political, economic, health, transport, labour and other welfare and technical questions with an international aspect. The writers of the report, from their own experience, fully endorse the argument of M. R. C. Greaves in "The League Committees and World Order", and maintain that unless political and welfare interests mutually reinforce each other even more than did the political and technical activities of the League itself and the International Labour Organisation, each is likely to fail of its full effect. They do not advocate, however, the immediate creation of a unitary and highly integrated organization complete in all its parts. Effective organizations for security and international justice must indeed be linked to welfare organizations, and it is obviously advantageous and economical to provide common legal, information, translating and other services for the various agencies. Accordingly, individual functional organizations would tend to become linked sooner or later in a general organization, comprising at least a central secretariat and an annual assembly in which all participating States would be represented. Furthermore, since progress in welfare matters can only be secured if peace is assured, the primary and essential duty of an international organization must be to check any tendency towards aggression, and if need be to prevent aggression by force.

The core of this report is to be found, however, in the following two sections which deal more specifically with the international secretariat itself. In regard to loyalty, it stresses the importance of breadth of outlook. The report quotes C. W. Jenks, legal adviser of the International Labour Office: "The international outlook required of the international civil servant is an awareness made instinctive by habit of the needs, emotions, and prejudices of the people of differently-circumstanced countries, as they are felt and expressed by the peoples concerned, accompanied by a capacity for weighing . . . these elements in a judicial manner before reaching any decision to which they are relevant". It is pointed out that experience shows that a spirit of international loyalty among public servants can be maintained in practice and is an essential factor in the activity of an international service.

Representation (in the diplomatic sense) and defence of national interests should not be the function of secretariat officials, and assurance that an official will not be penalized if his duties involve an attitude which is contrary to the policy of his own country on a particular issue is a natural corollary of demanding international loyalty from the service. This point is of particular importance in view of the recommendations in the recent report on the Training of Civil Servants and elsewhere, that selected officers should be seconded for duties with international bodies as one means of redressing the neglect of the experience of other countries which has characterized the British Civil Service. Officials seconded to an international service are particularly vulnerable in this respect.

There are other sound observations on this question of national representation. A system which depends upon the co-operation of member States cannot ignore the factor of national prestige and interest. Representation of all the member States is desirable in itself, both for the contacts it establishes and because it assuages the legitimate desires of Governments; but it ceases to be so unless each official can be usefully employed. It is an important principle that everybody in the service should have constructive work to do, and this principle must be served even if time is required before the expansion of the service

permits full representation on this basis. Beyond this the career must be made as attractive as possible for able persons, and the usual Civil Service principles of permanence, promotion for merit and pension on retirement must be adopted. Similarly, in interchange of personnel between the international and national services, seconding should favourably affect the individual's career in his own service and involve no diminution of his accumulated rights.

The application of these principles, however, must stop short of the highest posts. It should not be made impossible for an exceptionally qualified member of the service to reach these posts, but fresh recruits and interchange of nationals are here of overriding importance. Appointments to the highest posts should be for a limited period, such as seven years, and renewable only in exceptional cases. These responsible posts will be few in number and will command a high premium. A number of them would be reserved in practice for certain nationalities, but while political considerations cannot be entirely disregarded in making such appointments as the head of the service and his deputy, their effect, if possible, should be limited to the enforcement of a wise compromise between the reasons militating in favour of appointing nationals of major or of smaller powers, respectively, to these and other posts in the higher directorate. Apart from other qualifications, moreover, the high officials must be able and willing to work as a team with those above and below them in the service.

It is not easy to define, the report admits, the qualities which the head of the service should possess. He should be young. Political or diplomatic experience, but not necessarily great fame or eminence, is an advantage. Ability for administration in the broadest sense is important, implying a knowledge of when to be dynamic, to take the initiative and to force an issue; when, at the other extreme, to be content as an administrative official; and when, on a middle course, to be a moderator, impartially smoothing over difficulties. These same considerations will apply largely to other members of the high directorate, and in a new organization the only indispensable qualities of the director may well be common sense, courage, integrity and tact.

The central and essential point is that the head of the service and his staff must win the confidence of the member States, and of the policy-making organs which they may set up. In winning this confidence, the abilities and personal qualities of the officials may be as important as the existence of a proper framework within which to operate. As much care must be exercised in selecting the proper people to run the machine as is exercised in creating it; for if able men are not secured, little advance will be effected in world welfare and security however carefully the machinery be planned.

Among the ancillary problems considered in this report is the work of an information section and relations with the Press; and more detailed suggestions for a secretariat information section are included in an appendix. Understanding and support by world public opinion are as essential to the success of an international organization as the co-operation of member Governments. This is true for technical as well as for political questions, and effective publicity is a vital function of the international secretariat, which can do much to establish the atmosphere in which effective international action is possible. This, as Mr. Greaves notes, was one of the most valuable functions of the technical committees of the League of Nations. Similarly, good administration helps to create the internal atmosphere which is conducive to the loyalty of international officials; it will attract able persons to service in the secretariat, ensure the maintenance of good working relations with the national civil services, and reduce considerably the difficulties of collecting members' contribution quotas.

The Royal Institute of International Affairs has done a real service in publishing this study. Attention is directed to some of the problems which need examination and to some preparatory steps which may have to be taken before any new international organization is established. Some of these problems are intimately related to proposals for the reform of national Civil Services, as in Britain. Above all, the report gives a clear and affirmative answer as to the possibility of an efficient international secretariat if the right conditions are created and maintained, and it points equally emphatically to the way in which the effectiveness of international organization depends not only on the quality of the machinery but also on the will to use it. Success can be attained only if individual men and women exercise, through constitutional processes, ungrudgingly and resolutely, their will to use and support the organization and instruments of world order.

BIOCHEMICAL CANCER RESEARCH

The Biochemistry of Malignant Tumors

By Dr. Kurt Stern and Dr. Robert Willheim. Pp. xiv+951. (London: Macmillan & Co., Ltd., 1943.) 60*s*. net.

MAINLY because of the practical urgency of arriving at a fuller understanding of one of the most insidious diseases, but also because of the theoretical interest of a problem so closely related to the mysteries of animal growth, cancer research has for many years ceased to be the exclusive concern of the clinician and the morphological pathologist. The methods of biochemistry and experimental biology, in the widest sense of these terms, have been increasingly applied, and these sciences may reasonably claim a large share in some of the most hopeful advances of knowledge which have resulted. At present the major contributions appear to be the chemical carcinogens, the chemistry of tumour growth, the filterable agents of certain fowl and rabbit tumours, and the transmission of mammary cancer in mice by the milk-borne cancer agent: all these owe much to the application of biochemistry. More nebulous at present, but offering glittering prizes for the future, are the similar developments in the immunology and laboratory diagnosis of cancer.

These topics must comprise much of any treatise on the biochemistry of malignancy, and they are all surveyed in the present book. So large is the volume of research on these subjects that they alone could easily fill a book of this size; in fact, it is rather surprising that a symposium of this nature has not been published before. Yet, in addition to these major advances, there exists a vast amount of information about the chemistry of cancer, the significance of which is not yet clear and which cannot at present be fitted into any hypothesis concerning the origin and nature of neoplasia. It must regretfully be admitted that there is also a legacy of many years research, much of which is under the grave suspicion of being completely uncritical and technically unreliable.

The scope of the present book is ambitious, in that it attempts to cover the entire field of biochemical investigations connected with the cancer problem in all its aspects. This is a formidable undertaking, and although the result will scarcely satisfy the specialist in any one branch of cancer research, for whom something on the lines of a symposium seems more or less necessary, the authors fully deserve warm commendation for what is undoubtedly a valuable addition to the literature of cancer. The book is all the more welcome since no such compilation in English was hitherto available.

A word about the origin of the present volume may not be out of place. It is based on the extended text of an earlier (1936) German edition by the same authors, both of whom are known for their work in the University of Vienna upon the so-called 'carcinolytic' reaction of Freund and Kaminer. The fact that this reaction is by no means in general favour nowadays need not prejudice the reader against the book, since it is not at all propagandist for any one theory, and the balance of judgment is fairly held throughout; this particular theory not excepted. The present version covers the literature up to the end of 1941 and partially into 1942; the modernization is the work of Dr. Stern, who, in New York, was unfortunately deprived after 1941 of communication with his co-author in the Philippines. To avoid confusion, it may be pointed out that this Dr. Kurt Stern should be distinguished from Dr. Kurt G. Stern, until recently of Yale University, who has also contributed to the biochemistry of cancer.

The classification of the greater part of this book follows the conventional approach of a text-book of biochemistry, although it will be understood that its scope, presentation, and bibliography make it essentially a reference work. This is illustrated by the references to original publications, which appear as footnotes to each page and number from 250 to about 1,000 per chapter. Those that the reviewer has had occasion to consult were all correctly cited. The headings of the chapters indicate the wide variety of topics: inorganic, organic, and physical chemistry; enzymes; nutrition and vitamins; metabolism; hormones. In addition, three highly interesting chapters cover the relevant biochemical features of immunology, chemical and biological tumour diagnostics, and the biochemical aspects of tumour origin and growth. In every subject the treatment is exhaustive, and although not every paper of importance is quoted, nor could this be expected, the omissions are remarkably few, and in almost all fields a very comprehensive picture is presented. It is probably true to say that even the experienced cancer research worker will find many interesting observations recorded here that are unfamiliar to him or the existence of which he had forgotten. Reference to the excellent subject index will confirm this opinion.

In such a careful and thorough compilation it is a pity that the writing and editing call for some criticism. It should have been a simple matter to eliminate the rather frequent occurrence of un-English phrases, and there is an almost complete absence of sub-headings; for example, the important section on tar and the carcinogenic hydrocarbons as carcinogens occupies thirty pages of solid text without subdivision, in spite of the wide range of topics embraced.

This latter section is perhaps too highly compressed, since it deals with what is undoubtedly an outstanding achievement of cancer research; and the description of the biochemical effects of radium and X-radiation is also very much curtailed. The authors themselves recognize this, and refer the reader in both instances to published reviews. While I sympathize with the difficulty of summarizing what has already been so brilliantly recounted by the original discoverers of the synthetic carcinogenic agents (Kennaway, Cook and collaborators; *Amer. J. Cancer*, **29**, 219–259 (1937); **33**, 50–97 (1938); **39**, 381–582 (1940)), I consider that the balance of the book has been affected by this disproportionately short account. Space for a fuller discussion might perhaps be found by the elimination from other chapters of a number of very dubious earlier references, the claim of which even to historical interest is questionable. In this chapter it is erroneously stated that 1 : 2 : 5 : 6-dibenzanthracene is excreted by the rabbit as the 4′ : 8′-dihydroxy derivative, but not by the rat or mouse (p. 179); in fact, the latter species excrete this derivative, while an unidentified isomeric dihydroxy compound is eliminated in the rabbit. This prompts the suggestion that in general works of this kind the authors would do well to insert the key numbering of the carbon atoms in their published formulæ of polycyclic compounds; otherwise such descriptive names in the text mean little to any but the specialist. In this book, also, formulæ for the carcinogenic azo-dyestuffs might with advantage be included.

The descriptions of the mechanism of carbohydrate metabolism given in Chapter 6 need revising and bringing up to date, and I am not aware of the observation (incorrectly stated to be contained in reference No. 195 on p. 507) that the aerobic glycolysis of chorio(n)epithelioma is abolished when serum is used as the suspension-medium; if true, this would be unique among malignant neoplasms, and as it is this kind of statement that is copied from book to book, it should be correctly quoted. Is it possible that the authors have confused the terms chorionic epithelium and chorion-epithelioma? In any future edition it would be well to emphasize more strongly the loss of specialized metabolic function which accompanies the loss of morphological differentiation in malignant tumours (cf. Dickens and Weil-Malherbe; *Cancer Research*, **3**, 73; 1943).

Perhaps the general recognition of the multiplicity of carcinogenic stimuli is the most characteristic feature of the present stage of cancer research. The problem that still awaits solution is that of correlating these diverse phenomena. Thus, the occurrence of spontaneous mammary cancer in mice is now generally admitted to be determined by at least four distinct factors: the influence of the maternal milk-borne factor, the genetic constitution of the strain, the quantitative and qualitative composition of the diet,

and the effect of hormones, especially the sex hormones. The incidence of breast cancer may be varied almost from zero to 100 per cent by suitable known variations in these factors. On the other hand, in the case of the chemical carcinogens, the effects of the milk factor, hormones, and even genetics appear to be relatively unimportant. The explanation of this apparent paradox, which might perhaps provide a much-needed link between the chemically induced and spontaneous tumours, is an outstanding problem. The claims that filterable tumours can be obtained in fowls by the action of chemical carcinogens lead one to ask if even the milk-borne cancer factor might not also be induced by chemical carcinogens to appear in a strain of mice where its presence cannot normally be demonstrated. No doubt this question will soon be answered, if indeed the experiment has not already been done. The important point is, however, that the progress of the last two decades has made it possible to ask, and to answer, many such questions.

F. DICKENS.

HIGHER EDUCATION IN ENGLISH-SPEAKING COUNTRIES

Educational Yearbook of the International Institute of Teachers College, Columbia University, 1943
Edited by Prof. I. L. Kandel. Pp. xi+297. (New York: Teachers College, Columbia University, 1943.) 3.70 dollars.

THE Educational Yearbook of the International Institute of Teachers College, Columbia University, came into existence twenty years ago, during the whole of which time it has been under the able editorship of Prof. Kandel. The 1943 issue is devoted to higher education in English-speaking countries. At the moment, higher education in all countries is, of course, thoroughly subordinated to the urgent task of winning the War. Nothing else matters. What are usually called the humanities are in a state of suspended animation, and the scientific studies are pursued for utilitarian ends. But in the period following the War, the immediate future of higher education will certainly be one of the most important problems of educational reconstruction. In every country certain questions will inevitably arise. For how many students should higher education be made available? In what relation does higher education stand to the demands of the modern world? How can we develop a proper balance between the humanities and the sciences? What are the relative places of general education and specialization, and what is the relative importance of teaching and research? Already these questions are being discussed sporadically in magazines and newspapers, both in England and in the United States. This educational yearbook widens the outlook by extending the discussion to all English-speaking countries.

The chapters are placed in alphabetical order, beginning with Australia and ending with the United States of America. As no question of continuity arises, the chapters may be read in any order. Four are assigned to England, six to the United States, and one apiece to Scotland, Ireland, Canada, Australia, New Zealand, South Africa and India. One can well understand the editor's difficulty in enlisting the services of an adequate team of contributors, literally from the ends of the earth, and under war-time conditions. One proof of his success is that most of the chapters are marked by a catholicity of view which sees educational reform in its broad social, and sometimes political, setting. Some of the chapters are interesting and informing as much for the light they throw upon the general situation as for the special purpose for which they are written.

The selected countries present such diversity that no brief summary is possible. In the case of England, the obvious contrast, between Oxford and Cambridge on one hand, and the newer civic universities on the other, raises problems as yet unsolved. It is noteworthy that science has recently made great headway in both the older universities. London stands, as it always has, for religious equality, and it fairly claims to be the first university to admit women to degrees, and the first to give science its due. The chapter on the provincial universities of Britain is one of the most interesting in the book. The Scottish universities, strong in the affections of all classes of the population, present few puzzles to the expositor. Quite the contrary is the case of Ireland, where university education has been complicated from the start by political and religious differences, raising difficulties which have only gradually and as yet partially been overcome.

As for the United States, the general situation at present seems well described by one of the six contributors, who says that the colleges have become armed camps. The journal usually known as *School Life* is replaced by *Education for Victory*; and if this indication is true of the schools, it is certainly true of the colleges and universities. The contributors are quite the reverse of complacent, and post-war reforms are keenly advocated.

In Canada the tendency to educate children in the high schools as if they were all proceeding to universities is being corrected, and the high-school graduate is being "better fitted to meet the demands of modern life". But the outstanding point is that educationally there are two Canadas, representing the British and the French traditions. One of the challenges to the future is that a greater integration be achieved, and "all thoughtful Canadians will agree that, unless the challenge be met, Canadian unity will not be achieved". The report on Australia has many cheering features, but the universities are said to be so "sadly departmentalized" that students who may be trained efficiently for medicine, law, or engineering have no training as citizens, and no interest in the social implications of their professional activities. New Zealand has emerged from the callow stage of reliance upon external examinations conducted from England, but her universities need also to realize the inescapable duty of equipping their students to deal, both as professional workers and as citizens, with the problems of the new world.

A far more tangled problem is that of the Union of South Africa, with its 2,220,000 whites (of whom 60 per cent are Africaners, 35 per cent British and 5 per cent others, mostly Jewish), its 750,000 half-breeds, its 250,000 Indians and its 6,000,000 Africans —fundamental divisions which are reflected in the universities and colleges. Whether Africaner or English in character, the universities are said to remain "the organs of a dominant white group content with the place which it has built for itself at the top of the Union's racial-caste structure". There remains for comment gigantic India, "English-speaking" in the sense that a century ago it was decided that English should be the medium of instruction

in higher education. The dark cloud hanging over the system is the fact of thousands of young men with a university education who are unable to find suitable employment. Signs of a change are, however, discernible. "The old superstition that practical studies were not quite respectable and that technical training was a relatively low type of education is beginning to disappear." The work of the universities needs to be more fully directed to the many problems, human and material, with which the country is faced.

The survey brought together in this modest volume of three hundred pages presents an almost bewildering variety of conditions, and the actual work of the universities and colleges cannot be the same in all the countries included in the survey. One is left in no doubt as to the enormous influence, not always for unmixed good, which places of higher education exert upon a nation's life. The one deep impression which these records leave upon the reader's mind is that in the post-war world the universities must shun the evil of the narrow outlook. When the ancient and the modern, the cultural and the vocational, the humanistic and the scientific, the liberal and the utilitarian, stand rigidly apart, each secretly or openly despising the other, then the fatal narrowness, quite consistent with the utmost dignity and respectability, appears. Always and everywhere, the business of the university is "the education of the whole man".

T. RAYMONT.

A SYNOPSIS OF INDIA

India in Outline

By Lady Hartog. Pp. xiii+110+31 plates. (Cambridge: At the University Press, 1944.) 6*s*. net.

FOR a general conspectus of India as it is, in most of its aspects, and all comprised in one hundred pages, it would be difficult to find an equal to this little book by Lady Hartog. Its eleven chapters deal with geography and climate, custom and culture, history ancient and modern, the Indian States, natural resources and revenue, industry, administration (including education, public health, etc.), politics, the army, and India's part in the War. There are an appendix consisting of half a dozen compact tables from the 1941 census, a short bibliography, an index, a map, and thirty good photographs well reproduced.

With a scope of this breadth the treatment must be sketchy in the extreme, but the sketch is unbiased, is drawn in admirable proportion, and is surprisingly comprehensive. Inevitably occasional general statements are made which are open to contention. They would no doubt be qualified if there were room for more detailed treatment. One may legitimately doubt whether *purdah* was really introduced by Muslims; or whether the population of India north of the Vindhyas is anything like so distinct from that south of it as Lady Hartog would suggest, for though it is true that purely linguistic differences support her view, anthropological ones are less in her favour. The description of the *ryotwari* system of land tenure as found mainly in the south is scarcely accurate; a *zemindari* system prevails in much of the United Provinces, Bihar and Bengal, but not in the Punjab or Assam. The statement that the cost of the army absorbed about a quarter of the total pre-war revenues of the Government of India is apt to prove misleading to anyone unfamiliar with the division of financial responsibilities between the local and central governments in India. Shellac does not seem to be mentioned among the important commercial products.

The bibliography is disproportionately inclined to the political aspect; short as it is, it might well have included Macdonell's "India's Past" and Blackham's "Incomparable India", while *Great Britain and the East* might perhaps be added to the list of periodicals.

But the fact that there seems little more than that to be said in criticism is in itself high praise. No other outline exists nearly so good to put in the hands of persons ignorant of India and wanting information of every kind in a compact and easily ingested form. Even those who have known India well in pre-war years, but not since war broke out, may learn much from the chapters on India and the War, which bring out well both the remarkable advance which has been made in industry and the narrowness of the margin of India's food supply. In a concise general account of this kind it is far harder to keep due proportion and perspective than on a wider canvas, and the author deserves every credit for an admirable sketch.

J. H. HUTTON.

PHYSICS AND PHILOSOPHY

Proceedings of the Aristotelian Society

New Series, Vol. 43: Containing the Papers read before the Society during the Sixty-fourth Session, 1942–1943. Pp. xxvi+222. (London: Harrison and Sons, Ltd., 1943.) 25*s*. net.

THIS volume contains, among papers on a wide range of subjects, a symposium on "The New Physics and Metaphysical Materialism" in which the late Prof. Susan Stebbing, Sir James Jeans, Mr. R. B. Braithwaite and Prof. E. T. Whittaker took part (see *Nature*, June 19, 1943, p. 686). Prof. Stebbing in her life-time was convinced that Eddington and Jeans used their standing as scientific men to put across to the public metaphysical views which were thoroughly unsound. In her contribution to this symposium she argues that "the new physics does not imply idealism" (p. 184). If Sir James Jeans thinks it does, it is because he argues, erroneously, that because the wave-picture of the universe is essentially mental, the universe it pictures must be so also.

In answering Prof. Stebbing, Sir James Jeans is led to develop a metaphysic of objective idealism not unlike Spinozism. The particle-picture and the wave-picture both depict reality; one is material, the other mental in its ingredients; therefore reality has a material and a mental aspect.

Mr. Braithwaite out-Stebbings Stebbing in maintaining that the new physics has no relevance for metaphysics. As an exercise in philosophy his paper is the best of the four, but as criticism of Sir James Jeans it is wide of the mark, and what Prof. Whittaker says of Miss Stebbing's contribution would apply equally well to that of Mr. Braithwaite: "It has all the merits and perhaps some of the defects that one would expect to find, say, in a commentary on some of the more mystical poems of Wordsworth by Mr. Bertrand Russell". We may expect this state of affairs to continue until "physicists are philosophers and philosophers physicists".

WINSTON H. F. BARNES.

THE LIQUID STATE

THE twenty-eighth Guthrie Lecture of the Physical Society was delivered last April by Dr. J. H. Hildebrand, professor of inorganic chemistry in the University of California. He had chosen for his subject "The Liquid State". Prof. Hildebrand is one of the greatest authorities on the physical and chemical properties of solutions, and it is only natural that his vast knowledge and experience in this field have enabled him to tackle the difficult problem of the constitution of liquids on new and promising lines.

Prof. Hildebrand began by outlining and discussing the two conventional methods by which the problem is usually approached: the analogies to the gaseous and to the solid state. A liquid resembles to some extent a compressed gas, and the theoretical treatment of such a model has the van der Waals equation as its basis. However, when we compare the terms of the van der Waals equation with their counterparts in a purely thermodynamic equation of state, we find that it is not possible to fit them with the same constants over any considerable range in the case of liquids. It is, of course, possible to correct the equation by additional constants, but this does not bring us nearer to the desired theoretical interpretation. The customary analogy between the behaviour of gases and liquids as represented by van't Hoff's law for osmotic pressure leads to impossible consequences when concentrated solutions are considered. Instead of describing a liquid as a compressed gas, it can be treated—starting from the other extreme—as a very disordered solid, that is, as a crystal lattice which has been disturbed by the process of melting. This method has been helped to a great extent by the considerable amount of information on the structure of solids at our disposal, and it is a line of approach which offers good prospects for a theoretical interpretation of the liquid state.

Quite a different line of approach can, however, be developed by using a method of interpretation which arises out of the experimental study with the aid of X-rays, and it is on considerations of this kind that Prof. Hildebrand has based his views on the constitution of liquids. The scatter of X-rays in a liquid does not suggest a state of order in any way like that exhibited by a crystal lattice. Its interpretation reveals a short-range order which can be best represented by plotting the average number of molecular centres to be found in the neighbourhood of any given molecule against the distance from this molecule. The number of molecular centres contained in a spherical shell which surrounds the central molecule is given by the volume of the shell, multiplied by the number of molecular centres per unit volume of the substance. This estimate takes no account of the space required by the individual molecules, in so far as it clearly cannot be true for a shell of the order of magnitude of the minimum distance to which two molecules can approach. We must, therefore, introduce a correcting factor which varies with the distance from the central molecule and represents the structure of the liquid. This 'distribution function', W, is zero for any distance smaller than the molecular diameter. Beyond this distance we meet the first layer of surrounding molecules and W will be greater than unity. Between the first and the second layer of surrounding molecules, W shows a minimum, rising to a second maximum at the distance of the second surrounding layer. The success of this approach to a general interpretation of the structure

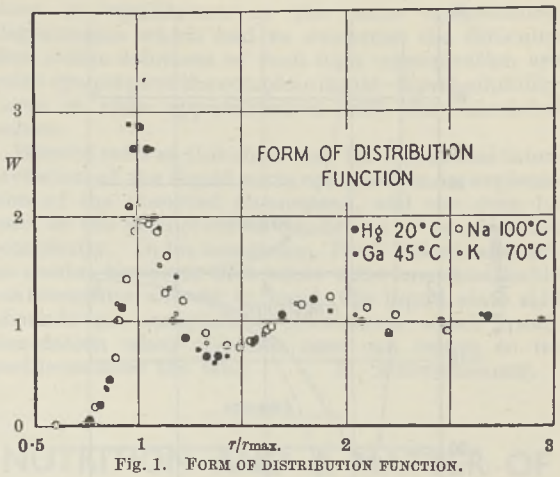

Fig. 1. FORM OF DISTRIBUTION FUNCTION.

of liquids can be gathered from Fig. 1, which shows the distribution function for a number of liquid metals at corresponding states. Here W is plotted against $r/r_{max.}$, where $r_{max.}$ is the position of the first maximum. The figure emphasizes the short range of order encountered in liquids, W remaining practically 1 for distances greater than the radius of the second surrounding shell of particles.

The full significance of this treatment becomes apparent when we consider the forms which W assumes in a solid and in a gas. In the latter case, W rises from zero for distances smaller than that given by the closest approach at collision to the value of 1, which is maintained for all greater distances. In the solid, the long-range order is represented in W by a succession of tall, narrow bands which occur at distances where new groups of molecules will be found. The temperature dependency of the structure becomes apparent by a widening of these bands

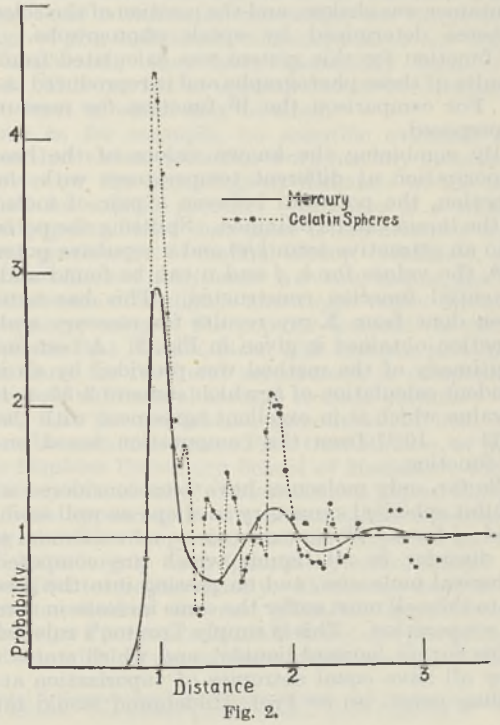

Fig. 2.

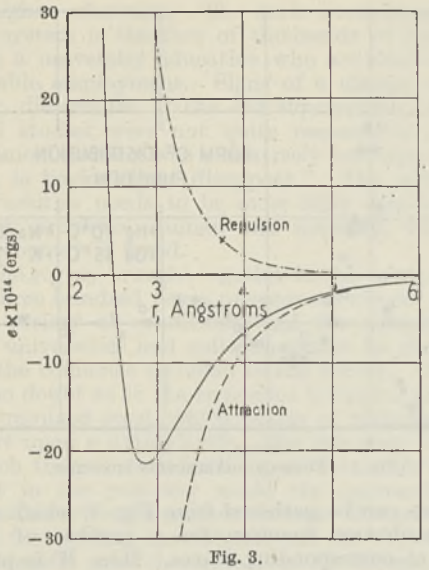

Fig. 3.

caused by the increasing amplitude of vibration of the molecular centres around the lattice points. At the melting-point the bands merge into the 'liquid' curve. With further rise in temperature the state of order in the liquid decreases progressively, the liquid curve flattens more and more, until finally W is unity for any distance larger than the molecular diameter; the gaseous state has been reached. Prof. Hildebrand mentioned an ingenious demonstration experiment on a mechanical model of a liquid which had been carried out at his laboratory. The place of the molecules was taken by a number of gelatine spheres which were inserted in a cubical container, filled with a gelatine solution of the same refractive index as that of the spheres. This made the spheres invisible except for a few which had been coloured. The container was shaken, and the position of the coloured spheres determined by spark photographs. The W-function for this system was calculated from the results of these photographs and is reproduced in Fig. 2. For comparison the W function for mercury is superposed.

By combining the known values of the heat of vaporization at different temperatures with the W function, the potential between a pair of molecules of the liquid can be obtained. Splitting the potential into an attractive term k/r^6 and a repulsive potential j/r^n, the values for k, j and n can be found and the potential function constructed. This has actually been done from X-ray results for mercury and the function obtained is given in Fig. 3. A test for the legitimacy of the method was provided by an independent calculation of k, which came to $3{\cdot}35 \times 10^{-10}$, a value which is in excellent agreement with that of $3{\cdot}52 \times 10^{-10}$ from the computation based on the W-function.

So far, only molecules have been considered which exhibit spherical symmetry in shape as well as in the field of force. There exists an equal maximum state of disorder in all liquids which are composed of spherical molecules, and on passing into the gaseous state they all must suffer the same increase in entropy on evaporation. This is simply Trouton's rule, which holds for all 'normal liquids', and which states that they all have equal entropies of vaporization at the boiling point, or, as Prof. Hildebrand would rather say, at the temperature where the molal volumes of vapour are equal. If, on the other hand, we deal with liquids the molecules of which are very elongated or contain dipoles, we can expect a certain degree of order in the spatial arrangement of these molecules, and the entropy of such liquids will be smaller than that of the completely disordered normal liquids. Since the entropies of all vapours under corresponding conditions are equal, the entropy of vaporization of liquids with non-spherical molecules will be greater than of normal ones. The significance of these exceptions from Trouton's rule is exemplified by the following table, in which the entropy of vaporization at equal molal vapour volumes ($\log R/V = 0{\cdot}1$) is given for a number of liquids.

Liquid	ΔS	$\Delta S - 20{\cdot}1$
Mercury	20·1	0·0
$C(CH_3)_4$	20·1	0·0
i-C_5H_{12}	20·2	0·1
n-C_5H_{12}	20·7	0·6
n-C_6H_{14}	21·5	1·4
$(CH_3)_2CH.CH(CH_3)_2$	20·3	0·2
$CHCl_3$	21·7	1·6
$(C_2H_5)_2O$	21·8	1·7
$(CH_3)_2CO$	22·5	2·4
C_2H_5OH	27·0	6·9
CH_3OH	26·5	6·4
CCl_4	20·7	0·6
$SnCl_4$	21·8	1·7
$C(NO_2)_4$	22·6	2·5

The second column, giving the differences between the vaporization entropies of the various liquids and that of mercury, denotes their state of order compared with the maximum disorder for spherical molecules. The degree of order which is introduced by alterations in the shape of the molecule is apparent in the differences between the pentanes, between di-*iso*propyl and normal hexane, and finally in the series carbon tetrachloride, stannic chloride and tetra-nitromethane. The deviations from Trouton's rule shown by chloroform, ether and acetone are due to the existence of a strong dipole in the molecule, and to the order created by the mutual interaction of these dipoles in the liquid. It is interesting to see that, though they all have dipole moments of roughly equal strength, the state of order in acetone is considerably greater than in the other two. The explanation is that the dipole in acetone is not buried inside the molecule as in chloroform and ether. The most striking exception, however, is that of the alcohols, and it seems difficult to account for this large deviation by either of the explanations. More information on this point can be gained by dissolving these dipole molecules in non-polar solvents and by observing the change in polarization with concentration. The very strong rise with increasing concentration in the case of the alcohols suggests that the high degree of order in the pure liquid is probably due to the formation of hydrogen bridges.

This is just one example in which the study of solutions aids in the interpretation of the general problem of the constitution of liquids. Thus we can combine observations of the composition of solutions with observations of the vapour phase, which leads us to consider deviations from Raoult's law. This rule states that for a great number of solutions, ideal solutions as they are called, the partial vapour pressure of each component is simply given by the product of its vapour pressure in the pure state and its molar fraction in the solution. Reverting to a description in terms of molecular characteristics, it

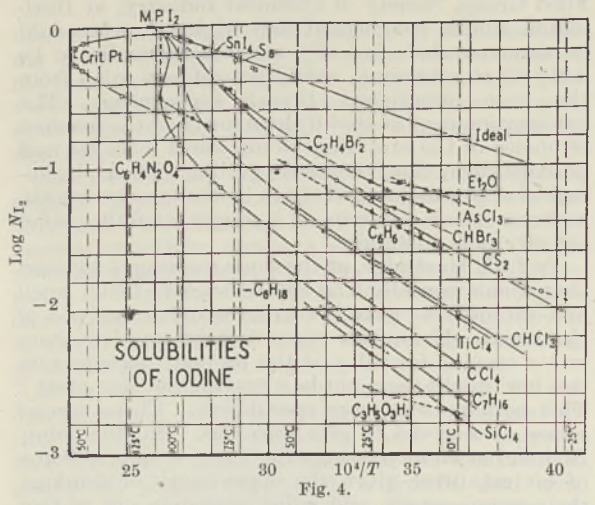

Fig. 4.

means that Raoult's law will hold for mixtures of the same species of molecule, that is, for molecules of equal size, shape and field of force. We can vary this condition by mixing different species and comparing the partial pressures. An interesting case is a mixture of molecules of equal field-strength, but of different size. Here the conceptions of the osmotic school, expressing concentrations in moles per litre, break down. According to these conceptions, we should expect, for example, ethane under one atmosphere to dissolve to the same extent in a given volume of any higher paraffin. On the other hand, the mole fraction of a given amount of ethane in dodecane would be twice that in the same volume of hexane. To achieve the same solubility the pressure of ethane over dodecane would have to be doubled. It is the latter alternative that is supported by the experiment. Normal paraffins of different length such as butane and heptane obey Raoult's law. It simply means that only the space between the molecules of the solvent is at the disposal of the second component, and not the total volume.

The properties of solutions offer almost unlimited scope for obtaining information on the problems of the liquid state. The same considerations as applied to the evaluation of the potential between a pair of identical molecules can be employed in evaluating potentials between molecules of different kind. If we have spherical molecules of equal size, but different molecular fields, the W-function is the same as in the pure liquid and can be made the base of calculations. Of the great number of examples given by Prof. Hildebrand, the set dealing with a comparison of different solvents for iodine is perhaps the most instructive one. The solubilities for this substance are given in Fig. 4. Most of the curves belong to one family; they represent 'regular solutions' for which computation on the lines indicated above is possible. They all show the violet colour of iodine vapour, which indicates that the iodine molecules are simply dissolved and have not taken part in chemical changes. The solutions corresponding to the non-regular curves, on the other hand, have different colours and make one suspect that chemical changes have occurred. Prof. Hildebrand directed special attention to the loop intersecting the curve for carbon tetrachloride. Calculation shows that the curve running through the points for the solubility of solid iodine must exhibit an S-shape, which means that there are two compositions in equilibrium at the same temperature. Experiments which had to overcome the difficulty that iodine solutions of such high concentration are quite opaque gave the complete liquid–liquid solubility curve in close approximation with the calculated values.

Results such as this show how far theoretical interpretation of the liquid state can provide an explanation of the observed phenomena, and can even be used in the prediction of conditions of considerable complexity. In his conclusion, Prof. Hildebrand left no doubt, however, that while there are remarkable achievements already at hand, the liquid state still abounds in unexplained phenomena which await elucidation when scientific men can return to its problems after the War. K. MENDELSSOHN.

NUTRITION AND A MATTER OF TASTE

By DR. MAGNUS PYKE

DURING the past twenty-five or thirty years the science of nutrition has made very great strides. These advances have been due almost entirely to the application of precise, objective, chemical methods, and have been paralleled by similar advances in other branches of biology. Those who study endocrine secretions can determine, according to his endocrine balance, how the character of a man will be influenced. Similarly, the nutritionist can say from an analysis of the foodstuffs of which a man makes up his diet whether or not, and in what way, his body will be influenced for good or evil. By these means it is now possible to decide, to a greater or less degree of precision, the physiological needs of such divers individuals as pregnant women, adolescent children or coal-miners for calories, protein, fat, four or five mineral substances and six or seven vitamins. In making these advances in knowledge, the subjective feelings of the individuals concerned have not only been neglected; they have specifically been excluded. This has led to several curious conclusions, two at least of which may be cited.

There is, for example, no scientific evidence to suggest that violent muscular work has any influence whatever on the physiological demands of an individual for animal protein; yet there is a widespread popular belief that meat is essential for the efficient prosecution of manual labour. Similarly, so far as the classical nutritionist is aware, onions, garlic and pickles are of negligible nutritional value. Nevertheless, so pressing is the popular demand for such condiments that Britain, faced with extreme pressure on her land for food and aerodromes, is compelled to devote a substantial acreage to their culture.

Now, into the traditional, generation-old field of respectable nutrition comes Prof. Curt Richter, of the Johns Hopkins University School of Medicine*, with a summary of a number of inconvenient papers which have been appearing in the physiological literature during the last ten years, and the implications of which have largely been ignored by nutritionists.

Prof. Richter begins quietly. If rats are kept in a cage on a salt-free diet and given the opportunity of drinking a 3 per cent salt solution out of a graduated tube they will, on the average, drink enough of the

* "Total Self-regulatory Functions in Animals and Human Beings." Curt P. Richter. The Harvey Lectures Series, 38, 63 (1942–43).

solution to provide for their nutritional needs. If the animals are then adrenalectomized, the consumption of the solution of sodium chloride increases enormously even if other solutions are made available. If, on the other hand, the calcium metabolism of rats is disturbed by parathyroidectomy, their appetite for solutions of calcium salts increases and also their desire for salts of chemically related metals such as strontium and magnesium, but not for any other substances.

The next stage of the work was clearly to divide the animals' diet into all its constituent nutrients, and this Prof. Richter did. The rats were placed in cages equipped with several food cups containing, separately, weighed amounts of purified carbohydrate, protein, fat and such materials as dried yeast. Furthermore, they were confronted with from eight to twenty graduated tubes containing measured amounts of solutions of sodium chloride, potassium chloride, calcium lactate, sodium phosphate, magnesium chloride, aneurin, riboflavin, nicotinamide, calcium pantothenate, choline chloride, pyridoxin hydrochloride, biotin, cod-liver oil and any other of the substances it was desired to test.

Some of the results were of surprising interest. For example, when presented with this plethora of choice among substances never normally encountered pure in Nature, and many of which are devoid of any definite taste or smell, not only did the rats choose for themselves a perfect diet, according to the most up-to-date nutritional knowledge, but also they made on their self-chosen diet more economical growth than on a stock diet of non-purified foods. When the rats were depancreatized, they spontaneously avoided carbohydrate and maintained their calories with fat. When the bottle containing aneurin, which is specifically concerned with the intermediary metabolism of non-fat calories, was taken away, the rats reduced their consumption of non-fat calories and ate more fat. When given aneurin but deprived of riboflavin, nicotinamide and pyridoxin, the animals ate more carbohydrate, some fat but almost no protein, thus suggesting that one or other of these vitamins is specifically concerned with intermediary protein metabolism.

Further interesting results were obtained by following the diet which was spontaneously chosen by female rats during the course of pregnancy and lactation. As might, perhaps, have been expected, the calcium consumption rose only slightly during pregnancy but increased very markedly during lactation. An unexpected finding was, however, that the sodium chloride intake increased during pregnancy, and increased again even more substantially during lactation.

What is the application of this line of approach to problems of human diets? Man has survived for some few thousand years on a self-chosen diet so that, presumably, even without the benefits of academic qualifications in nutrition, he must apparently possess certain powers of discriminating what is good for him. But one has only to look at the physique of the population of a London underground station during an air raid, or notice the enormous incidence of defective teeth among the bulk of even the younger members of the British industrial population, to realize that *laisser-faire* in human nutrition is not enough. Prof. Richter's rats can practise self-selection in their diets when each nutrient is separated from the other. Sir Jack Drummond, on June 27 from the chair of the Nutrition Panel meeting of the Food Group, Society of Chemical Industry, at Burlington House, commented that workmen, who could be demonstrated clinically and biochemically to be deficient in vitamin C, would yet refuse a salad from the best intentioned British *restaurateur*. The explanation may be that if these men had the freedom of choice of the rats, they would select more fat and perhaps sugar than they were getting. Their physiological urge was more likely to be for calories, which, however much vitamin C it might contain, salad signally fails to supply.

Prof. H. Hartridge, at the same meeting, suggested that, fundamentally, the special senses—taste, smell and the others—gave the brain a quick analysis of the blood. If the salt concentration was low there was a craving for salt; if the protein concentration was low, might there not be a craving for, say, meat? This perhaps was more speculative. These special senses also served to give warnings. On this point, Richter has an interesting experiment to quote. Some of his rats were given the opportunity of drinking their water equally and indiscriminately out of two graduated bottles. To the water in one bottle, very small but increasing concentrations of mercuric chloride were added day by day. When the amount reached 0·003 per cent, which was far too little to exert any physiological effect, the rats suddenly stopped taking the solution from the poison bottle.

Dr. D. R. Davis, of the Psychological Laboratory, Cambridge, also had some interesting comments to make. For example, rats can maintain their calorie needs on solutions of sugar, alcohol and water. When the sugar solution was exchanged for a similar-tasting solution of saccharine, the animals maintained an equal calorie intake by increasing their consumption of alcohol.

Dr. Davis went on to show, however, some of the reasons why whatever biochemical powers of selection man may possess are not sufficient to enable him to dispense with his objective knowledge of nutrition. The first point is 'habituation'. Rats can get used to eating out of a pot placed in a special position and will then fail to select more nutritious food placed in an unfamiliar part of the cage. Animals get 'accustomed' to certain meal-times. Pavlov's experiments with dogs and dinner bells were mentioned here. There was also some discussion of diurnal metabolic variations; but the meeting of the Nutrition Panel seemed quite incapable of coming to any reasonable conclusions about the best meal-times for people working on awkwardly arranged shifts. The palatability of 'appropriate' food was mentioned. To a Briton, sour milk is nasty, and cream-cheese nice; putrid chicken is bad, but putrid pheasant good. Finally, there was the point that people taste with organs other than their mouth and nose. Not only can a blindfolded man not distinguish between a two-penny cigar and a three-shilling one; he rarely knows whether either is alight or not. Dr. Davis cited the example of two chocolates of identical taste and consistency but one white and the other brown. These were rated equally during blindfold tests, but when the examiners could see, they thought the white one 'fatty', 'tallowy' and generally inferior.

Dr. G. W. Scott-Blair showed how many of the ancillary sensations, such as firmness, 'liveliness' and 'body', which combine together with taste to give an individual ideas as to whether or not he likes a food, can be measured mathematically. That the mathematical functions are complicated is, apparently, no

deterrent to the subjective influence on people assessing food. Indeed, they are prepared to compare mathematically incomparable quantities, and provided that they are young and unbiased can, apparently, consistently measure viscosity in terms of elasticity.

But whereas Dr. Scott-Blair tried to explain to a slightly mystified audience of chemists at the Nutrition Panel meeting how to measure in mathematical quantities senses, about which Prof. Hartridge as a physiologist and Dr. Davis as a psychologist had spoken, Mr. R. R. Plowman, an expert and experienced tea-taster, showed how the senses of smell, taste, sight, touch and temperature can, in actual practice, all elegantly be combined.

Evidence which has been accumulating in the literature and much of which was summarized at this meeting of the Nutrition Panel now suggests that the special senses of taste and the rest offer, if used with proper precaution, a fruitful and new method for nutritional research. Richter quotes at least two interesting experiments with human subjects. The first concerns a 3½-year-old boy with undiagnosed destruction of the adrenal cortex. This child kept himself alive for more than two years by eating handfuls of salt. When he was taken under control and fed a 'proper' hospital diet he died. The second experiment is of more general application. A graph was made of the percentage of children between the ages of 5 and 14 years who liked a test sample of cod-liver oil. In general, the frequency decreased as the age increased and as the known physiological needs diminished. The precautions to be exercised when trying to carry out experiments of this nature are many and obvious. Habituation, learnt custom, suggestion, whether visual or of any other kind, are a few. Certain tastes may be exceptional to the rule, if rule it is, that animals, if given the opportunity, will choose the nutrients they need. For example, the nutritionist hitherto has been nonplussed by onions, garlic and perhaps sweetness. Furthermore, people eat food, not nutrients. Nevertheless, it has often been a safe rule when studying industrial nutrition to start from the traditional dietary pattern and try to improve on that, rather than impose a theoretical regime.

The science of nutrition has progressed a long way. It certainly has still a long way to go. Perhaps this meeting of the Nutrition Panel, where nutritionists, chemists, physiologists, psychologists and those forgotten folk who taste and choose and cannot explain, all met to talk together and partially to comprehend each other, may have served in some small way to send it off on a new, fruitful journey.

THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE IN WAR-TIME

By PROF. C. W. WARDLAW
University of Manchester

ONCE established, the continuity of British institutions tends to be maintained no matter what the impact of external circumstances may be. In the gloomiest periods of the years 1940–42 it was a feature of life in Britain that bodies concerned with matters of cultural interest were not merely kept in being but in some instances even acquired a new vitality. The publication of the report of the Governing Body of the Imperial College of Tropical Agriculture, Trinidad, for the year 1943, serves to remind us of yet another instance of this continuity of the national effort in the arts of peace, this time in spheres remote from the European conflict—a continuity all the more remarkable in view of the difficulties that lie in the way.

Readers may perhaps recall that the Imperial College of Tropical Agriculture was founded to provide higher instruction in tropical agriculture and in the cultivation and preparation for market of tropical produce of every kind. Practically all members of the Colonial Agricultural Service pass through the College as a first stage, or otherwise have associations with it; thus the bonds that unite past students confer an almost unique unity and coherence to the collective personnel of this Service.

That an effort to maintain the College and its work should be made is not surprising. The developments and improvements that must be effected in agriculture in practically every corner of the Colonial Empire, both as immediate and long-range post-war aims, demand that preparations be put in hand now; and, as we have seen, the Imperial College of Tropical Agriculture is an integral part of the system.

What is remarkable is that it has been possible to keep the establishment actively in being, to continue the recruitment and training of students, to keep the long-term experimental programmes in operation, and to turn out a not inconsiderable body of research. This is a notable achievement; it is something in which we may take a legitimate pride. But it has not been without its rigours, both for staff and students. Most of the academic staff and their families, accustomed to home leave in a temperate climate every two years, have now been continuously in the tropics for six years. Even local travel, which helps to dispel the inescapable tropical *ennui*, has been seriously restricted. There have been periods of food restriction, and even scarcity, more rigorous than at home; and 'digging for victory' in the moist tropics—for that, too, has had to be done—is not quite the same pastime as in our own temperate clime.

Lack of transport provides the clue to the many difficulties. Thus Colonial Office scholars, going out to take the associateship course prior to being posted to different Colonies, have mostly arrived in small batches many months late. For example, the last of those due on October 1, 1942, arrived in the second week of April 1943! As in home universities, the defects of shortened courses have had to be borne. So, too, research work has been hampered by restrictions and delays in the arrival of apparatus and materials.

And so the tale of difficulties mounts up. The near view no doubt suggests a somewhat gloomy picture. But there is clearly another side to it. Agriculture is an art, and art is proverbially long. Nothing is more damaging to agricultural progress than restriction and discontinuity in the scientific research directed towards its improvement. In Trinidad, in spite of all set-backs (and they have been not a few), this essential continuity has been maintained. To those who have held the fort and advanced the tradition of science in its relation to agriculture, under the stress of war, a word of recognition is due.

OBITUARIES

Sir Ralph Fowler, O.B.E., F.R.S.

THE death, the tragically early death, of Sir Ralph Fowler in Cambridge on July 28, 1944, at the age of fifty-five, leaves a gap in British and indeed in international mathematical physics which will be hard to bridge in the years that are to come. Whatever Fowler touched, he did well, superlatively well; he was a hard hitter, both at work and games; and he had a quickness of apprehension, and power of plunging into a new subject, of getting abreast of all its details and more than holding his own with it in the presence of its acknowledged experts, at the shortest possible notice, that are exhibited in equal fashion perhaps only in the higher flights of advocacy. He was that rare combination, an accomplished pure mathematician with a sound physical insight. In fact, the only criticism I ever heard of his use of his powers was that he mistook physics as a field for the exercise of mathematical rigour. It was scarcely a fair criticism; only the gruelling training he received in pure mathematics at Cambridge, and the use that he put it to in his early pamphlet on the differential geometry of plane curves, could have given him the experience which was afterwards to mean that no non-rigorous deduction in mathematical physics proper ever escaped his trenchant and sometimes pungently expressed comments. He could make up his mind with lightning rapidity (he was a first-class bridge-player) and his conclusions were always strongly based on common sense, but his mathematical powers ensured that his strokes were savoured with something subtler than mere common sense.

Ralph Howard Fowler was born on January 17, 1889, the eldest son of Howard Fowler, of Burnham, Somerset. He was educated at Winchester (of which he was afterwards a fellow) and at Trinity College, Cambridge, where he was elected to a prize fellowship in 1914 for work in pure mathematics. He already had a commission when he was admitted fellow—I was in chapel at the time, being admitted a scholar, and remember the unaccustomed sight of a gown over an officer's uniform—and while serving as a lieutenant in the Royal Marine Artillery he was seriously wounded in Gallipoli. During convalescence, he encountered A. V. Hill (then a captain in the Cambridgeshires) who was engaged in developing with Horace Darwin what eventually became known as the Darwin-Hill mirror position-finder. The two officers, with the author as assistant, went down to Northolt Aerodrome in March 1916 for the first experiments with this instrument, and there were joined by the late W. Hartree. Thus began A. V. Hill's 'band of brigands' who were to become the A.A. Experimental Section of the Munitions Inventions Department; and thus began R. H. Fowler's interest in mathematical physics. Fowler's main work in the rest of the War of 1914–18 was carried out at Whale Island, under H.M.S. *Excellent*'s hospitality, and besides covering all aspects of the then nascent science of anti-aircraft gunnery, dealt experimentally and mathematically with the fundamental problem of the motion of a yawed shell under aerodynamic forces. These papers, written in conjunction with other well-known mathematicians, and published in the *Philosophical Transactions of the Royal Society*, became classical.

Fowler became a member of the mathematical staff of Trinity in 1919, and turned his attention to the problems of mathematical physics that came to the fore with the return of the late Lord Rutherford to Cambridge as Cavendish professor—problems of kinetic theory, of Aston's mass spectrograph, of collisions 'of the second kind' and the principle of detailed balancing. He also made important contributions to astrophysics. This series of papers developed into a fundamental treatment of problems of statistical mechanics, begun in collaboration with Sir Charles Darwin: evaluations of the enumeration of 'complexions' of a given assembly of similar systems under given external macroscopic conditions, in the forms of coefficients of 'partition functions', were expressed as contour integrals, which in turn were evaluated by the method of 'steepest descents', and led to the identification of a certain mathematical parameter with the absolute temperature, to evaluations of mean energies, mean fluctuations of energy and degrees of dissociation in reversibly reacting constituents. The method was one of extreme generality and power. In essay form it was awarded the Adams Prize of the University of Cambridge in 1925, and in book form it appeared as "Statistical Mechanics", which is now in its second edition and was translated into German. It is a mine of information, of the most detailed kind, on the thermodynamic and quantal properties of dynamical systems in large assemblies—gases (perfect and imperfect), mixed phases, crystals. The first edition contained, too, many astrophysical applications. The work is nowhere easy reading, but its professional competence is amazing. It brought Fowler an international reputation, and led eventually to his joint editorship (with Kapitza) of the Oxford series of Monographs on Physics, and his membership of the editorial board of the newly founded American *Journal of Chemical Physics*.

In the middle nineteen twenties, astronomers had concluded that certain stars, of which the companion of Sirius is the best known, from the evidence of their high-surface temperatures, normal masses and faint absolute luminosities, must have small surface areas and so excessively large densities. It was for some time a mystery as to how matter could exist in this state. In a fundamental paper under the title "Dense Matter", Fowler pointed out that these stars, in their deep interiors, must be examples of ionized gases in the 'degenerate state' to which theoretical physicists had recently been directing attention. This state, differing completely in its physical properties from the classical ideal gas, supervenes under conditions of *relatively* high density and low temperature. The theory was afterwards applied by Sommerfeld to assemblies of electrons in conductors, but to Fowler belongs the credit of first realizing a physical application of the statistical mechanics of degenerate gases.

Fowler was always ready to turn aside to abstract problems of pure mathematics. A notable example was his definitive treatment of the general solutions of the second-order differential equation known as Emden's differential equation, which is of importance in the theory of stellar structure. In 1929 and 1930 there was considerable controversy as to the configurations of a gaseous mass—controversy which is still not settled—and certain empirical results obtained numerically concerning solutions of Emden's equation with non-central boundary conditions attracted Fowler's attention, reminding him of some of his pre-fellowship work. He now found

the clue; and in a set of papers developed a partly geometrical, partly analytical, method of surpassing beauty, which finally classified all solutions of Emden's equation and its generalizations. As G. H. Hardy remarked in a debate on the subject at the Royal Astronomical Society, theories of stellar structure may come and go, but Fowler's contributions to the pure mathematics of the subject have a permanent value.

Fowler had become the mainstay of theoretical physics at the Cavendish, and in 1932 he was appointed to the new Plummer chair at Cambridge. Here he found the fullest opportunity for the exercise of his remarkable versatility and power of assimilating new ideas. Anyone in doubt over an unusual argument, anyone in need of encouraging but salty criticism, always turned to Fowler and came away comforted.

In 1938 Fowler was appointed director of the National Physical Laboratory. But an unexpected illness made it undesirable for him to take up the appointment, and he had the unusual experience of being re-elected to his resigned chair. But he could not be persuaded to reduce his activities. During the present War he undertook important liaison work between British and Canadian science, in Canada, and later he did similar work in the United States. He was created a knight in 1942. Unfortunately, his illness returned, and though he threw himself into further work at the Admiralty, it gradually mastered him. He was attending important conferences up to within a few weeks of his death.

Fowler was elected a fellow of the Royal Society in 1925, and awarded its Royal Medal in 1936. He married Eileen, only daughter of the late Lord Rutherford; she died in 1931. He leaves two sons and two daughters.

Fowler had a forceful, even a masterful personality. As I once put it in a sketch of Fowler for the *Granta*, when Fowler was proctor at Cambridge, he had a short way with any committee he was chairman of, and a short way with the chairman of any committee he was a member of. He could be outspoken to the point of inducing tears, but his subsequent contrition was so endearing that he never left bitterness. He was a man who, starting his scientific career in a promising but by no means excessively distinguished way, went on maturing throughout his life, and attained a fame which surprised even his earliest admirers, but which was wholly deserved, and wholly earned. Had he lived, Fowler would have become one of the greatest scientific powers in the land. He had a tremendous capacity for personal friendships; to collaborate with him on a scientific paper was to embark on high adventure, and the thrill and 'agogness' of working alongside him, when results were being turned out quickly and one was on tip-toes as to what was round the next corner, were things never to be forgotten.

Fowler was big and powerful of frame, and he applied his strength with success to a variety of ball-games. He had claims to distinction as a cricketer, both in batting and bowling; he played an excellent game of both lawn tennis and real tennis; he represented Cambridge at golf and declared (and, we hope, made) many a 'Barnwell no-trumper' on his way home from golf at Mildenhall; he was also a rock-climber.

Fowler was the whole man, of many parts. His life was one of unsparing devotion to high scientific ideals. We cannot over-estimate the loss his untimely death means to Great Britain and to science generally.

E. A. MILNE.

WE regret to announce the following deaths:

Mr. Selskar M. Gunn, vice-president of the Rockefeller Foundation, and formerly director of the Paris office of the International Health Board of the Foundation, aged sixty-one.

Sir Henry Lyons, F.R.S., formerly director of the Science Museum, London, on August 10, aged seventy-nine.

NEWS and VIEWS

Prof. T. R. Elliott, C.B.E., F.R.S., and the Beit Trust

MANY generations of Beit Memorial research fellows will hear with regret of the retirement of Prof. Elliott from the honorary secretaryship of the Advisory Board to the Beit Memorial Trustees, an appointment he has held since 1930 when he succeeded the late Sir James Kingston Fowler. The Beit Trust, one of the first great benefactions for medical research in Great Britain, has played a very notable part in the training of a number of skilled investigators who have made important contributions in most branches of scientific medicine. From its inception in 1910, the Trust has been particularly fortunate in its first two honorary secretaries to the Advisory Board, both of whom have been distinguished by their enthusiasm for its work, pride in its achievements and vision in its possibilities. The continuity of the generous policy of the Trust, the ease of its adjustment to changing conditions without any lowering of standards or narrowing of aims, have owed much to their work.

Prof. Elliott, a former Beit fellow (1911–12), became a member of the Advisory Board in 1922, and thus has been able to draw upon his own earlier memories in acting as friend and adviser to many of those he has helped to elect to fellowships. During the last fourteen years his intimate knowledge of the working of the Trust has been of the greatest value to the work of his colleagues on the Advisory Board, and of the Trustees to whom he carried their recommendations. Prof. Elliott will take with him the grateful memories of all who have worked with him on the Advisory Board and of many in all parts of the world who, as Beit Memorial fellows, have had his friendly guidance. He hands on a fine tradition to his successor, Dr. A. N. Drury, director of the Lister Institute.

Metallurgy at the National Physical Laboratory: Dr. N. P. Allen

DR. NORMAN P. ALLEN, who has been appointed superintendent of the Department of Metallurgy at the National Physical Laboratory in succession to

Dr. C. Sykes, studied metallurgy in the University of Sheffield under Prof. C. H. Desch, graduating B.Met. in 1923 and M.Met. in the following year. He collaborated in research on the die-casting of alloys of low melting point for the Non-Ferrous Metals Research Association, at first in Sheffield and later at University College, Swansea. In 1928 he was appointed to a lectureship in metallurgy in the University of Birmingham, where he obtained the degree of D.Sc. Since 1935 he has been on the staff of the research laboratories of the Mond Nickel Co., Ltd.

Dr. Allen's published investigations, undertaken on behalf of the Non-Ferrous Metals Research Association, have dealt with the effects of gases on non-ferrous metals and alloys, and in a series of papers he has described new methods of examining the solution and release of gases from molten alloys, chiefly of copper, and of the relations between the nature and amount of dissolved gases and the porosity of the resulting ingots and castings. The work involved the design of apparatus for applying both high and low pressures to the alloys when molten, and has been of material help in dealing with problems of porosity in non-ferrous alloys, at the same time providing interesting thermodynamic data.

Chair of Aviation, Imperial College: Mr. A. A. Hall

THE Department of Aeronautics at the Imperial College of Science and Technology is the largest activity of its kind in the British Empire. The announcement of the appointment of Mr. A. A. Hall as the new head, to succeed Prof. Leonard Bairstow as Zaharoff professor of aviation, is therefore of great interest. Mr. A. A. Hall will be one of the youngest professors in the country. If the course of the War makes it possible for him to take up his new appointment in October 1945 he will then be just over thirty years of age. He comes from Liverpool. Educated at the Alsop High School, Liverpool, and at Clare College, Cambridge, he obtained first-class honours in the Mechanical Sciences Tripos of 1934, with distinction in aeronautics, in thermodynamics, in applied mechanics and in the theory of structures. He was awarded the Rex Moir prize in engineering, the John Bernard Seely prize in aeronautics, the Ricardo prize in thermodynamics, and the Robins prize of Clare College. After a short period at the Royal Aircraft Establishment, he returned to Cambridge with an Armourers and Braziers' research fellowship to pursue aerodynamic research under Sir Melvill Jones and Sir Geoffrey Taylor. The work he did then, on the turbulence in a free stream and on the laminar and turbulent boundary layer, was an outstanding contribution to the subject. He joined the staff of the Royal Aircraft Establishment in 1938 and his activities there have covered a wide field—aerodynamics, wind tunnel design, and jet propulsion, followed since the outbreak of war by investigations on night interception of aircraft and on many scientific and engineering problems in the field of aircraft armament. In all he has shown high qualities of original thought and of leadership—the best augury for his future in a most responsible position.

Miss Grace Wigglesworth

MISS GRACE WIGGLESWORTH retires in September from the Manchester Museum, where she has served in the Botanical Section as assistant keeper since 1910. An old pupil of the Manchester High School, she entered Owens College in 1900 and graduated B.Sc. with honours in botany in 1903. In the same year "The Victoria University of Manchester" received its title, and Miss Wigglesworth continued her botanical studies in the University as an honorary research fellow until 1907. During this period she published several papers, the first in 1902 in vol. 1 of the *New Phytologist*, entitled "Notes on the Rhizome of *Matonia pectinata*, R.Br.". This was followed by "A Note on the Cotyledons of *Ginkgo biloba* and *Cycas revoluta*" (*Ann. Bot.*; 1903), "The Papillae of the Epidermoidal Layer of the Calamitean Root" (*Ann. Bot.*; 1904) and "The Young Sporophyte of *Lycopodium complanatum* and *L. clavatum*" (*Ann. Bot.*; 1907).

In 1907 Miss Wigglesworth was appointed lecturer in botany at the L.C.C. Clapham Day Training College, but in 1910 she returned to Manchester as assistant keeper in the Museum. She was able to devote some time to research, and further published papers are "The Development of Cœnobia from Resting Spores in the African Water Net (*Hydrodictyon*)", 1928; "A New Californian Species of *Sphaerocarpus*", 1929; and "South African species of *Riella*", 1937. But much important work remains unpublished. She spent several years working on the developmental morphology of *Polytrichum commune*, and has more recently been working on Prof. W. H. Lang's collection of Malayan Hepaticæ. She is a member of the Bryological Society and has an expert knowledge of hepatics. During her period of office in the Museum Miss Wigglesworth has been responsible for the reception, housing and care of the valuable herbaria of Leo Grindon and Cosmo Melvill. Her intimate knowledge of the contents of the Museum has been invaluable to members of the staff of the Botanical Department of the University who have been able to make use of its resources for teaching purposes. Her personal charm and kindliness have endeared her to all who have known her, and her many friends wish her a happy retirement, after a most fruitful scientific career.

Manchester Joint Research Council

THE vice-chancellor of the University of Manchester and the president of the Manchester Chamber of Commerce have announced the personnel of the Manchester Joint Research Council which is being set up jointly by the Chamber and the University. Representing the University are: Prof. P. M. S. Blackett, Dr. C. T. J. Cronshaw, Prof. D. R. Hartree, Prof. J. R. Hicks, Prof. Willis Jackson, Prof. J. Jewkes, Sir William Clare Lees, Dr. J. E. Myers, Prof. W. E. Morton, Prof. M. Polanyi, Sir Ernest Simon, Sir John Stopford (vice-chancellor), Sir Raymond Streat and Prof. F. C. Thompson. The Manchester Chamber of Commerce will be represented by Mr. J. Harold Brown, Mr. E. A. Carpenter, Mr. J. Curwen, Mr. R. H. Dobson, Mr. John S. Dodd, Dr. A. P. M. Fleming, Mr. H. M. Harwood, Mr. A. H. S. Hinchliffe (president), Mr. Frank Longworth, Mr. L. E. Mather, Mr. N. G. McCulloch, Earl Peel, Mr. C. G. Renold, Mr. A. V. Sugden and Mr. John F. West. The first meeting of the Council will be held at the University on October 9.

School Certificate Mathematics

A conference of representatives of examining bodies and teachers' associations was held in April 1944 and drew up a new syllabus designed to sweep

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

STOKES STUDENTSHIP

The Master and Fellows of Pembroke College, Cambridge, announce that the Stokes Studentship is vacant.

Candidates for the Studentship should send their applications, together with a birth certificate, a certificate as to personal character, and, if possible, seven copies of (1) a brief statement of their educational history, (2) a list of their published works, and (3) any testimonials (not exceeding four in number) which they may desire to submit, to the Master of Pembroke College, Cambridge, on or before November 15, 1944, marked on the outside "Stokes Studentship." If owing to service or other conditions a candidate cannot reasonably obtain seven copies of any documents he should give the reasons. One set of copies of their published works should also be sent.

The conditions under which the Studentship will be awarded are as follows:

1. The Studentship will be awarded without distinction of sex.

2. Preference will be given to graduates of the University of Cambridge.

3. Candidates must not be less than 23 or normally more than 30 years of age on Dec. 1, 1944, but on the present occasion an allowance will be made to candidates of more than 30 years of age equivalent to any time spent by them on work of national importance.

4. Candidates for the Studentship must have shown capacity for research in Mathematical or Experimental Physics or in subjects cognate thereto, such as Physical Chemistry or the study of Physical Laws in relation to Living Matter.

5. The student appointed will be expected to devote himself to research in Cambridge, unless he is permitted for special reasons and for a limited time to conduct his researches elsewhere. If he is now engaged on work of national importance he will not be expected to start work until he can be freed for this purpose.

6. The student will be allowed to give each term a course of lectures or demonstrations in the Department to which he is attached, but will not be permitted to undertake other work.

7. Normally the tenure in the first instance will be for a period of three years with a possibility of renewal for a further period not exceeding five years.

8. The value of the Studentship has been normally £400 to £450 a year, and the Board of Managers will be prepared to recommend the election of more than one student on similar terms if suitable applicants are forthcoming.

9. The student appointed, if a man, will be required to become a member of Pembroke College.

UNIVERSITY OF ABERDEEN

SESSION 1944-5

The WINTER TERM for Students in all Faculties will open on TUESDAY, OCTOBER 17, 1944.

NOTE: All male students (including those entering the University for the first time in October), other than those already enrolled in the Medical Unit of the Senior Training Corps, must report at the Headquarters of the Senior Training Corps or University Air Squadron at 9 a.m. on Tuesday, October 10, 1944.

H. J. BUTCHART,
Secretary.

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY

(Faculty of Technology in the University of Manchester)

APPOINTMENT OF ASSISTANT LECTURER IN CHEMICAL ENGINEERING

The Governing Body invites applications for an Assistant Lectureship in Chemical Engineering in the College of Technology, with the title and status of Assistant Lecturer in the University of Manchester.

Salary £300 per annum, rising by annual increments of £25 to £400 per annum, plus war bonus (which at the present time is £52 per annum). Commencing salary according to qualifications.

Conditions of appointment and form of application may be obtained from the Registrar, College of Technology, Manchester, 1. The last day for the receipt of applications is August 28, 1944.

Canvassing, either directly or indirectly, will disqualify a candidate for appointment.

J. E. MYERS,
Principal of the College.

MANCHESTER ROYAL INFIRMARY

TECHNICAL ASSISTANT FOR CLINICAL LABORATORY WORK

(Non-resident, Female)

The Board of Management of the Manchester Royal Infirmary invite applications for the above post.

Applicants should hold a Degree in Science or should have had special training in scientific methods of a nature which will qualify them for the work. The duties of the post require attendance daily (Sundays excepted) from 9 a.m. to 5 p.m.—Saturdays to 1 p.m.—working under the direction of the Director of the Clinical Laboratory. The work comprises routine examinations of blood, basal metabolism, etc. The appointment is for one year, renewable for a further period subject to the provision of the By-Laws as to notice, etc., with a commencing salary of £200 per annum, rising by annual increments of £25 to £300 per annum, plus £25 per annum war bonus.—Applications (stating age), with testimonials, to be sent to the undersigned.

F. J. CABLE,
General Superintendent.

THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

The Governors invite applications for the following appointments:

1. Lecturer in Agricultural Zoology, including Entomology. Candidates should have a degree in Pure Science (Zoology principal subject). A veterinary qualification might be a recommendation.

Salary on the range £450 to £600, according to age, qualifications, and experience (plus appropriate war bonus).

2. Assistant Advisory Officer in Animal Husbandry. Applicants must have a Degree in Pure Science or in Agriculture and have experience of animal husbandry.

Salary ranges, according to age, qualifications, and experience (plus appropriate war bonus), are: Men £275 to £375; Women £220 to £300.

Particulars of the terms and conditions of appointment may be had from the undersigned, with whom applications are to be lodged not later than 25th current.

A. J. WILSON,
6 Blythswood Square, Secretary.
Glasgow.

THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

Applications are invited for the post of ADVISORY OFFICER IN ECONOMICS DEPARTMENT. Candidates should be graduates, preferably in Agriculture, with some Economic Training, have a sound knowledge of Farming Practice, and considerable experience of Farm Economic Investigations.

Salary on the range £400 to £650 (men), or £350 to £520 (women), with appropriate war bonus.—Applications, giving full details of training, experience, and three recent testimonials, to reach the undersigned not later than 8th proximo.

A. J. WILSON,
6 Blythswood Square, Secretary.
Glasgow.

CITY OF LEEDS

APPOINTMENT OF CURATOR OF THE CITY MUSEUMS

The Corporation invite applications for the position of Curator of the City Museums. Preference will be given to persons who have had experience in general Museum work.

The salary is £600 per annum, plus cost of living bonus which is at present £50 per annum.

The appointment will be subject to the provisions of the Local Government Superannuation Act, 1937, and the passing of a medical examination.

Canvassing in any form, either directly or indirectly, will be a disqualification.

Applications, stating age, education, experience, and qualifications, accompanied by copies of two recent testimonials, and endorsed "Curator of the City Museums," must be delivered at my office, Room 57, Civic Hall, Leeds, 1, not later than Saturday, September 9, 1944.

O. A. RADLEY,
Town Clerk.

NATIONAL INSTITUTE FOR RESEARCH IN DAIRYING

UNIVERSITY OF READING

Applications are invited from men or women of suitable qualifications and experience for the post of SCIENTIFIC OFFICER (temporary) in the Cod Liver Oil (Poultry) Standardization Laboratory at the Institute, to carry out biological assays of the vitamin D3 potency of various substances; duty to begin on or as soon as possible after September 1, 1944. Salary on the Scientific Officer range—men £400 to £650, women £350 to £520, plus war bonus. F.S.S.U. superannuation only if the Officer selected is already a contributor.

Applications, with references, to Secretary, N.I.R.D., Shinfield, near Reading.

UNIVERSITY OF ST. ANDREWS

UNITED COLLEGE, ST. ANDREWS

TEMPORARY LECTURER in MATHEMATICS required for Session beginning October, 1944. Salary £350 to £400 per annum, according to qualifications.—Letter of application, together with not more than three testimonials or three references, should be sent to the undersigned not later than August 26.

DAVID J. B. RITCHIE,
The University, Secretary.
St. Andrews.

UNIVERSITY OF DURHAM

KING'S COLLEGE, NEWCASTLE UPON TYNE

The Council of King's College invite applications for the post of TEMPORARY ADVISER in AGRICULTURAL ENTOMOLOGY. Salary will be at the rate of from £400 to £680 per annum, according to qualifications and experience. The appointment will date from October 1, 1944.

Further particulars may be obtained from the undersigned to whom four copies of applications, together with the names of three persons to whom reference may be made, should be sent not later than August 31, 1944.

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

UNIVERSITY OF ABERDEEN

ASSISTANT IN PHYSICS

Salary £300 to £350, according to qualifications.

Applications should be sent, not later than August 21, 1944, to the Secretary to the University, from whom further particulars may be obtained.

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

UNIVERSITY OF ABERDEEN

ASSISTANT IN BOTANY

Salary £300 to £350, according to qualifications.

Applications should be sent, not later than August 28, 1944, to the Secretary to the University, from whom further particulars may be obtained.

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

BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION

Owing to the forthcoming retirement of Dr. H. Moore, C.B.E., the Council of the Association invites applications for the post of Director.

The initial salary offered is £1,750 per annum.

Applications should be marked "Personal," and should be addressed, not later than Sept. 15, to—The Chairman of Council, British Non-Ferrous Metals Research Association, Euston Street, London, N.W.1.

Research Chemist required by firm of

Fine Chemical Manufacturers in the Midlands for work in field of Surface Chemistry, mainly on particle properties of fine powders. For post-war only. Some industrial experience would be an advantage as applicant will be required to sustain a programme of fundamental research for a period of years while maintaining an interest in factory possibilities. The post carries good prospects. A detached laboratory and assistance will be provided and opportunities given for publication and outside contracts. Applicants should be about 30 years and should state salary required.—Box 216, T. G. Sco't & Son, Ltd., 9 Arundel Street, London, W.C.2.

A large industrial undertaking will shortly appoint one senior and one junior Entomologist, and one Plant Pathologist, who will be required to carry out field and laboratory research on the control of pests and diseases, primarily in agriculture and horticulture. Applicants should possess good academic qualifications and a sound knowledge of applied entomology or mycology. The positions will be progressive, and offer unusual opportunities.—Apply in the first instance to Box 229, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Applications are invited from persons of either sex with Chemical training and experience, including those demobilized from Forces, for technical positions, one of which involves laboratory work, on the London Staff of a well-known Chemical Company.—Full particulars to Box 226, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Research Fellow (Biochemist) required.—Applications, with full particulars, to Secretary, Research Institute, 117 Grove Street, Liverpool, 7.

Bacteriologist, Ph.D., with several years' experience in University post (both Lecturing and Research), and experience in industrial and hospital pathological laboratories, requires post, with prospects of permanency, in University or Research Laboratory.—Box 227, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Organic Chemist, Ph.D., B.S. (1st Class), B. Pharm., age 31, 7 years' academic and applied research experience, desires to change to another post with opportunity for fundamental research.—Box 228, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Wanted: back numbers of this Journal as follows: Year 1942—January 17, July 25, August 1 and 29, October 3 and 31, November 7 and 14. Year 1943—February 20 and 27, July 24, September 4 and 25.—Indian Jute Mills Association, Imperial Institute, London, S.W.7.

Owing to enemy action advertiser is anxious for immediate purchase of laboratory bench and other chemical research equipment.—Box 213, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Photometric Apparatus urgently required for Government work; either a Zeiss Pulfrich Photometer or a Photometer Head suitable for comparisons at low brightness.—Reply to Box 224, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Microscopes, of all descriptions, only a few available second-hand, perfect condition. Send details of your requirements enclosing 3d. stamp.—Telephone or correspondence only: Chards, 47 Beckenham Road, West Wickham, Kent (Spring Park 1628).

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away the traditional divisions of the various mathematical subjects studied at the School Certificate stage. The suggested new syllabus, which has now been printed with specimen papers (Mathematical Association), is arranged under seven headings: numbers; mensuration; formulæ and equations; graphs, variation and functionality; two-dimensional figures; three-dimensional figures; practical applications. The main points of it may be summarized as follows. (1) The whole syllabus is designed to bring mathematics more closely into relation with the life and experience of the pupils. (2) It is intended to be alternative to the existing syllabuses and of equal weight. It is not suggested that it has been framed for weaker candidates by any lowering of the standard. (3) The fusion of the relevant mathematical subjects, particularly geometry and trigonometry, should be developed by the setting of mixed papers, three in number each of $2\frac{1}{4}$ hours duration, so that complete freedom of method should be permitted. This freedom should extend to the use of mathematical tables and instruments. (4) To remove much of the emphasis from formal work, only proofs of key theorems should be demanded. From these key theorems many others can be deduced and proofs of these are unnecessary. The Conference admits that the list of key theorems given is not ideal; but it is about the desired length of the essential formal work. (5) Perhaps the most striking feature of the syllabus is the inclusion of the beginning of the calculus, which should grow naturally and easily out of the consideration of graphs. (6) Heavy arithmetical calculations and algebraic manipulation must be excluded. The omission of these will allow the due emphasis needed on the all-important ideas connected with functionality, which begins with graphs and leads naturally to gradients. The whole report is inspiring, and if the basic ideas of it can be successfully carried out, mathematics should indeed become a really vital subject. Too long have we encouraged the blind manipulation of the symbol, with little or no relation to reality, while the deadening influence of the traditional formality in geometry has almost completely obscured the many ramifications of the subject in everyday life. It is to be hoped that this encouraging beginning will lead to the removal of many more artificial divisions in the mathematical honeycomb.

Ley Farming

"ALTERNATE HUSBANDRY", issued as Joint Publication No. 6 by four of the Imperial Agricultural Bureaux (Aberystwyth. 5*s*.), has been compiled by a number of authors, each of whom deals with different aspects of the subject. It is emphasized that the use of leys in rotation under a wide range of climatic and soil conditions and in combination with a great variety of crops is a question upon which much research is needed, and that the purpose of the publication is largely to provide a basis for that research. The system is flexible, but cannot be applied to all types of agriculture, it being unsuitable, for example, in semi-arid or wet tropical regions where problems of establishment and management multiply considerably. The publication opens with a geographical review in which the trends of development in the practice in fifteen different countries and regions are described. Later chapters deal with the question in more detail, showing among other matters that the type of ley selected depends largely on the climatic factor, and that a closer study of the root systems of herbage plants is required before the effect of the various species and their different combinations on the soil can be properly assessed. It is generally recognized that a ley is a method for improving the structure of the soil, as it increases granulation, which both benefits the crop and helps to prevent erosion. Other problems such as weed control, soil conservation, plant health and the economic factors involved in the system are also discussed. As regards the animal crop many factors are involved; but it seems likely that the regular ploughing of grassland will reduce the liability to disease even in spite of increased concentration of stock. For those requiring more detailed information, a list of more than three hundred references are arranged in groups appropriate to each chapter.

Birth-rate in the United States

ACCORDING to an annotation in the February issue of the *Statistical Bulletin* (the organ of the Metropolitan Life Insurance Company of New York) the War has caused not only a sudden rise in the birth-rate but also very marked though undoubtedly temporary changes in the seasonal pattern of the birth-record. In contrast with the normal pattern of a major peak in the summer months, a minor peak in February and March, and low points about May and December, in 1942 there was a rise in the birth-rate through most of the year with a high peak in December; the accelerated rise in the last quarter of 1942 represented the increased number of conceptions in the period immediately following the attack on Pearl Harbour on December 7, 1941. In 1943 the births were at a maximum in January with a general trend downwards throughout the rest of the year. There was a seasonal dip in May, but births in that month were higher than in November and December. Births in July and August were lower than in each of the first three months of the year and lower than in June. The experience of the last few months clearly shows that a continuing decline of the birth-rate may be expected for the duration of the War, and for at least a year after the cessation of hostilities.

Irrigation Research in India

THE report for the year 1941 of the Punjab Irrigation Research Institute describes fully the researches on soil grading and soil density, water seepage, movement of silt beds, model investigation of water flow of rivers, weirs and headworks, and land reclamation with particular reference to salt accumulation. In addition to these main researches, many original methods of analysis and measurement are described, and a section deals with the sampling of suspended silt. The volume, which consists of 230 pages and 210 figures or photographs, would be more useful for reference purposes if an index had been provided.

The Royal Institute of Chemistry

THE Council of the Royal Institute of Chemistry recently decided that the offices of registrar and secretary of the Institute, previously held by Mr. Richard B. Pilcher, should be separated. To the office of registrar, the Council has appointed Mr. R. Leslie Collett, who has for nearly twenty years been assistant secretary, and to the office of secretary, Dr. H. J. T. Ellingham, of the Imperial College of Science and Technology. Both appointments will take effect from January 1, 1945.

LETTERS TO THE EDITORS

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

Synthesis of Amylopectin

NATURAL starch is a mixture of two components, which can be separated in a number of ways although it is doubtful if complete separation has yet been attained. The names, amylose and amylopectin, used earlier in a different sense, may be conveniently retained to describe the two components. Amylose, forming about 25 per cent of whole starch, is constituted of unbranched chains of glucose residues, the members being mutually linked by α-1 : 4-glycosidic linkages. Amylopectin possesses for the most part the same 1 : 4 glucose linkages and forms about 75 per cent of natural starch, but its chain structure is branched or laminated through the lateral linking of its shorter lengths of 1 : 4 glucose chains by certain α-1 : 6-glycosidic bonds.

C. S. Hanes[1] isolated from the potato (and from the pea) a phosphorylase which effected, in the presence of phosphate ion, the conversion of whole starch into glucose-1-phosphate, and demonstrated that this reaction was, in a sense, reversible *in vitro*. The polysaccharide produced in this reverse reaction was not, however, identical with whole starch but with only one of its components. At least 85 per cent of the Hanes' synthetic starch had the properties of an amylose. Thus, (1) it retrograded rapidly from solution, (2) it gave a pure blue colour with iodine, and (3) it was completely hydrolysed to maltose by β-amylase. End-group assay showed its continuous chain-length to be 80–90 glucose members[2] whereas that of whole starch averages 24–30 units. Furthermore, the molecular weight of the methylated product determined osmotically corresponded to a particle size of 80–100 glucose units, thus providing clear evidence of the absence of branching in this synthetic amylose.

We now have to report the separation from the potato of an enzyme system which catalyses the conversion of glucose-1-phosphate into a polysaccharide which is not amylose but which is probably identical with the amylopectin component of natural starch. This new polysaccharide is constituted entirely of *d*-glucose units, it gives a purple-red colour with iodine, it is soluble in water and does not retrograde from solution. In these properties it is not to be distinguished from the amylopectin fraction of natural starch. Furthermore, it is attacked by β-amylase and maltose is liberated, but, as with natural amylopectin, the hydrolysis is arrested before the conversion into maltose is complete. This behaviour is characteristic of the branched-chain type and distinguishes it sharply from the unbranched, amylose type which is entirely converted to maltose by β-amylase. Under identical conditions and by the same preparation of β-amylase, synthetic amylopectin and natural amylopectin were converted to maltose to the extent of 45 and 49 per cent respectively. These figures represent resting points in the hydrolysis and were attained after about four hours in each case.

In an exploratory experiment, a few grams of the synthetic amylopectin have been methylated and the proportion of end-group assayed. The result quite definitely indicates that the substance is not amylose, inasmuch as the number of glucose residues in the unit chain is 20. We lay no stress on the actual numerical value given for the chain-length because this preliminary assay was carried out on too small a quantity of methylated product to conform to the usual standard of accuracy, and, moreover, the sample submitted to assay contained only 41 per cent methoxyl as compared with the usual 44–45 per cent. The margin of error is not, however, greater than ± 10 per cent. Although much dubiety is attached to the estimation of molecular weight by viscosity measurement, it may nevertheless be of significance that our viscosity measurements indicate a molecular size corresponding to about 100 hexose units when the K_m constant for methylated whole starch is used. With this reservation in mind, the particle size is seen to be some five times the size of the unit chain, a fact which supports the evidence of branching given by the observation of the cessation of β-amylase activity at 45 per cent conversion.

Hassid and McCready[3] find for separated natural amylopectin, by end-group assay, a unit chain-length of 25 glucose residues and a molecular weight (by viscosity measurement) corresponding to 450 glucose units. The same experimental error margin (± 10 per cent) will apply to this assay figure as to ours for the reason that less than 0·5 gm. of end-group was estimated.

It is our intention to repeat the end-group assay and also to determine the molecular weight by the more trustworthy osmotic method when adequate quantities of synthetic amylopectin become available.

It is too early to discuss the bearing of these observations on the question of starch synthesis in the plant; but we have some reason to believe that Hanes' amylose-synthesizing enzyme participates also in the enzyme system responsible for the synthesis of our amylopectin. It would appear that an additional factor—the *Q* factor—is present in our enzyme preparation which modifies the normal synthetic activity of the phosphorylase (*P* enzyme) and enables 1 : 6-glycosidic cross-linkages to be formed.

It is perhaps important to mention that our synthetic amylopectin cannot be an amylolytic degradation product of an amylose synthesized in the normal way by phosphorylase. We have taken the greatest care to ensure the absence of both α- and β-amylase from our enzyme preparations.

W. N. HAWORTH.
S. PEAT.
E. J. BOURNE.

A. E. Hills Laboratories,
The University,
Edgbaston, Birmingham, 15.

[1] Hanes, C. S., *Proc. Roy. Soc.*, B, **128**, 421; **129**, 174 (1940).
[2] Haworth, W. N., Heath, R. L., and Peat, S., *J. Chem. Soc.*, 55 (1942).
[3] Hassid, W. Z., and McCready, R. M., *J. Amer. Chem. Soc.*, **65**, 1159 (1943).

Penicillinase from *B. subtilis*

IN the bacteriological examination of blood or exudates of patients under treatment with penicillin, it is necessary to inactivate any penicillin present if viable penicillin-sensitive organisms are to grow. The routine testing of penicillin products for sterility also requires a means of neutralizing the antibacterial effect of penicillin. The coli-penicillinase method[1] has the disadvantages that the preparation is turbid and the activity of the final product varies.

Among many chemical and biological materials tested for penicillin-inactivating properties, we have found a strain of *B. subtilis*, previously isolated as a chance contaminant, that was a good source of penicillinase. Our original method was as follows :

24-hour agar cultures in 20-oz. bottles were washed off in a minimum amount of saline. The suspension was then standardized to give an opacity equal to 10 times that of tube 2 of the Brown's opacity tube set. 60 ml. of the suspension were centrifuged for 30 minutes at 5,000 revolutions per minute (radius, 13 cm.). The clear supernatant fluid was decanted and the residual organisms were transferred to an agate mortar and ground for 30 min., when a stained smear showed very few undisrupted bacteria present ; 25 ml. of distilled water were added and extraction proceeded at room temperature overnight. After centrifuging until the supernatant fluid was clear (about 10 min.), the deposit was removed and the supernatant fluid was sterilized by Seitz filtration.

Another and a simpler method is to grow the organism in a 100 ml. bottle of papain digest broth at 37° C. for two to three days. The metabolic fluid is then sterilized by Seitz filtration. In preliminary tests 0·5 ml. of the filtrate inactivated 250 Oxford units of sodium penicillin after one hour's contact at room temperature. Control tests showed that the metabolic fluid had no adverse effect on the strain of *Staphylococcus aureus* used as test organism.

showed slight inhibition (in a dilution of 1 : 4) of the test organism.

There is some evidence to show that free formation of penicillinase in the metabolic fluid is marked in penicillin-resistant strains of *B. subtilis*, and that the amount of the penicillinase is related to the strength of the surface pellicle on the culture. Investigations are now being made into the properties of penicillinase produced in agar cultures. The data at present available show that 1 ml. of a dilution of 1 : 250 of the culture fluid still inactivates 50 O.U. of penicillin after four hours incubation. In routine sterility tests the fluid is added to the dried or dissolved samples (for example, to 1 ml. containing 3,000–4,000 O.U.) and left in contact for 24–48 hours at 37° C., after which the penicillin is inactivated. The metabolic fluid kept in the refrigerator over a period of 3–4 weeks shows no deterioration in potency; heating to 80° C. for 30 minutes destroys part of the penicillinase activity.

Penicillinase may safely be added to exudates and body fluids from patients receiving penicillin treatment, for it does not inhibit the growth of bacteria cultivated from such specimens.

The inhibitory effect of penicillinase on penicillin can be clearly shown either in broth tubes using the serial dilution method, or by inseminating agar plates containing penicillin-sensitive organisms ; in fact, Heatley's cup method or filter paper disks can be

	24 hours					48 hours				
	Turbidity	Deposit	Pellicle	*p*H	Activity	Turbidity	Deposit	Pellicle	*p*H	Activity
Hartley's broth	+	0	+++	7·2	+	+	±	+++	7·0	++
Peptone water ('Difco Bacto') in 8 per cent CO_2	+	0	+++	7·8	++	±	0	+++	7·2	++
Peptone water (French)	±	0	+++	7·4	+	±	0	+++	7·3	++
Peptone water (Paines and Byrne)	+	0	++	7·4	+	+	0	++	7·2	++
Peptone water (Evans)	++	0	+++	7·0	+	++	±	+++	6·8	++
Peptone water ('Difco Proteose')	±	0	+++	7·4	+	±	±	+++	7·0	++
Peptone water ('Difco Bacto')	++	0	+++	7·8	++	±	0	+++	7·0	++
Papain digest broth	+	0	+++	8·0	+	±	±	+++	7·6	++

+ = 50 O.U./ml. inactivated in 6 hours. ++ = 50 O.U./ml. inactivated in 2 hours

We examined the influence on penicillinase production of different conditions of growth—such as presence of oxygen, carbon dioxide, sugars and serum. Glucose (1 per cent) in papain digest broth decreased penicillinase production, as did 5–10 per cent human serum in the medium. Anaerobic cultivation or growth in 8 per cent carbon dioxide had no direct influence, provided growth of the cultures took place. Penicillinase was produced when the strain was grown in 2 per cent peptone water, but in this medium the addition of glucose did not decrease the amount formed.

The accompanying table summarizes the characteristics of the penicillinase obtained on different media.

The lower *p*H of the glucose broth had no direct effect on the rate of penicillinase production, for in many of our tests with other media we found as much penicillinase to be produced at *p*H 5–6 as at *p*H 7·5. The addition of other carbohydrates (1 per cent starch, mannitol, maltose, lactose) to the medium had a less marked effect in depressing the formation of penicillinase. Although the amount of penicillinase formed with different peptones is similar, it is preferable to use the purer brands, because the metabolic fluid from cruder peptones, containing impurities, used for estimating penicillinase potency. Alternatively, this can be done by putting the material to be tested on to 'Cellophane' sheets "P.T. 300" on the surface of the agar plates. The penicillinase does not diffuse into the agar and does not pass through the 'Cellophane' membranes as does penicillin, and this permits the test to be easily performed.

This work was carried out in connexion with investigations of the Therapeutic Research Corporation of Great Britain.

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July 4.

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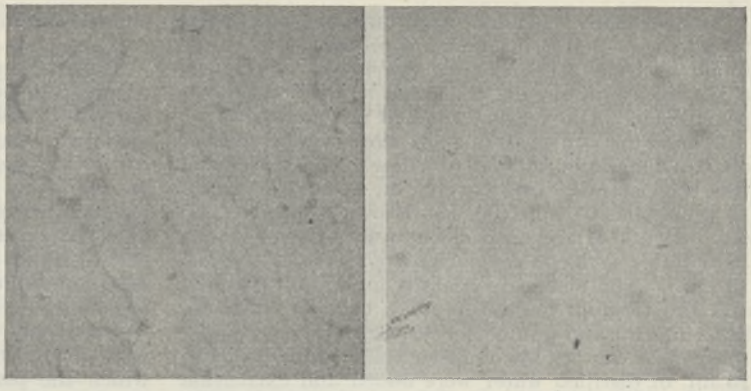
Dextran and Levan Molecules Studied with the Electron Microscope

THE fundamentally improved designs for the electron microscope made in recent years by different workers have led to such an improvement in the resolving power that a direct study of giant molecules with the aid of this instrument may contribute in

a certain degree to our knowledge of their appearance. If we except the researches on viruses, the following investigations already performed in this direction should be mentioned: M. von Ardenne[1] and W. M. Stanley and Th. F. Anderson[2] have succeeded in photographing hæmocyanin and edestin; E. Husemann and H. Ruska have also photographed glycogen[3] and iodobenzoylglycogen[4]. All these molecules, however, are more or less spherical ($\phi \sim 100$–300 A.). They therefore appear on the plates as small diffuse dots. The electron-microscopical investigation of these molecules is facilitated by their more compact structure, which gives a good contrast with the substrate. In the case of iodobenzoylglycogen, this contrast has been further improved by the introduction of heavy atoms into the molecule.



a *b*

FIG. 1. ELECTRON-MICROSCOPE PHOTOGRAPHS OF (*a*) DEXTRAN MOLECULES, × 30,000; (*b*) LEVAN MOLECULES, × 35,000.

In the course of an investigation of the high-molecular components of sugar beet juice, one of us has encountered a polysaccharide of very high molecular weight, dextran[5]. This substance is obtained by the action of a bacterium, *Leuconostoc mesenteroides*, on the juices of the sugar beet, and its composition corresponds to the empirical formula $(C_6H_{10}O_5)_n$. The researches of Levi, Hawkins and Hibbert indicate that the dextran molecule consists of a long principal chain to which side-chains are attached[6]. (Physico-chemical measurements also indicate that the dextran molecule is thread-like[5].) The side-chains may consist each of five glucose units[6]. Since the length of a glucose unit is 5 A., the presence of these side-chains would give the whole molecule a breadth and thickness of 50 A. Consequently it may well be visible under the electron microscope, designed by Prof. Manne Siegbahn, at the Research Institute for Physics in Stockholm, which has a resolving power of about 30 A.

The customary technique has been employed in the electron-microscopical investigation; namely, a dilute solution of the water-soluble dextran (0·002 per cent) was allowed to dry on the foil ($\sim 0{\cdot}008\ \mu$) on the object-holder. The direct electron-optical magnification has been maintained at 7,000 ×, in addition to which the fine-grained plate allows a subsequent enlargement of up to 10 ×. Fig. 1*a* shows the result of such an exposure with total magnification 30,000 ×. On further dilution, pictures are obtained where the dextran threads lie farther apart. The long and branched form of the molecules gives them a strong tendency to cohere, so that in the photograph certain threads may correspond to several molecules lying side by side. In several places, however, extremely thin threads may be distinguished, the thicknesses of which are rather uniform, namely, 30–100 A.; this corresponds well with the estimated molecular thickness of ~ 50 A. This estimation of the thickness is naturally quite uncertain in view of the fact that the resolving power of the microscope is just of this magnitude. It is an interesting feature that it is possible, on many different photographs, to distinguish small nodes situated on the fine molecular threads at equal distances from each other, namely, ~ 800 A. This phenomenon, unfortunately, is not so evident in the reproductions. The distance between two nodes thus corresponds to about 160 glucose units[7].

We have also taken photographs of levan molecules, that is, polysaccharide molecules built up exclusively of fructose. The levan used by us was prepared from a solution of crude sugar, seeded with a culture of *Bacillus vulgatus*. Investigations performed by one of us with the help of Svedberg's ultracentrifuge showed that this levan has an extremely high molecular weight. Sedimentation constants of the order of 200–300 × 10^{-13} and diffusion constants of the order of 0·2 × 10^{-7} were measured. If these values are substituted in Svedberg's molecular weight formula, particle weights of the order of 50–100 million are obtained, which values are considerably higher than those usually encountered among soluble polysaccharides. It may well be asked whether these particles with weights of one hundred million may be called molecules. Everything indicates, however, that the particles, despite their size, are stable. The sedimentation constant, for example, is unaltered after the levan has been precipitated with alcohol, dried and redissolved. These experiments with the ultracentrifuge, etc., will be published at a later date by B. Ingelman.

To judge from Fig. 1*b* (total magnification 35,000 ×) these levan molecules would appear to have a more compact structure than the thread-shaped dextran molecules. The particle size varies in a striking manner, which is also to be seen in the ultracentrifugal data. The electron-microscopical photographs indicate, as do the experiments with the ultracentrifuge, an extremely high molecular weight.

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A Simple Fluorometer of the Duboscq Type

VARIOUS fluorometric methods are employed in determining riboflavin and thiamin. The fluorescent substance is freed, and in the final stage is compared with solutions of known concentration. Weisberg and Levin[1] recommended the use of a block-comparator, but later authors[2,3,4] employ a photo-cell connected with a galvanometer for testing the intensity of fluorescence. These photocell arrangements, however, are very expensive.

The method described below is simple and relatively inexpensive. The light-source, a U-shaped Hanovian quartz burner, is projected on to the cups of a Duboscq colorimeter by means of a flask so that each branch of the U-shaped burner illuminates one cup. The fields of the colorimeter are then matched in the usual way and the intensities compared. The advantages of this method are as follows. (1) Both cups are illuminated by the same light-source; therefore changes in the output of light cannot influence the readings. (2) In passing through the liquid the exciting light is partially absorbed; for this reason sample-holders are kept as short as possible in fluorometric work. On the other hand, only low concentrations of fluorescent matter yield a linear response. (3) When illuminating the cups through the window at the bottom, the whole length of the cup cannot be evenly illuminated. In my arrangement, however, the exciting light enters from the front. Hence (*a*) the activating light passes through only the width of the cup (the path thus being rather short); (*b*) the whole length of the cup is evenly illuminated; (*c*) since the cups are viewed through the colorimeter from above, the bright halves of the fields can be easily matched.

The light-source is a 220-volt Hanovian U-shaped burner. The light passes through a Wood's filter to a 500 ml. round-bottom flask filled with distilled water or a saturated solution of copper sulphate (to exclude the red portion of the spectrum transmitted by Wood's filter). If the colorimeter is not fitted with blackened rods, both rods are covered with black varnish and only the bases are left free. The supports of the cups of the colorimeter are copied from the original supports. A ring is soldered on to the support. Then two test-tubes with flat bottoms are fitted into the ring and sealed to it. The size of these tubes depends on the length and diameter of the rods, in our case 60 mm. and 14 mm. respectively. To avoid reflexions, a black ring of about 10 mm. height is painted on the outside of the cups. To protect the eyes an ultra-violet absorbing filter (or an ordinary photographic plate, fixed and bathed in picric acid) is inserted into the eyepiece or between rods and eyepiece.

The estimation of fluorescein is given as an example. (1) Solutions of sodium fluorescein, 0·2, 0·4, 0·6, 0·8, 1·0 and 1·2 gamma/ml., are prepared. (2) Both cups are filled with 0·2 gamma/ml. sodium fluorescein; and the rods are brought to the same position, say, 50 mm. (3) Now a piece of white paper is put up immediately in front of the cups. Then lamp, colorimeter and flask are so adjusted as to project on each cup one branch of the 'U'-lamp. To get an illumination of the whole width of the test tubes, these should be slightly out of focus. Then the paper is removed and the whole arrangement shielded against daylight by a black cloth. By small movements of the stand (but not by moving the rods) a position can be found where both halves of the field are evenly illuminated. Without moving the stand, both rods are now brought to, say, 30 mm.; then again both halves of the field should be equal. Between 0·2 and 1·0 gamma/ml. the relation between scale readings and concentration is a linear one. (4) When determining the concentration of an unknown solution of fluorescein, the unknown is diluted so as to give a fluorescence slightly stronger to the naked eye than the 0·2 gamma/ml. solution. One cup is filled with 0·2 gamma/ml. fluorescein, the other one with the diluted unknown. The rod dipping in the 0·2 gamma/ml. solution is brought to, say, 50 mm. By moving the rod, both fields are matched and the concentration of the unknown read off from a reference diagram.

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May 11.

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Natural Selection in the Six-spot Burnet Moth

THE larva of the common six-spot burnet moth (*Zygaena filipendulæ* L.) forms an elongated cocoon on grass or other stems often at a height of six or more inches above the ground. Sometimes, however, the cocoon is spun on low vegetation or a twig in a hedge.

During last summer, when collecting large numbers of cocoons to breed the parasites, I noted that cocoons affixed to a coarse-meshed wire netting fence bordering a road had often been opened and the contents extracted. This was also the case with cocoons on a hawthorn hedge, but was not so with cocoons on tall upstanding grass stems in the open. The tentative conclusion that the enemy was a bird was confirmed when I saw a great-tit perch on the wire fence, open the end of a cocoon, pull out the larva inside, and thrust it into the mouth of a clamorous young one close by. The damage to this cocoon was similar to that previously noted. Thus it seems that a cocoon is liable to attack by a bird *which can reach it.*

This summer I have taken notes on the fate of all the cocoons on the wire fence for a length of about eighty yards. Each one, as soon as the imago emerged, or after it had been opened, was pulled off the fence and recorded. The results, during May 24–July 10, were as follows: opened and larva or pupa extracted, 22; opened, larva or pupa pecked and damaged but not extracted, 2; moth emerged, 8; moth formed but failed to emerge and died, 2; larva or pupa destroyed by Hymenopterous parasites, 3. Thus out of 37 on the fence, no less than 24 were destroyed by birds—a percentage of 64·8. I had hoped that it would be possible this year also to record the fate of cocoons out of reach of birds, but pressure of work has prevented this, and I have only the unrecorded experiences of last year.

Here is a promising and convenient subject for investigation by school scientific societies, for the

full-fed larvæ are easily found in quantity early in the summer term. A test could also be made of the presence of an instinct in the larva to make its cocoon on a tall waving grass stem rather than on more solid objects, and also whether the larva will be satisfied with any height of stem, or will come down again from one that is too short for safety and seek for a longer one. It is obvious that such an instinct would be selected by attacks such as have been described.

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Stability after the War

THE programme of the United Nations, as broadcast at the end of 1943, may at its briefest be stated thus: the Germans and Japanese are to be defeated and disarmed, and thereafter watched for so long a time as may be necessary by an armed force controlled by the United Nations, who are firmly resolved to remain united.

Historical facts, taken alone, do not predict the future; they do so only if they are combined with some hypothesis. A general form of hypothesis for the quantitative interaction of two entities is a pair of simultaneous differential equations, having time t as independent variable. Almost the simplest of such pairs is

$$dx/dt = g-\alpha x+ky, \qquad dy/dt = h+lx-\beta y, \qquad (1)$$

where g, h, α, β, k, l, are constants. The most relevant of the quantitative historical facts are the numbers of persons engaged on war-preparations in the opposing groups. Let these be x and y. It is then found that the equations (1) are capable of describing the European x and y for the years 1908–13 and again for 1933–38, during the greater part of the arms-races[1]. Moreover, the constants have psychologically intelligible names, thus: g, h, grievances and ambitions; k, l, defence coefficients; α, β, fatigue-and-expense coefficients. This analysis emphasizes, what is also obvious to common sense, namely, that if the several nations, now united, were to attempt to regain their former so-called freedom, sovereignty and independence, then after the present War had faded out of mind, disastrous arms-races would be likely to develop between them.

The other essential part of their programme is the submission of the defeated. Equations (1) are too simple to describe defeat or submission. For this purpose it is necessary to introduce at least the quadratic term in the constant ρ, which has been called a 'submissiveness', thus[2]

$$\left.\begin{aligned} dx/dt &= g-\alpha x+ky, \\ dy/dt &= h+lx\{1-\rho(x-y)\}-\beta y. \end{aligned}\right\} \qquad (2)$$

It is very ominous that the turn in the year 1930 from the long pause into the arms-race can be described by equations (2). I am not saying that no other motives were operative. On the contrary, it seems almost certain that the great trade depression and the fading of war-weariness were involved. But I do say that there is no warrant either in those facts or in that theory for the belief that Europe will be permanently stabilized by submissiveness in the presence of grievances, ambitions, defensiveness, and the dislike of fatigue and expense. Balance of power, according to the theory, may be of various types, some stable, some unstable. The need for some other and more binding motive is clearly indicated.

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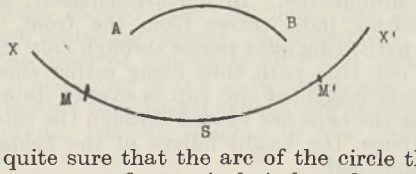
Argyll. July 1.

[1] *Nature*, **135**, 830; **136**, 1025; **142**, 792; and much yet unpublished.
[2] "Generalized Foreign Politics", 23 (Camb. Univ. Press, 1939).

A Halo Phenomenon

AT 10.15 a.m. G.M.T. on May 2 last some cirrus clouds drifted across the sun; I suspect that they were the remains of condensation trails. As they passed over, I noticed a very peculiar halo phenomenon. The part first visible was the arc $M'X'$; I did not suspect that it was part of a halo circle, though it struck me that it was very like one; I took it to be a long wisp of cirrus or part of a condensation trail. But there then appeared at M' a very brightly coloured parhelion, and at the same time I noticed part of a 22° halo at A,B. A few minutes later the arc $X'M'$ had extended through the sun (S) to M and X; there was another brightly coloured parhelion at M; I think that M and M' were rather more than 22° from the sun. The whole phenomenon lasted a very few minutes; I went indoors to get a camera, but by the time I came out again it was all over.



I am quite sure that the arc of the circle through the sun was part of a vertical circle and not part of the horizontal parhelic circle, though like the latter it was white. I am not sufficiently up in meteorological optics to know whether a white vertical circle passing through the sun at its lowest point has been previously observed, but in any event it must be extremely rare. The figure is purely diagamatic; there was no time to take any measurements.

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Centenary of Dalton's Death

THE Manchester Literary and Philosophical Society, which was so closely associated with John Dalton during the whole of his life in Manchester, is commemorating his work on the occasion of the centenary of his death which falls this year. The first meeting of next session is to be devoted to a memorial lecture. In connexion with it the Society hopes to publish a memorial volume in which it would be of interest to give the whereabouts of relics of Dalton, many of those which the Society possessed having been destroyed as a result of fires started by enemy action. The secretaries would therefore welcome any information relating to Dalton's scientific interests or his connexion with the Society. They are also in a position to receive gifts or offers of gifts.

C. M. LEGGE.
D. E. WHEELER.
(Hon. Secretaries.)

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RESEARCH ITEMS

Mechanism of Visceral Pain

EXPERIMENTAL morphologists will be interested in the two Lettsomian Lectures on the mechanism of visceral pain delivered by Henry Cohen of Liverpool before the Medical Society of London (see *The Lancet*, 764; June 10, 1944). In the first lecture, Prof. Cohen surveyed and criticized the clinical and experimental data available at present; in the second he discussed the hypotheses which have been formulated to explain why viscera which are normally insensitive to painful stimuli will often reveal themselves by pain in states of disease. None of these hypotheses satisfies Prof. Cohen. It seems necessary, he believes, to postulate a constant stream of subthreshold impulses from the end organs of all pain fibres to the central nervous system, which do not enter central subconsciousness unless central inhibition is lowered. Even an increase in these may not pass the threshold unless it is reinforced by impulses from somatic structures within the same somatic innervation, and vice versa. The metamere, being the phylogenetic unit, renders it unlikely that impulses from any structure within it will reach closely related areas in the sensorium. When any pain impulses, or the sum of them all, rises above the threshold, pain is localized in the segment. If the somatic component of these impulses is cut off, a much stronger stimulus is required in the viscus if pain is to be experienced, and it may then be felt, not only in the segment, but also in the anæsthetized part.

Life-History of a Mite

STUDENTS of the Acari will be interested in the observations on the behaviour of *Acarus scabiei* made by Dr. Clayton (*Brit. Med. J.*, 752, June 3, 1944) when he placed on the interdigital web between his left thumb and index finger an active female mite. Moving quickly about 1 cm. from the place where it was put, the mite lodged in a furrow of the skin, tilted its body obliquely with the help of its hind-leg bristles and began to bore into the side of the skin furrow. Within a very few minutes "the head and appendages" were buried, but it was 67 minutes before the distal end of the mite had disappeared. J. W. Munro (*J. Roy. Army Med. Coll.*, **33**, 1; 1919) states that, under favourable warm conditions, the mite can conceal itself completely in 2½ minutes. After two full days, the mite observed by Clayton had progressed 0·1 cm. After 24 days the burrow was ⅜ in. long with perforations in its roof, giving it the typical dotted appearance. In it four translucent eggs were found when it was opened for the removal of the mite. Meanwhile, itching had developed between the middle and ring fingers of the left hand and on the right wrist. A mature female mite was removed from a burrow ⅜ in. long on the left index finger 34 days after the first mite had begun to burrow. The author does not agree that the posterior direction of the spines of the mite prevent its retrogression out of the burrow and therefore cause its death. He thinks that the spines act as 'pit props' and withstand pressure from the roof and from outside, and help the mite's passage through the skin. There was "strong presumptive evidence" that the eggs of the mite had hatched and that larvæ had migrated and burrowed after slightly less than 5½ days. The author's observations tend to support Monro's statement that the complete life-cycle (egg to egg) varies between 7½ and 13 days.

Transfusion into the Bone Marrow

IN a paper on transfusion into the bone marrow of the sternum, Hamilton Bailey (see *Nature*, **153**, 258, Feb. 26, 1944) reported favourably on this procedure under certain conditions, and there have been further notes upon this method in the medical literature. Janet D. Gimson (*Brit. Med. J.*, 748, June 3, 1944) now reports on transfusion into the bone marrow of the tibia of infants and young children. The new needle which she has designed for the purpose is figured and described. The technique has been devised because of the difficulty of transfusing into the veins of premature and small infants. The needle is inserted through the flat subcutaneous plate of bone below and medial to the anterior tibial tuberosity well below the epiphysial line of the splinted limb, where there are no important anatomical structures which might be damaged. A photograph of a transfusion in progress is given. Any of the usual transfusion fluids may be given by this method. The constant rate of drip which can be maintained is usually remarkable. The longest time during which one transfusion was maintained was six days, and there was no reason to suppose that it could not have been maintained longer.

Staining Mammalian Hair

J. Davidson and W. D. Taylor have described (*J. Quekett Micro. Club*, Ser. iv, No. 1, 1943) a technique for the treatment of mammalian hairs so that their structure, more especially that of the cuticular scales, can be studied in detail. Since each species of mammal appears to have its own distinctive hair structure it is easy to see that a means of preparing it for accurate examination may be of importance from the medico-legal point of view as well as for other purposes. The opacity of the medulla in ordinary preparations of hair is shown to be due to the presence in it of air, which can be removed under a vacuum, and not to the presence of pigment. Heavily pigmented hair has next to be bleached, and the formula for a reagent that will do this without injury to the hair is given. The staining is carried out with 1–100 carbol fuchsin (Ziehl Neelson) in a vacuum oven. A series of excellent photomicrographs shows how successful this method is for demonstrating (i) the structure and arrangement of the cuticular scales and (ii) the structure and relative proportions of the cortex and medulla, as shown in optical section, in the hairs of various mammals.

Enzymatic Adaptation in Yeast

SOME yeasts can ferment galactose whereas others cannot. Of those possessing the ability, some do so only after acclimatization in culture containing the sugar. Some authors claimed that new cells must be formed before the formation of galacto-enzyme occurred, while others suggested that there was a direct cytoplasmic reaction of an original cell. S. Spiegelman, C. C. Lindegren and L. Hedgecock (*Proc. U.S. Nat. Acad. Sci.*, **30**, 13; 1943) have evolved a method by which the reaction of one cell as distinct from that of the population may be followed. It was found that in a haploid population which was presumably heterogeneous, the adaptation to galactose fermentation only occurred after cell divisions, whereas, in diploid-stable populations, this took place throughout the population without the necessity of cell division. A warning is given against the assump-

tion of galactose fermentation taking place when this sugar is the only carbohydrate source for a living yeast colony. Of 34 cultures, only one failed to survive on galactose, but 80 per cent of the cultures were unable to ferment the sugar.

Genes in Rice

B. S. Kadam and K. Ramiah (*Ind. J. Gen. and Plant Breed.*, **3**, 7; 1943) have listed the inherited characters that have so far been discovered in rice. The number of genes is more than three hundred, and these have been placed under a suitable nomenclature by the authors.

Synchronous Turbo-Generators

IN a paper (*J. Inst. Elec. Eng.*, **91**, Pt. 2, No. 21; June 1944) on the "Fundamental Electrical Characteristics of Synchronous Turbo-Generators", W. Szwander deals mainly with the MVA. rating or the power factor rating, and with the synchronous-reactance value of large, non-salient-pole machines; and discusses essential factors for selecting these values and a method of making the selection. An analysis is made of the manner in which the two values affect the operation of the generator. From a power chart based on the classical circle diagram, diagrams of 'working area' limitations are derived and represented in co-ordinates of reactive power versus active power, power factor versus active power and excitation current versus active power. These diagrams are suitable for comparing properties of different generators when ordering new units, and for the supervision of operation of generators. Problems of capacitive loads and of synchronous stability of generators are also discussed. From a comparison of external characteristics of an isolated generator, with different load characteristics, conceptions of voltage stability and of 'absolute power limit' in respect of that voltage stability are derived. The author discusses the influence of stator-winding resistance and of saturation on representative diagrams and curves, and illustrates the paper by an example of an actual 50 MW., 58 MVA. turbo-generator.

Electromagnetic Effects in Solid Iron

IN a paper (*J. Inst. Elec. Eng.*, **91**, Pt. 2, No. 21; June 1944) on "Electromagnetic and Mechanical Effects in Solid Iron due to an Alternating or Rotating Magnetic Field", R. Pohl points out that a problem still awaiting solution is the complete predetermination of the phenomena connected with the penetration of alternating flux into solid iron. The classical expressions for the flux and current distributions and the iron loss due to an alternating magneto-motive force rest on the assumption of constant permeability, and therefore apply only to values of induction far below those now employed. Moreover, they ignore hysteresis, which affects both the loss and the power factor to such an extent as to invalidate these expressions for practical purposes. A further difficulty arises in machine design, in that the magneto-magnetic force acting upon the iron surface forms an unknown component of a known primary magneto-motive force: a second component is absorbed in flux paths outside the iron and depends on the magnitude of the total flux. The paper presents the subject to the designers of electrical machines in a manner with which they are familiar and, in addition to discussing the connexion between the primary ampere-turns and their surface component, shows the effects of hysteresis, and extends the theoretical and experimental investigation to values of induction beyond the knee of the magnetization curve. So far, only the theoretical boundary case of ideal saturation has been solved, and it is shown that a computation based upon a given iron magnetization curve is possible by means of a graphical method. Section 2 of the paper, on practical applications, deals with the utilizable mechanical effects in various types of machines, and indicates means for improving their performance.

Solar Flares and Magnetic Storms

H. W. NEWTON has continued his work on this subject (*Mon. Not. Roy. Astro. Soc.*, **104**, 1; 1944), discussing the relationship between the less intense flares and geomagnetic activity. The most intense flares of all are denoted by 3+, and, as his earlier paper showed, these proved to be of great importance in the occurrence of great magnetic storms. The present paper is restricted to flares of intensity 3 and 2 in decreasing order of magnitude, and the data for these less-intense flares are almost entirely from the present 11-year solar cycle. Flares of intensity 3 and 2, during 1934–42, are compared with magnetic storms recorded at Greenwich (Abinger), and also with the daily international magnetic character figures (De Bilt). The subject is discussed very fully and is illustrated with the aid of a number of diagrams. In the case of flares of intensity 3, there is a small statistical rise of geomagnetic activity within a few days of the mean flare, but in individual cases the disturbance is generally less intense and is less probable than for flares of 3+. In the case of flares of intensity 2, less than two out of ten flares are associated with a magnetic storm on the day of the flare or one or two days later. This result is very little more than can be expected from pure chance. Fade-outs and magnetic activity are dealt with towards the end of the paper, and the percentage frequency of magnetic storms is plotted against the time-interval in days from fade-out. In a general way the radio fade-out data confirm a small statistical rise of geomagnetic activity within a few days after the mean fade-out. These results are, however, less definite than those from the solar flare data.

Solar Cycle and Weather

CHARLES G. ABBOT, secretary of the Smithsonian Institution, states that there is close agreement between measurements of calcium flocculi on the sun, made daily by the monks at the Observatory del Ebro, Spain, and changes in the solar constant (*Sky and Telescope*, February). Changes in the solar constant begin two days ahead of changes in the clouds of calcium gas seen on the sun in calcium spectroheliograms. Weather-changes on the earth extend from three days before to seventeen days after the occurrences of the solar changes with which they are correlated. Dr. Abbot finds that for many places the weather features tend to be repeated at intervals of 273 months and still more clearly at double intervals of 546 months, and these characterize the complete cycle of solar constant changes. In addition, the short-interval day-to-day solar variations dominate the weather for many succeeding days. A tentative trial of solar forecasting of temperature departures at Washington for 201 days, based jointly on the work at Ebro and the Smithsonian Institution, gave a correlation coefficient of 59 $\pm$ 3 per cent. Dr. Abbot predicts a repetition of the past great North-west droughts in 1975 and again in 2020.

MAKING AND PRESENTATION OF SCIENTIFIC FILMS

A JOINT meeting of the Association for Scientific Photography and the Scientific Film Association was held at the Ministry of Information on June 24, papers being given by the presidents of the two Associations and by Mr. Geoffrey Bell. Two films were projected, "Control Room" and "Nitrous Oxide-Oxygen-Ether Anæsthesia".

Mr. Arthur Elton, president of the Scientific Film Association, in opening the meeting, welcomed those present on behalf of the two Associations. He said that they could and should be complementary, and that the regions where they overlapped should constitute a strong bond rather than a weakness. He was glad that they were in fact working together and assisting each other materially. To achieve democratic self-government in any country, it is necessary for the citizens to have a knowledge of the scientific processes which govern their lives. The Association for Scientific Photography and the Scientific Film Association are ultimately engaged in public education; while it is not necessarily desirable for everyone to be able to solve a differential equation, the more informed the general public is, the less the danger of its being led away by filibusters such as those who had led away the countries of our enemies.

Mr. Elton then defined the fields covered by the two Associations. The Scientific Film Association, besides seeking to spread the general principles of scientific thought by means of the film, is engaged actively in the more practical problems of the production and distribution of scientific films for the public, and of specialized training films for engineers, chemists, physicists and so forth. The Association for Scientific Photography is concerned with the uses of still photography and cinematography as instruments of scientific research. While the two bodies may appear to be serving separate fields, their functions actually tend to overlap and support each other. For example, a scientific worker might use film in connexion with an investigation, say, for the analysis of high-velocity movements by means of the ultra-speed cine-camera. Sooner or later, he would want to tell people what he had done and therefore to show the film. Unless he was careful his record might well be incomprehensible to all except the specialist. With proper preparation, however, the film could be as useful a method of communication as a published paper. This is where the two Associations overlap most, for they can give advice both on the technique of preparing the film and on its method of presentation and distribution.

Mr. Geoffrey Bell, speaking on "Shooting a Scientific Film", illustrated his talk with "Control Room", a film which was made in Bristol. This shows how the Civil Defence organization works in Great Britain. Though made primarily for American and for general home audiences, the film has also been used for showing to Civil Defence personnel, many of whom did not know how their huge and new organization worked as a whole. The film shows the nature of the technical problems of different branches of Civil Defence and the technique used to achieve co-ordination between these branches. For example, if the telephone engineers and the waterworks engineers want to repair their respective services in the same bomb crater, it is not enough that each should have prepared emergency measures for such a case; there obviously must be co-ordination between the two services. Mr. Bell dealt particularly with the problem of getting this kind of subject-matter converted into film terms. The whole technique of Civil Defence serves in the film as a means of studying the processes of community life, although they are seen in a special light, functioning under the stress of air-raids.

After the film had been screened Mr. Bell pointed out the value of the animated diagram for presenting an abstract process, in this case the procedure by which co-ordination between individual services was achieved through a series of different 'control centres'. He then selected from the film examples of various technical devices and methods of exposition.

One incident was used as typical of the problems of the public services and their relations to the community. The film shows damage to a high-voltage main cable, leaving Avonmouth docks without their normal supplies of electric power. A method of temporary jointing of 33,000-volt cable is shown which takes six hours, instead of the seventy-two hours needed for a permanent jointing. The skill and resource of the electrical engineers is shown to be related directly with the restarting of activity in the docks, and off-loading from ships of essential supplies. Films enable one to show, in a convincing fashion, that detailed aspects of one technical problem can be related with much wider issues affecting the community.

Prof. J. Yule Bogue, president of the Association for Scientific Photography, speaking on "The Production of Scientific Films for Biological and Medical Purposes", divided films into two main groups—those making no new contribution to knowledge but presenting in a suitable form the knowledge at our disposal, and those making a new contribution to knowledge. He then dealt with the former group and followed the making of such a film, from the consideration of its subject-matter for suitability for film treatment, through possible methods of construction, the writing of the script, the photographic techniques involved and the actual shooting of the film, to the cutting, editing and final presentation*.

Prof. Bogue stressed that whether a professional film unit is employed or the film is made by those normally engaged in photography in the department, it was essential to decide all the preliminary work, and to write the complete script, before a foot of film is shot. Although anything scientific implies an orderly presentation of the facts in an objective manner, it is unfortunately true to say that many biological and medical films are neither orderly nor objective although labelled scientific. This is almost always caused by lack of planning and insufficient appreciation of the possibilities of the film.

Prof. Bogue also dealt with the choice of making a film in sound or silent. He believes that, if the worker's or teacher's opinion has to be considered, the film should be silent, but where the film is used to demonstrate a particular scientific discovery or an applied technique by an acknowledged expert in the field, then it should carry a recorded commentary. Having decided this, it is necessary to prepare a full shooting script based on a very clear, short, model lecture manuscript of the subject. Only shots essential to the film should be included, and all camera instructions

* A full report can be obtained from the Secretary, Association for Scientific Photography, Tavistock House North, Tavistock Square, London, W.C.1.

should be clearly given; this requires a full visualization of the finished film while writing the script. When the script is complete, it is highly desirable to send copies to colleagues in the same field for their comments. This usually improves a film very much; it should be noted, however, that two or three outside critics are sufficient and a committee should be avoided.

After a full discussion of the technical details of the filming and of the apparatus used, Prof. Bogue stressed the need for keeping the original film intact and employing a duplicate for cutting and editing, particularly when "Kodachrome" is used. The script should be broken down into shots, each on an index card with full technical information; the editing can then be carried out largely from this file. This is, of course, the stage at which the film is made or spoilt. The best films demand good presentation if they are to be used successfully. A good-quality projector and screen, suitable for the size of hall and audience, are essential.

After the screening of "Nitrous Oxide-Oxygen-Ether Anæsthesia", there was a discussion which ranged over detailed problems of technique in film making, as well as wider issues regarding the production and use of scientific films. Among the matters discussed were the illumination most suitable for the photographing in colour of fatty tissues, and the desirability of making films on specialized subjects about which there might be controversy.

TECHNICAL EDUCATION IN THE U.S.S.R.

IN a paper read at the fiftieth annual meeting of the Society for the Promotion of Engineering Education (United States), which has recently been published, J. G. Tolpin, of Universal Oil Products Co., described the progress of technical education in the U.S.S.R. up to the end of the third Five-Year Plan in 1942, with special reference to the engineering industries. It is a record of great achievement in the face of many difficulties, and may be viewed as both cause and effect in an unprecedented industrial expansion since 1914; especially since 1931, when Stalin said that Russia was still fifty to a hundred years behind the world's leading nations, and would have to make up this lag in ten years.

In 1914, manufacturing industry was only about one-twelfth its present size, and the whole country was still mainly agricultural. Moreover, the full extent of her vast natural resources was very inadequately realized compared with the knowledge now acquired by research and exploration. For example, it has now been discovered that the reserves of potassium minerals in Kazakhstan are the largest in the world; and the coal seams of the Pechora region are now estimated at 120,000 million tons. These and many other new discoveries of mineral wealth have meant corresponding developments in industrial activity and consequently an ever-increasing and more urgent need for trained and well-educated workers. The following figures indicate some of the progress made since 1913:

	1913	1937	1942
Coal output (mill. tons)	29·1	128	230
Iron ore ,, ...	9·2	27·8	—
Oil (mineral) ,, ...	9·1	28·4	48·5
Sulphuric acid (1,000 tons)	121	1,666	—
Electrical energy (bill. kWh.) ..	1·9	36·4	75
Locomotives	664	1,214	2,090

In this period the agricultural population, which represented 80 per cent of the whole in 1913, fell to 55·5 per cent of the total in 1939; or, in other words, the non-agricultural wage earners numbered 28 millions in 1938 as compared with 11·2 millions in 1913; total population increased to 170·5 millions in 1939. Industrial output has been stimulated not only through the ordinary channels of better trained workers, but also by special methods and incentives, including the distribution of medals and other decorations for specially good work, mention in the general and technical press, and by other means: at the same time poor results due to bad management or otherwise are equally publicized. The total number of youths of 14–17 at present being mobilized for industrial training is nearly 1,000,000. After preliminary training they will work for four years on State enterprises. In the case of these and possibly other groups, it is said that special inducements are being offered to encourage them to attend the factory technical schools rather than the college grade schools, as the latter do not, it is alleged, turn out quite the right type of skilled workers for industrial plants. In the U.S.S.R., therefore, the old problem met with in other countries of striking a judicious balance between academical and practical or shop training also presents difficulties.

Looking at this matter of technical education and training in more detail, it may be said that the general school organization in the U.S.S.R., like other things in the social system, undergoes constant change, so that, as Tolpin points out, the latest official publication (1940) on school regulations is nearly all new. An important factor in this gradual evolution of the educational policy was the national convention of professors and administrative officers in May 1938, in the Moscow Kremlin, which was attended by Stalin himself. V. M. Molotov then stated that the number of students in college grade schools exceeded the combined figures for Germany, England, France, and Italy, but neither the quantitative nor qualitative objectives had been reached. The total enrolment in all types of schools in 1939 was 34 millions, of whom 600,000 studied in college grade schools. It would scarcely seem that this latter figure is an excessive proportion of the whole, or needed special efforts for its further reduction. There are no sex distinctions, and the Revolution opened all schools equally to men and women, of which the latter seem to have taken full advantage. They are now active in every field of technical and professional work and in all branches of social research. In 1939 sixty per cent of all physicians were women, and in the Bashkir country the percentage reached 75. Many of them are directors of research in medicine and other sciences, pure and applied. Women formed more than 41 per cent of the total of college students in 1939, and 27 per cent in the technical (factory) schools. The most marked advance in this respect has been in the Moslem countries (for example, Uzbekistan and Turkmenia), as might be expected, since in such countries women had much further to travel along the paths to emancipation than in others.

Nor is any distinction made in regard to national minorities or in the numerous parts of the Soviet Union where the native language is not Russian, such as the Ukraine, Georgia, Armenia, White Russia, and parts of Siberia. There are more than a hundred different languages and dialects altogether in the Union, of which more than sixty are recognized for use in public institutions. Many newspapers and

technical journals are printed in these languages, and Russian itself is merely one of the more important subjects of instruction in the schools.

In the early years after the Revolution, schools for adults formed an important part of the Russian educational system, and were strongly supported by the State. Adult students numbered 320,000 in 1932; but the numbers are, of course, gradually declining, as the younger generation, much better educated than its forbears, is growing up. Among all classes of the population—old and young—there is a zeal and keenness for education, stimulated by the teachings of Lenin and other early leaders; but for some time there was a serious lack of suitable teachers. In 1939 the number of professorships or chairs was about 10,000, more than half of which were held in the technical and agricultural colleges; while the total teaching staff was a little more than 40,000. Education is mostly entirely free, and some 90 per cent of the students of college grade schools receive grants.

Special attention is, of course, devoted to vocational training, and the aim is to give at least a minimum of technical training to every worker, including labourers. The Five-Year Plan ending 1942 called for the training of more than 9 million persons for work in industry in different capacities. The technical schools in the Soviet Union, in addition to the higher college grade schools or universities, include also the 'technicums' or secondary technical schools. In 1938 there were in existence 3,400 of these, and it was expected that the number of students would reach 800,000 in 1942. For admission to a 'technicum', seven years of preliminary schooling is required, as compared with ten years for the college grade school; and the course lasts four years.

The factory schools fulfil important functions in training qualified workers. They were reconstituted in a different form in 1940. During the first Five-Year Plan these schools trained 450,000 workers; treble that number during the second; and the number planned for the third was 1,700,000. In addition to purely vocational training, they give a certain amount of general and political education, and also special training designed to meet the needs of any particular industry.

Special facilities, largely controlled by the Committee for Higher Education in Moscow, are provided for a first-class engineering training for students who have taken the general courses in secondary schools and have reached the age of 19–20. These are available either in the universities or technical colleges, and extend over five years, with examinations every year. The programme of study comprises almost the same basic subjects as those of engineering schools in other countries, with a few exceptions. In the case of non-Russian students, ample provision is made for the study of Russian for the first two years, the time being taken out of that allotted for foreign languages. Social and economic science and philosophy are included, with particular reference to that of the Communist Party. Parenthetically, it may be remarked that this philosophy is not necessarily the same as it was in the early days: one of the points most strongly emphasized by Lenin was that social philosophy must be constantly subject to change and evolution, and this appears to have been confirmed in the recent history of the Soviet Union. In regard to foreign languages, it is interesting to note that, until lately at all events, English was the foreign language to be studied by petroleum engineers, whereas German was preferred for mechanical engineers.

Special efforts are made to provide sufficient numbers of the right kind of fully trained teachers for the engineering courses; and no money is spared in buildings and equipment, in facilities for research, and so forth. More attention also is now being given to the matter of patents for invention, with the view of making the patent system a more effective means of encouragement in developing the inventive skill or genius of students. Employment bureaux are an essential part of the organization, but their chief difficulty is that there are always more positions open than applicants to fill them. The 150,000 young engineers and scientific agriculturists trained in more than two hundred technical colleges during the third planned period were certain to be less than the number required. Provision is also made for post-graduate work and preparation for D.Sc., D.Ph. and other degrees. In view of the shortage of trained men just mentioned and the vast programme of rebuilding, etc., at the end of the War, it is thought there may be scope and opportunity for collaboration with British and American engineers, and no doubt this is already under careful consideration in the right quarters.

NATIONAL RESEARCH COUNCIL, CANADA

THE twenty-sixth annual report of the National Research Council, Canada, 1942–43, includes the report of the president together with the reports of the directors of the Divisions of Applied Biology, Chemistry, Mechanical Engineering, Physics and Electrical Engineering, of the Section on Codes and Specifications and of the Research Plans and Publications Section. Owing to war-time requirements, publication of the "Review of Activities" has been discontinued temporarily. The National Research Council is now serving as a central co-ordinating body directing scientific research in Canada, within its own laboratories, in the universities and in industry, and the Council has been appointed the official research station of the Navy, Army and Air Force in Canada.

With the exception of a long-term project on forest-tree breeding, the work in the Division of Applied Biology is now wholly related to the war effort. The pre-war staff of nine has been increased to twenty-nine to cope with the food problems submitted by various Government departments. Investigations on modified curing practices have led to the adoption of a standard cure, with the result that Canadian bacon is now held in higher favour on the British market than ever before, and even under war-time conditions of transport and storage the proportion of Canadian bacon de-graded by the British Ministry of Food is so exceptionally small that rigorous inspection is no longer considered necessary. Studies on egg-shell treatment to extend the storage life of eggs under the storage and transport conditions of war-time have been completed and large-scale investigations undertaken to determine the best conditions applicable in industry for processing and storing dried eggs. Standard canning procedures in line with the Council's findings have been adopted by manufacturers of canned pork and ham, and a laboratory method has been developed

for processing Irish moss. Work is being continued to find a commercial method for preparing a good gelling substance from this seaweed. Work has been undertaken on improvement of the stability and other properties of lard as a suitable alternative for other vegetable oil shortenings. A survey was made of the vitamin intake of Canadian Army troops garrisoned at district depots, and much work has been done on the development of substitutes for metal containers with special reference to the packaging of dehydrated foods for export or Army use. The Fermentation Section's staff has been increased from four to fourteen members, and much of the time of the Section has been devoted to the study of the manufacture of butylene glycol from wheat by a fermentation process. Pilot plant is under construction.

In the Division of Chemistry, research on photosensitized reactions has continued, but experimental alkaloid research has been on a reduced scale. Fundamental investigations on the chemistry of leather and plastics have continued, and that Section has been considerably enlarged to take care of the test work required by the Armed Services and Inspection Board. The laboratories of the Textile Section were occupied chiefly with defence work involving investigations on substitute materials and preparation of purchase specifications, acceptance tests and fundamental research on problems arising out of war uses of textiles. The Paint Laboratory has been occupied to an increasing extent with the needs of the Services for special paints, lacquers, protective coatings, shell-filling material, anti-freezes, etc. The Rubber Laboratory has given special attention to the study of rubber substitutes and synthetic rubber.

In the Division of Mechanical Engineering, all work having no bearing on the war effort has been suspended or abandoned. Installation of the driving and controlling equipment of the horizontal wind tunnel has been completed, and calibration and adjustment of the vertical spinning tunnel are proceeding. The staff of the Division of Physics and Electrical Engineering has been further increased, and, as before, the bulk of the investigations have been of a secret nature and not at present suitable for publication. The General Physics Section has been engaged largely on naval work, ballistics and the design of fire-control gear, as well as on the development of equipment for one phase of anti-submarine warfare. Work in the Optics Section has involved research and development in optical instruments, photography, spectrochemical analysis and geometrical optics as well as the making of a large number of optical components of military instruments in the optical shop.

The Section on Codes and Specifications has been restricted during the War to a maintenance basis in respect of its two main branches—the National Building Code and the Canadian Government Purchasing Standards Committee. The Research Plans and Publications Section, which is responsible for the conduct of the National Research Council Library, refers to the increasing use of the Library, to its bibliographic work and literature searches, technical inquiry work and the issue of the *Canadian Journal of Research*.

Other details of the war work of the Divisions are included in the president's report, which also gives a survey of extra-mural activities of the Council. Among these may be specially mentioned the Service committees established under the Associate Committee on Medical Research to deal with Aviation Medical Research, Naval Medical Research and Army Medical Research. The first has carried out an impressive programme of work in the fields of high-altitude flying, protective clothing for flyers, oxygen equipment and in special studies relating to personnel selection. The second, in addition to dietary surveys in vessels under operating conditions and in shore establishments, has carried out experiments on the use of vitamin A to improve night vision. Special lighting techniques designed to minimize interference with night vision have been devised for use on bridge controls, bridge instruments and chart tables. Special tests elaborated for the evaluation of night vision, colour vision, and visual acuity have been adopted by the Navy, while experimental work on fatigue of personnel operating anti-submarine detection devices has yielded information which has been applied in determining the watch period to be used for this work. Other investigations have covered underwater blast injury, eye-protection for bridge and look-out personnel, obtaining fresh water from sea-water in lifeboats, protection of naval personnel from noise, combating fatigue in radio detector and wireless operators, and sea-sickness problems. Another war-time committee of the Council has co-ordinated and directed research in Canadian universities on sixty projects concerned with the production of explosives now in use and the development of new explosives.

THIRD ANNUAL MEETING OF THE ANTI-FASCIST SOCIETY OF SOVIET SCIENTISTS

By VICTOR KRASILNIKOV*

PROMINENT representatives of Soviet science attended the third meeting of the Anti-fascist Society of Soviet Scientists held in Moscow on June 18. In his opening remarks, the president, Derzhavin, reminded his audience of the solemn oath taken by them at their first meeting in the memorable days of October 1941 when the German Army was driving on to the capital of the U.S.S.R. They then vowed to devote all their energy and knowledge to the war effort of the nation. Soviet men of science, he said, have kept that vow.

An eloquent speech was made by the vice-president of the Academy of Sciences, Alexander Baikov. He gave an account of the great contributions of Soviet men of science to the war effort. Metallurgists have speeded up existing processes of production, and introduced important improvements in the technology of iron and steel production. Geologists have discovered new deposits of manganese, mercury, lead and petroleum. Botanists have investigated new varieties of medicinal herbs and vitamin-yielding plants. Agricultural scientists have helped to increase crop-yields. Medical scientists have shown numerous examples of self-sacrificing service to their country.

Prof. Peter Kapitza, of the Academy of Sciences, remarked that since the second meeting of the Society, in July 1943, many stirring and cheering events have taken place. But, while rejoicing at the Army's advance, in the course of which Russian territory is being liberated from the hands of the

* Transcribed and prepared by A. Clifford.

invader, scientific workers cannot but be deeply pained by the damage which the enemy is inflicting on the country. "We scientists have reason to feel gratified by the fact that we have been able to help, with our knowledge, to improve the armaments of the army, and to facilitate the struggle against German barbarity."

The audience listened with great interest to the speech delivered by Prof. Maria Petrova, of Leningrad. She remained in Leningrad all through the siege. "It was painful," she said, "to see how German artillery destroyed the scientific and public institutions of the city, but I never for one moment lost faith that the enemy would be defeated. Work was the best answer to the crimes of the barbarians. During the siege I completed twelve scientific investigations."

Igor Grabar told of the appalling destruction by the Germans of monuments of Russian art in Novgorod and in the environs of Leningrad. Prof. P. V. Pavlov, of the University of Odessa, who lived in that city during its occupation by Germans and Rumanians, and Prof. Alyoshin, of the University of Kiev, who likewise saw all the horrors of German occupation, spoke of the damage done by the invaders to scientific and cultural institutions in the Ukraine. This was also the subject of a speech by Alexander Beletsky, of the Ukrainian Academy of Sciences.

Nikolai Nikolsky, member of the White Russian Academy, told the meeting of the 'new order' in German-occupied Minsk. This elderly grey-bearded scholar escaped from Minsk with the aid of White Russian partisans in August 1943. He had spent seven months with a partisan detachment, and only in April 1944 made his way to the "mainland", as partisans call Soviet territory across the front line. Prof. Krisciunas spoke of the plight of the intelligentsia in German-occupied Lithuania. Nikolai Propper-Grashchenkov, corresponding member of the Academy of Sciences, denounced the practices of German physicians. He said that the Soviet medical profession is in possession of irrefutable proofs of the participation of representatives of German science in the killing of prisoners-of-war and of mentally diseased people, and in the bleeding of Soviet children for blood transfusions to such an extent that the children died. They also have documents showing that German surgeons carried out experimental operations on prisoners-of-war.

Alexander Poraj-Koszyc, another member of the Academy, made an inspiring speech in which he called upon the scientific and professional men of Poland to devote all their efforts to the defeat of Hitlerism.

Many messages of greeting were received from various institutions as well as from private individuals in the Soviet Union and abroad. The meeting enthusiastically adopted the text of a message of greeting to the Commander-in-Chief of the Armed Forces of the U.S.S.R., Joseph Stalin, and issued an appeal to men of science throughout the world. This appeal said, among other things: "Fascism is the most malignant foe of science and culture. . . . There is only one way to save human beings and cultural treasures, and that is, to defeat Germany and her satellites at the earliest possible date. . . . All of us must take an active part in this struggle. Let every intellectual and every scientific worker who is not fighting 'arms in hand' contribute his mite to the common cause of humanity by intense creative effort."

EARTHQUAKES IN SOUTHERN CALIFORNIA

BENO GUTENBERG and C. F. Richter have recently studied in detail several hundred earthquakes in southern California with the view of finding out the physical properties of the earth's crust in the region. The first paper under discussion, "Recent Results of Earthquake Study in Southern California", by both authors (*Trans. Amer. Geophys. Union*, 1943) contains first the travel-time equations of the district. These are:

$$\begin{array}{llll} \bar{P} - 0 = D/5{\cdot}577 & & \bar{S} - 0 = -0{\cdot}5 + (D/3{\cdot}26) \\ Py - 0 = 1{\cdot}2 + (\Delta/6{\cdot}05) & & Sy - 0 = 2{\cdot}0 + (\Delta/3{\cdot}64) \\ Pn - 0 = 6 + (\Delta/8{\cdot}06) & & Sn - 0 = 8 + (\Delta/4{\cdot}46) \end{array}$$

where Δ is epicentral distance in km. and D is hypocentral distance for focal depth of 18 km.

The authors state that the terms independent of Δ in the equations for *Pn* and *Sn* show appreciable variation for shocks in different parts of the region, with maxima of about 9 and 13 respectively in the shocks of northern Owens Valley east of the Sierra Nevada. This is an effect of the 'root' of the Sierra.

The travel-times indicate no variation in the thickness of the 'granitic' layer, which is about 18 km. Most of the shocks originate near the base of this layer. There is at least one 'intermediate' layer between this and the base of the continental crust (the Mohorovičić discontinuity). The velocity of *Py* in this layer differs notably from that of the similar wave *P** as observed in Europe (6·05 instead of 6·4 km./sec.). If this is a single layer, its thickness varies from about 20 km. in the coastal area to almost 50 km. in the Sierra region.

The term $-0{\cdot}5$ in the equation for $\bar{S}$ represents a frequently noticed discrepancy between the apparent origin-times of $\bar{P}$ and $\bar{S}$. The writers attribute this to development of the fault-fracture with speed greater than the velocity of transverse waves, resulting on the average in early arrival of $\bar{S}$ at the observing stations. The following are mean values of elastic constants (C.G.S. units) from all available data for the region:

Layer	Bulk-Modulus	Rigidity	Poisson's Ratio
Granitic	$4{\cdot}5 \times 10^{11}$	$2{\cdot}9 \times 10^{11}$	0·24
Intermediate	$5{\cdot}5 \times 10^{11}$	$3{\cdot}8 \times 10^{11}$	0·22
Below Intermediate	$12{\cdot}4 \times 10^{11}$	$6{\cdot}5 \times 10^{11}$	0·28

J. M. Nordquist is in the course of developing a new application of the magnitude scale in association with these earthquakes. Assuming a special distribution function already employed by E. J. Gumbel in the investigation of flood-statistics ("Statistical Control-Curves for Flood-Discharges." By E. J. Gumbel, *Trans. Amer. Geophys. Union*, 489–509; 1942) makes it possible to choose a scale for a plot in which the points for various magnitudes fall nearly on a straight line, the level of which is an indication of the degree of activity. This method promises a quantitative definition of seismicity.

The second paper here discussed is "Variations in Physical Properties within the Earth's Crustal Layers", by Beno Gutenberg (*Trans. Amer. Geophys. Union*, 1943). In it the author states that the travel-times as well as the amplitudes lead independently to the conclusion that most of the fifty shocks discussed in this second paper originated at the bottom

of the Granitic layer. In shocks with faulting completely inside the Granitic layer only, the amplitudes of *Py* should be about the same as those of *Pn*. The fact also that the amplitudes of the various *S* waves change with distance in a similar way to those of the corresponding *P* waves indicates that the effect of pressure and temperature on the coefficient of rigidity is relatively the same as on the bulk-modulus.

Gutenberg states that the Mohorovičić discontinuity is at a depth of about 35–40 km. in the coast areas of southern California, but deeper under mountain ranges. The velocity of *Pn* below it is close to 8·0 km./sec. At first, the velocities of both *P* and *S* increase with depth, probably at a rate similar to that in the upper layers; but the rate of increase falls off rapidly with increasing depth, resulting in a rapid decrease of the amplitudes of *Pn* and *Sn* with distance beyond $\Delta = 200$ km. Amplitudes of *Pn* and similarly of *Sn* in intermediate shocks without appreciable surface waves, on records of shocks originating at various depths within a radius of about 2,000 km. from Huancayo, Peru, and recorded at the station there, confirm results obtained previously by Gutenberg and Richter concerning the relationship between the epicentral distances at which the amplitudes of *Pn* are very small, and the focal depth of the shocks.

These findings, according to Gutenberg, can be explained on the assumption that at a depth of about 80 km. the melting point of the material is reached. Immediately above that critical depth, the effect of temperature on the bulk-modulus and on the coefficient of rigidity may approach, or even surpass, the effect of pressure. At the critical depth itself, there may be a slight sudden decrease of the wave-velocity. At greater depth, the effect of the temperature on the bulk-modulus and the coefficient of rigidity becomes more and more insignificant. Whereas above the critical depth a certain minimum stress, the strength, is required to start plastic flow, below this depth no appreciable strength exists, and the plastic flow is controlled only by the viscosity of the material.

FORTHCOMING EVENTS

Saturday, August 19

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at Austria House, 260 Oxford Road, Manchester), at 7.30 p.m.—Dr. E. Broda: "Science in Austria (with special reference to the 100th Birthday of L. Boltzmann)".

Tuesday, August 22

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Exhibition of specimens and discussion.

APPOINTMENTS VACANT

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

SPEECH THERAPIST (whole-time)—The School Medical Officer, County Hall, Chichester (August 23).

ASSISTANT MASTER preferably with Graduate or equivalent qualifications in Engineering, mainly for work in the Junior Technical School—The Acting Secretary to the Education Committee, 1 Eastbank Street, Southport (August 23).

ASSISTANT PSYCHOLOGIST in the School Psychological Service—The Director of Education, Education Department, Newarke Street, Leicester (August 25).

GRADUATE TEACHER OF ENGINEERING (full-time) for Day and Evening Classes in the Crewe Technical College—The Director of Education, County Education Offices, City Road, Chester (August 25).

LECTURER IN AGRICULTURAL ZOOLOGY, including ENTOMOLOGY, and an ASSISTANT ADVISORY OFFICER IN ANIMAL HUSBANDRY—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (August 25).

PRINCIPAL OF THE BURNLEY MUNICIPAL COLLEGE—The Director of Education, Education Offices, Burnley (August 26).

ASSISTANT IN BOTANY—The Secretary, The University, Aberdeen (August 28).

ADVISER IN AGRICULTURAL ENTOMOLOGY (temporary)—The Registrar, King's College, Newcastle-upon-Tyne (August 31).

ASSISTANT LECTURER IN ENGINEERING—The Registrar, The University, Manchester 13 (August 31).

LECTURER IN GEOGRAPHY—The Secretary, University of Durham, 38 North Bailey, Durham (September 1).

BOROUGH ENGINEER AND SURVEYOR to the County Borough of Southampton—The Town Clerk, Town Clerk's Office, Civic Centre, Southampton (endorsed 'Borough Engineer and Surveyor') (September 4).

BOROUGH ENGINEER AND SURVEYOR—The Town Clerk, Town Hall, West Ham, London, E.15 (endorsed 'Borough Engineer and Surveyor') (September 4).

LECTURER IN PHYSIOLOGY—The Secretary, The University, Birmingham 3 (September 5).

UNIVERSITY READERSHIP IN PHYSICS tenable at King's College—The Academic Registrar, University of London, South Kensington, London, S.W.7 (September 6).

CHAIR OF MINING—The Acting Registrar, The University, Leeds 2 (September 30).

LECTURER IN PHILOSOPHY—The Very Rev. the Dean, Christ Church, Oxford (October 15).

HYDROGRAPHICAL SURVEYOR for the Basrah Port Directorate, Iraq—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. O.4962S).

SCIENTIFIC OFFICER (man or woman, temporary) in the Cod Liver Oil (Poultry) Standardisation Laboratory—The Secretary, National Institute for Research in Dairying, Shinfield, Reading, Berks.

SPEECH THERAPIST (full-time)—The Secretary for Education, Education Offices, York.

LECTURER (man or woman, full-time, temporary) IN BIOLOGY in the Leeds College of Technology—The Director of Education, Education Offices, Leeds 1.

LECTURER (woman) IN MATHEMATICS AND BIOLOGY (Nature Study) OR GEOGRAPHY in the Swansea Training College for Women—The Director of Education, The Guildhall, Swansea.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Metallurgical Abstracts (General and Non-Ferrous). Vol. 10, 1943 (New Series). Edited by N. B. Vaughan. Pp. xii+523. (London: Institute of Metals.) [257

Medical Research Council. War Memorandum No. 3: Economy in the Use of Drugs in War-Time. Revised second edition; with an Appendix on Economy in the Use of Bactericides. Pp. 16. (London: H.M. Stationery Office.) 3*d*. net. [257

Some Recent Advances in Chemistry in relation to Medicine. By Dr. D. H. Hey. Pp. 24. (London: Royal Institute of Chemistry.) [257

National Veterinary Medical Association of Great Britain and Ireland. Publication No. 6: Report on Diseases of Farm Livestock, Section 2: Diseases of Sheep. Pp. 101. 10*s*. Publication No. 7: Memorandum on Farm Buildings. Pp. 48. 5*s*. (London: National Veterinary Medical Association.) [257

Ministry of Food. Insect Pests of Food. 1: The Larvæ of the Lepidoptera associated with Stored Products, by H. E. Hinton; 2: Keys for the Identification of the Lepidoptera infesting Stored Food Products, by A. S. Corbet and W. H. T. Tams. Pp. 144+5 plates. (London: H.M. Stationery Office.) 5*s*. net. [257

British Association for the Advancement of Science. Report of Committee on Post-War University Education. Pp. 52. (London: British Association.) 2*s*. 6*d*. [267

Transactions of the Royal Society of Edinburgh. Vol. 61, Part 1, No. 6: Growth Stages in some Jurassic Ammonites. By Dr. Ethel D. Currie. Pp. 171–198+1 plate. (Edinburgh and London: Oliver and Boyd.) 7*s*. 6*d*. [277

Other Countries

League of Nations: Economic, Financial and Transit Department. Food Rationing and Supply, 1943–44. (Publication: 1944: II.A.3.) Pp. 101. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 4*s*. 6*d*. [257

Annals of the New York Academy of Sciences. Vol. 45, Art. 7: The Distribution of the Salamanders of the Genus *Plethodon* in Eastern United States and Canada. By Arnold B. Grobman. Pp. 261–316. (New York: New York Academy of Sciences.) [257

Proceedings of the American Philosophical Society. Vol. 87, No. 5 (May 5, 1944): Papers on Archæology, Ecology, Ethnology, History, Paleontology, Physics, and Physiology. Pp. iii+365–460. (Philadelphia: American Philosophical Society.) [257

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 178: Food Composition Tables. Compiled by Hedley R. Marston and Mary C. Dawbarn. Pp. 104. (Melbourne: Government Printer.) [257

U.S. Office of Education: Federal Security Agency. Leaflet No. 69: Education in China To-day. By C. O. Arndt, Severin K. Turosienski and Tung Yuen Fong. Pp. 12. 5 cents. Vocational Division Leaflet No. 13: Professional Nurses are Needed. (Revision of Leaflet No. 10.) Pp. vi+30. 10 cents. (Washington, D.C.: Government Printing Office.) [257

U.S. Department of Agriculture. Technical Bulletin No. 846: The Cabbage Looper as a Pest of Lettuce in the Southwest. By K. B. McKinney. Pp. 30. (Washington, D.C.: Government Printing Office.) [257