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CONTENTS

	Page
Scientific Research and Man-power	711
Anti-Cancer Drugs. By Dr. I. Hieger	713
Testing Petroleum Hydrocarbons. By H. B. Milner	714
Chemistry of Acetylene. By R. A. Raphael	715
The Anodizing of Aluminium. By H. W. L. Phillips	715
Taxonomy and Evolution of Cotton. By E. Lord	716
Movements of Population in the British Commonwealth. By Prof. Brinley Thomas	718
Physical Chemistry of Process Metallurgy. By Dr. F. D. Richardson	719
Veterinary Education: Developments at Cambridge. By Dr. James T. Edwards	721
Obituaries:	
Prof. Ruth Benedict. By Dr. Audrey I. Richards	725
Sir George Hill, K.C.B. By Sir John Myres, O.B.E., F.B.A.	725
Mr. O. H. Latter. By J. C. Thomson	726
News and Views	726
Letters to the Editors:	
Life-Span of Red and White Blood Corpuscles of the Hen.—J. Ottesen	730
Introduction of Radioactive Tracers into Antisera.—F. D. S. Butement	731
Succinic Acid in the Blood of the Larva of <i>Gastrophilus intestinalis</i> .—L. Levenbook and Dr. Y. L. Yang	731
Staphylococcal Coagulation and Fibrinolysis.—Earl B. Gerheim	732
Excretion of α -Pyrrolidone Carboxylic Acid by Rat and Dog Fed with Tumour Proteins.—Prof. F. Kögl, T. J. Barendregt and A. J. Klein	732
Bacteriostatic Action of Oximes.—J. D. Allan Gray and R. A. Lambert	733
Aluminium Phosphate as Precipitant of Agglutinable and Non-Agglutinable Strains of <i>H. pertussis</i> .—Dr. J. Ungar and P. Muggleton	734
N. Acridyl-(5)-Alanines as Antibacterial Substances.—Prof. W. H. Linnell and M. J. H. Smith	735
Genetic Transmission of Two Rare Blood-Group Genes.—Dr. A. S. Wiener	735
Methylene Blue as a Vital Stain for the Golgi Apparatus.—Prof. J. Bronté Gatenby and Tohamy A. A. Moussa	736
Passage of Hæmoglobin from Blood into Eggs of <i>Daphnia</i> .—Elisabeth I. B. Dresel	736
Effect of Carbon Dioxide on Availability of Manganese in Soil Producing Manganese Deficiency.—B. D. Bolas and G. B. Portsmouth	737
Protection of Grain against Weevils.—V. A. Beckley	737
Fast Neutron-Proton Scattering and the Law of Interaction between Nucleons.—E. H. S. Burhop and H. N. Yadav	738
Photo-Elastic Effect in Barium Nitrate.—Prof. S. Bhagavantam and D. Suryanarayana	740
Inclusions in Aluminium Crystals.—W. May, T. J. Tiedema and Prof. W. G. Burgers	740
Electrokinetic Potentials of Aged Barium Sulphate Crystals.—Prof. R. Ruysen and R. Loos	741
Factors Controlling the Atlantic Coastline of Europe.—Muriel A. Arber	741
'Pins and Needles'.—G. Gordon	742
Persistence of D.D.T. in the Soil.—Phillip B. Carne	743
Entomological Aspects of 'Swollen Shoot' of Cacao.—F. A. Squire	743
International Union of Geodesy and Geophysics. By Prof. J. Proudman, F.R.S.	744
Order of Stability of Metal Complexes. By Dr. H. Irving and R. J. P. Williams	746
First International Congress on Rheology. By Dr. G. W. Scott Blair	747
National Research Council of Canada: Annual Report	748

SCIENTIFIC RESEARCH AND MAN-POWER

THE address which Mr. Herbert Morrison, the Lord President of the Council, delivered to the Conference of Industrial Research Associations on October 15 (see *Nature*, October 23, p. 645) should be studied carefully by all who are concerned with the conduct of scientific research and, in this time of stringently limited man-power, with the most effective distribution of the available scientific man-power between industry, the universities and the Government services in Britain. The development of the industrial research associations, with which the Lord President was ostensibly concerned, cannot wisely be considered apart from the general research effort of the country. As the recent report of the Advisory Council on Scientific Policy indicated, approximately ten per cent of the qualified scientific workers engaged in Great Britain's research effort are already employed by the research associations. At the present time, any appreciable increase in their numbers must be at the expense of those employed in research in industry, in the universities or in other Government departments.

Mr. Morrison, in referring to the Government policy of encouraging the establishment of research associations and the assurance given three years ago that Government support would not be withdrawn after an initial stage, said that the Government had been very much impressed by the results being obtained by some of the research associations. Last year, their total expenditure was close on £2 millions, as against £470,000 in 1938, and the total estimated for next year is £2.5 millions. Even allowing for the general rise in costs, the effort has more than doubled, and there are now thirty-eight research associations as against twenty-one in 1938; while the formation of others is expected in the near future. He hoped that the Conference would lead to even bigger developments.

Through all the examples of the work of the research associations which Mr. Morrison cited as having particularly impressed the Government runs the thread of increased productivity, or the increase of industrial efficiency by the saving of fuel and of labour. The Lord President seems to regard the research associations primarily as valuable contributors to the increased industrial productivity by which alone Great Britain can hold its place in competitive world industry. Further, his speech indicates approval for greater encouragement of the study of man in relation to the machines he has to operate—a matter in which, as Sir Henry Tizard pointed out in his presidential address at Brighton to the British Association, industry has lagged far behind the Services. It might, indeed, be inferred from his speech and from the increased attention being given by the research associations to what is known as 'operational research', as judged by examples recently quoted, that an increasing proportion of their effort will be directed to the study of the human aspects of production and economic and

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sociological problems, as distinct from those physical problems to which their original effort was almost exclusively devoted.

It is not disputed that the particular technique developed in war-time under the name of 'operational research' and long since employed in progressive industry in its technical service to customers may have large potentialities. Both the need and the opportunity for such methods might possibly diminish, however, if we could secure the more effective utilization by industry—and by the State—of existing knowledge. Mr. Morrison frankly recognized that a large part of the problem of increasing productivity and industrial efficiency lies in securing the utilization of the results of past research as well as of that at present proceeding, and he indicated the readiness of the Government to use whatever resources are at its disposal to see that proved processes and equipment developed by the research associations should not be left unutilized.

Nevertheless, although the Lord President stressed the importance of those engaged in research having full opportunity to know what are the problems of industry, and above all, the needs of users and consumers of industrial products—and, indeed, asked whether the opportunities in the research association movement for co-operation between all engaged in industry are being fully taken—he did not stay to discuss the fundamental question whether that was or was not due to any inherent defect in the research association idea itself. He did inquire whether there is enough in industry of the approach and interchange which characterized the development of equipment for the Armed Forces, and he also asked whether there are enough scientific workers employed in industry helping to get the best of the scientific results which are already available. He also dwelt at some length on the importance of scientific interpreters and liaison officers, and of encouraging, in every way possible, contacts and exchange of visits between scientific men and industry.

There is, indeed, a large field for co-operative effort where the research association, as Mr. Morrison indicated, may pay handsome dividends in terms of productivity and the saving of materials and labour. It is by no means established, however, that the research associations can compare with the research departments of industrial firms in the development of those new products and processes which place British industry ahead and not just abreast of its rivals in the world markets, and which, as Sir Henry Tizard reminded us, are the product of the work of very few men.

What needs to be considered much more closely is how best that spirit of enterprise and inventiveness can be fostered. Mr. Morrison touched on many important factors and indicated some of the means by which industry in Great Britain could recover some of the ground lost in the development stage to such countries as the United States. He said little, however, to show that he appreciated the importance of the really fundamental research in which Britain excels, and on which in the long run industrial advance is based.

Some of that work is being carried out by the research associations, and some of it in the laboratories of leading industrial firms. By far the greater part of it, however, is proceeding in the university laboratories; and the questions that have to be faced, before and not after any considerable expansion of the research associations, are: first, will such expansion affect adversely the fundamental research at the universities, now seeking to make up for the lost years of war? And secondly, will such expansion yield higher dividends in creative work as well as productivity than a corresponding expansion of industrial research laboratories themselves, or if not, then some alternative form of co-operative research, such as the Mellon Institute type? In the present man-power situation we cannot expand all three types indefinitely; we must attempt to establish some order of priority based on an impartial critical survey.

In this speech, for all the appreciation of the value of scientific research which it shows, Mr. Morrison passes over the seriousness of the man-power situation. Research workers, he said, must have the resources and status they need to keep up the flow of new and improved products, and he welcomed the improvement in the status and conditions of British scientific workers. He also stated that the Government has now decided that a larger share of building resources must be made available for the equipment of research and other institutions likely to contribute to raising the productivity of industry.

That will be welcome news to some firms, whose plans for expansion and development have been restricted by lack of such facilities, and by the policy laid down in the White Paper last spring. It must be remembered, however, that the major difficulty experienced by the larger and the smaller firms alike is the recruitment of first-class men for research and development; and particularly from the university schools of chemistry. If in consequence some firms who have recently been imbued with the research spirit are driven to recruiting men of inadequate standing for their new research departments, the new enthusiasm of those firms is likely to be damped, and still more as the results may well fall short of expectation.

Such factors may well lie outside the field of such a conference as that addressed by Mr. Morrison, but they should not be overlooked by one who carries so large a share of responsibility for determining the distribution of the scientific effort of Britain at a time when expansion in any one direction of necessity involves curtailment elsewhere. Nor can he well afford to disregard those factors which, like conditions of service, may influence as profoundly as Government policy the distribution of scientific workers in particular occupations. Quite apart from the distribution of, say, the available chemists, biochemists and physicists between industry, academic research, the research associations and Government departments, has any real thought been given, from the national point of view, to the effect of unbalanced expansion of university departments of medicine in comparison with their other scientific departments,

or of the wide disparity in the inducements offered to the graduate in medicine as compared with those received by the chemist, biochemist or physicist?

It is true that industry itself might well do something to redress that balance by the evolution of financial incentives, possibly of the invention-bonus type; but those responsible for the scientific and industrial policy of the Government can no more ignore such considerations in determining the future of the research associations than they can the effect on the universities themselves of the conflicting and unco-ordinated pressures for expansion, on which the recent statement from Nuffield College on "The Problem facing British Universities" commented so pointedly. Dr. C. J. T. Cronshaw's remarks on this subject to the Society of Dyers and Colourists in Bradford on October 7 should be noted in this connexion, as should those of Sir Ian Heilbron at the annual dinner of the Association of British Chemical Manufacturers on October 13.

A short-term policy which concentrates on securing the more effective utilization of existing knowledge may, as Sir Henry Tizard suggested in his presidential address to the British Association, be our immediate need from the point of view of increasing productivity and restoring the industrial health of Great Britain. In that policy the research associations have clearly a part to play, and the policy will simultaneously encourage the continuous application of science to industrial practice. That, however, does not mean putting research into the second place; and such a short-term policy must not be pursued at the expense of a long-term policy designed to ensure the nation a sufficient supply of scientific men and technologists in every sphere and to provide them with the equipment and resources they require. A long-term policy of that type can only be evolved as a result of the open-minded study of the effectiveness of particular instruments for our purpose, such as the research associations, in comparison with other methods. A resolute attempt must be made to decide where and how creativeness and inventiveness are best fostered, and an impartial and continuing appraisal made of the demands of industry, the universities and the Government services, and the interactions of those demands.

To achieve a reasonable balance is no easy task, but no more urgent task awaits the Advisory Council on Scientific Policy than such a fundamental and comparative inquiry into the research association movement in relation to other forms of co-operative and industrial research. Sir Henry Tizard, it would appear from his presidential address to the British Association, is ready to make that attempt; the Lord President of the Council might well support such a task, for no other way seems so likely to establish the best means by which during the next few critical years our limited resources in scientific man-power and equipment may be deployed so as to yield the quickest and largest return in productivity and in new and improved products. The inquiry would not be an easy one; and the evolution of a policy on the basis of its results could be undertaken only at the highest levels.

ANTI-CANCER DRUGS

Approaches to Tumor Chemotherapy

A symposium of Papers and Discussions on various Aspects of Tumor Chemotherapy, developed from the Summer Meetings of the Section on Chemistry (C) of the American Association for the Advancement of Science at Gibson Island, Maryland, 1945-1946. Edited by Forest Ray Moulton. Pp. x + 442. (Washington, D.C.: American Association for the Advancement of Science, 1947.) n.p.

THE historical introduction to this series of papers is by the *doyen* of American cancer research, W. H. Woglom, who with brilliant lucidity and charming modesty of style describes the use of the innumerable agents of mineral, plant, animal or synthetic origin which have figured in the untiring attack on malignant disease by chemotherapy. He believes that hormone therapy has given the first hopes of ultimate success.

Algire discusses the method that he has developed of introducing a transparent chamber into a skin flap of the mouse, enabling the vascularization of transplanted tumours, or the regression of a tumour undergoing treatment with bacterial polysaccharide, to be observed. No doubt the method is a triumph of technique; but the photomicrographs are not very informative to the uninitiated and there is nothing startling about the discovery that the blood vessels rapidly develop to cope with the new growth; further, is it really necessary, to-day, to introduce an illustration of a photomicrographic camera?

Kopac's article is on "Cellular and Surface Chemical Aspects of Tumor Chemotherapy"; it is no easy task to find one's way through the thirty pages of complicated laboratory data and question-begging hypotheses. His thesis seems to be that one group of chemotherapeutic agents acts by selective nucleoprotein dissociation. Although there are references to selective destruction of neoplastic cells *in vitro* by these compounds, no mention is made of the results of tests *in vivo*. It is to be feared that some hiatus was discovered between physico-chemical hypothesis and biological facts.

Aptekman uses an alcoholic extract of transplantable rat tumour to destroy grafted tumours in other rats; but his extract contained about 20 per cent alcohol which alone, apart from tissue constituents, could scarcely have been encouraging for the growth of the tumour.

Turner and Miller's paper on "The Chemistry of Substances Specific for the Stimulation of Lymphopoiesis and Myelopoiesis" describes the investigation of agents present in the urine of patients with myeloid leukaemia which produce myeloid metaplasia in the organs of experimental animals. Heinele, Hirschmann and Wearn also write on the myeloid metaplasia factor in human urine; but their work is obviously unfinished, for they state: "This issue obviously is not decided by the fact that the protein fractions prepared from various urines show great differences in biological activity. These observations, however, could suggest that the active principle in these fractions may possess the degree of structural specificity that one expects to find in a regulatory hormone." These two papers deal largely with the biochemistry of the substances from urine which influence the myeloid tissue; on the other hand, the discussion which followed the papers centred around the interpretation of the pathological changes in the injected animals.