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BRITISH EMPIRE SCIENTIFIC CONFERENCE

THE address on "Scientific Co-operation within the British Commonwealth" which Prof. A. V. Hill delivered to the Royal Empire Society on January 31 has claims on the close attention of all scientific workers. In the first place, it gives an account of the actual progress that has been made in implementing co-operation since the committee appointed by the Royal Society reported in 1943. In particular, the Empire Scientific Conference to be called in London by the Royal Society either later this year or, more probably, in 1946, which is one indirect result, not merely of that report, but also of Prof. A. V. Hill's visit to India, of the more recent visit of Indian men of science to Britain and of Sir Henry Tizard's visit to Australia and Canada in 1943, will call for the active support of many more scientific workers than the sixty actual delegates contemplated.

Prof. Hill said that the Conference will probably be held in two parts, the first and more purely scientific gathering being followed by a more official conference for working out concrete plans for submission to the Governments concerned. During the interval, the visitors will travel about Britain in small groups, to see British science, industry, agriculture and medicine in operation, and above all to gain by informal discussion personal acquaintance with each other's problems, programmes and ideas. The value of this informal contact is rightly stressed by Prof. Hill, as in the British Commonwealth Science Committee's report, where it formed the subject of two of the six main recommendations; such contacts are in fact one of the most important things to implement. No organization, as we have urged repeatedly, can be an effective substitute for that full freedom of intercourse and communication, both spoken and written, which for more than five years has been severely limited by war conditions.

If it is true and right that such fundamental freedom should be restored first within the British Commonwealth and as early as possible, it is true also that these proposals to improve and extend imperial co-operation in science are also important in relation to the wider field of scientific co-operation generally, to which Dr. Joseph Needham directed attention in his plea for an international science co-operation service as a functional body parallel with the International Labour Organisation and the Food and Agricultural Office, and on which Sir Henry Dale dwelt at some length in his anniverary address to the Royal Society on November 30. Prof. Hill also emphasizes the importance for international scientific co-operation of such developments in scientific co-operation within the British Empire, and one of his reasons for urging British leadership in this field is the vital importance of building up as rapidly as possible a world organization for sharing the beneficent results of scientific discovery. Above all, it might be fittingly urged at the present time that it is essential to re-establish as early and as fully as

possible those contacts in science which will revive in the harassed peoples of Western Europe the sense of common traditions and heritage in science no less than in law and government, in humanism and in Christianity, with all that such a revival can mean to them as they address themselves to the reconstruction of their national life.

While that appears to be the setting in which Prof. Hill rightly views proposals for imperial co-operation in science, the practical tone of his address is unmistakable. His visit to India has convinced him that the best hope of friendly co-operation between India and Britain lies in the scientific, technical and medical fields. It is now probable that the Government of India will set up an Indian Scientific Office in London, and an Indian Scientific Liaison Service may be established with its headquarters in Delhi, its main overseas office in London, and branches in other countries.

Other promising developments are also noted by Prof. Hill, such as the work of the Colonial Research Committee and of the Colonial Products Research Council, and closer contact and co-operation between these bodies and the Dominions and India could scarcely fail to be of mutual advantage in dealing with many scientific, technical, agricultural or medical problems. Again, the attachment of two able scientific advisers to the Middle East Supply Centre is of special interest. In the region covered by the Middle East Supply Centre, science, particularly the biological sciences, could play a dominant part in determining the welfare of the peoples and their relations to the outside world. Problems are encountered in agriculture, irrigation and soil survey, in land conservation and erosion, in geology, meteorology and water supply, in forestry and the preservation or utilization of flora and fauna, in health and nutrition and the like, which are closely analogous to those encountered in other parts of the British Empire; and, further, neglect of the scientific factors will lead to trouble and difficulties which no political astuteness can curb or avoid.

It is, however, in his references to the specific problems in which scientific co-operation within the British Commonwealth is of practical importance that Prof. Hill's address is of the greatest interest. Here he enforces the point that such co-operation alone can provide the solution to important practical problems, some of which, such as that first mentioned by him, namely, the fear of isolation, which deters first-class teachers and research workers from accepting posts in more distant centres, have been raised in recent reports like those of the Colonial Research Committee. Their effects, and means of overcoming it, are obviously problems not for one colony or dominion alone, but for joint consideration and a common policy.

Similarly, the need for quick and frequent personal contacts between research workers in analogous fields is widely recognized; but almost certainly an imperial policy alone can ensure that air transport will supply such contacts regularly for people who are mostly not well paid and have no great political or industrial standing. Again, regular interchange of personnel between the scientific staffs of universities, industrial firms and research institutions throughout the Commonwealth must largely wait on the formulation of common arrangements, including an appropriate pension system. Allied to this is the problem of organizing and financing the training of young research workers and the higher grades of technologists and workmen by exchange between countries which have special opportunities to offer.

Another group of problems instanced by Prof. Hill as calling for co-operative attention is the combined study of natural resources and conditions—forests, minerals, land utilization, water-power, plants, animals, pests and diseases, and the application of the principles of lend-lease both to their investigation and the utilization of the new knowledge so gained. Here we touch on the question of regional research. Certain regions form natural units for research and development in particular subjects or groups of subjects, although the regions may fall, as in Africa, under the authority of different Governments. The means of securing co-operation and the sharing of effort and expense in such regions require working out; while again, in attempting a concentrated attack on a key problem, we lack the machinery for deciding on the problem and on the method, the scale and the direction of attack and the means by which the expense is to be shared.

Finally, Prof. Hill refers to the question of science and imperial defence, and faces frankly the fact that scientific workers have been troubled in the past as to secrecy being a cover for inefficiency, and the danger of its breeding fear and suspicion. He insists on the need for critical minds and up-to-date methods, for contact with recent scientific discoveries and industrial technique, and for interchange between scientific workers in Government service, in industry and in the universities throughout the British Empire. The relations between civil and military research need to be worked out critically and with imagination; here it may be noted that three of the nine points of imperial defence which Lord Chatfield pressed in the House of Lords on March 7 as requiring investigation closely concern scientific workers. Two of these questions, whether our statesmen require better opportunities of informing themselves on strategical and technical problems of defence, whether service Ministers, when possible, should serve three or four years in their departments so as to master the technical problems, could well be included in the agenda of the proposed conference. The third question, whether the defence of the Empire and the security of the British people could be removed from party strife, or some other means devised to lessen political differences on the basic problems of defence, might also be considered.

Prof. Hill's address shows clearly that a definite practical programme and not mere generalities can be placed before both sessions of the forthcoming Empire Scientific Conference when it meets. There will be ample scope for critical discussion and imaginative planning; but if the Conference is to result in the bold executive action desired, scientific workers must manifest their interest and support in

no uncertain manner in the months preceding its assembly. The application of the methods of biological science, in its widest sense, to the problems of general welfare, and of physical and engineering science to economic and industrial problems, calls for much effort by the individual scientific worker, and, as Prof. Hill points out, may involve facing political as well as scientific and technical issues. Not everyone who recognizes as desirable that fuller and more effective co-operation among men of science for which Prof. Hill pleads will feel as sanguine as he is that such co-operation in the British Commonwealth will appreciably influence the relations of the world as a whole; but it must help rather than hinder international co-operation generally. That the closer co-operation of scientific workers and fuller and freer contacts between them are important factors in the continued advance of science cannot be denied. They are indeed essential conditions in order that mankind may enjoy those higher standards of health and welfare which science has put within our reach. Prof. Hill's address should stir scientific men to take their part not only in thinking about the technical and scientific aspects of the special problems he has indicated for consideration by the Empire Scientific Conference, but also, and equally important, in educating their fellow-citizens as to what is at stake. They can prepare the way for the measures required to implement such co-operation, and to establish and safeguard that code of common ethical standards which, as Prof. Hill so emphatically urged, will be a safeguard against the abuse of science either in peace or in war.

A PHYSICIST LOOKS AT GENETICS

What is Life?

The Physical Aspect of the Living Cell. By Prof. Erwin Schrödinger. (Based on Lectures delivered under the auspices of the Dublin Institute for Advanced Studies at Trinity College, Dublin, in February 1943.) Pp. viii+91+4 plates. (Cambridge: At the University Press, 1944.) 6s. net.

AS a result of the War, many scientific workers have been too busy with the applications of science to keep up even with the development of their own branch. Schrödinger, as an exile in neutral Eire, has found the leisure to study another, namely, genetics, which he describes as "a new branch of science, easily the most interesting of our days". I wonder if posterity will find crossing-over as interesting as exchange energy, or mutation as atomic transition. However this may be, every geneticist will be interested in Schrödinger's approach to his or her science.

Schrödinger sets out to answer the question "How can the events in space and time which take place within the spatial boundary of a living organism be accounted for by physics and chemistry?". He believes that they can, but not by present-day physics and chemistry. Accepting the view, first, I think, put forward by Koltsoff, that a chromosome is a giant molecule, Schrödinger describes it as an aperiodic crystal. Thus it may be expected to have some of the properties of a crystal, including that of self-reproduction, and yet to be of so highly complex a structure that it can act as a "code-script" for the development of an organism. He thinks that just because a gene is of molecular dimensions, and there are only one or two genes of a kind per cell, one cannot apply statistical mechanics to the behaviour of genes. This is perhaps not quite certain; for an organic catalyst can, in favourable circumstances, transform more than 100,000 substrate molecules per second. If genes are catalysts of this order of activity, even a single gene requires statistical treatment.

Much of the book is devoted to mutation, and the author not merely accepts Delbrück's account of this process, but also writes that "If the Delbrück picture fails, we would have to give up further attempts". This seems a rash statement from a quantum physicist. The modern 'picture' of an atom is not superficially very like Bohr's picture, for discrete orbits of electrons have been replaced by a continuous probability distribution. Yet Bohr's theory explained so much that it was hard to believe that it would be so greatly modified.

Actually I believe that the Delbrück picture will have to be modified profoundly, for the following reason. Schrödinger (p. 65) states that the single event which produces a mutation "must be an ionization or similar process". Lea and Catcheside, in unpublished work communicated to the Genetical Society, which they very kindly allow me to quote, produce strong evidence that many, if not all, lethal mutations produced by irradiating *Drosophila* spermatozoa are due to chromosome breakage followed by restitution; and in *Tradescantia* they[1] calculate that "at least 17 ionizations must be produced in a chromatid to cause a break". In spite of this they think that the 'target-area' gives the size of the gene correctly. In fact, as so often in quantum mechanics, a simple theory gave fairly correct results, but nevertheless had to be modified.

Again (p. 64), the fact that the mutation-rate of wild-type genes is more enhanced by temperature than that of less-stable mutant genes is neatly explained on quantum-mechanical grounds. But Fabergé and Beale[2] found that the mutation-rate of a very unstable gene actually fell off at high temperatures. Perhaps there are more things in chromosomes than are dreamt of even in wave mechanics.

I make these criticisms not from any desire to denigrate the book before me, but because many geneticists will read it, and all of them should. And not only geneticists. The physiologist who can assimilate the idea that a living organism feeds on negative entropy will come back to the study of metabolism with a slightly novel set of questions to ask. Nevertheless, a whole series of biological problems are not raised. Many biologists have found it impossible to explain the facts of organic regulation on mechanistic lines. Prof. Schrödinger's views on genetics are so interesting that I hope he will tackle this problem, too, in another book. In a living organism we find a hierarchy, so to say, of normal conditions. A man does his best to keep the partial pressure of carbon dioxide and the concentration of bicarbonate ions in his plasma constant. If he fails in either respect, he will use his lungs, kidneys, or both, to bring their ratio, and therefore his pH, back towards normal. But even pH is less important than an adequate oxygen supply. And so on. A mathematical physicist might be able to find physical analogies, or even explanations, for such facts as these.