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AN INTERNATIONAL SCIENCE CO-OPERATION SERVICE

WHILE scientific workers may well find it scarcely less difficult than their fellow citizens to grasp as yet the full implications of the new force resulting from scientific discovery which we have seen in action in the atomic bomb, they will unhesitatingly endorse Mr. Attlee's view that a re-evaluation of the whole situation, especially in the sphere of international relations, is required. This is particularly true in respect of the exchange and dissemination of information and of the organization of defence, to both of which questions scientific men in Britain have been giving close attention during recent months. Nothing can stop the progress of research and experiment in every country; but although research will no doubt proceed in many places, the immense plants necessary to transform theory into action cannot well be constructed in countries not possessing the necessary resources. Our organization of scientific research and development, the whole system of the organization and co-ordination of the nation's resources for defence purposes, which Lord Hankey reviewed under a somewhat misleading title in his recent book, "Government Control in War", must be reconsidered in the light of this new situation.

This no doubt will be one of the prime tasks of the new Atomic Energy Advisory Committee which, as announced on August 21, the Government has set up, under the chairmanship of Sir John Anderson, to assist in dealing with the many far-reaching questions raised by this new discovery, in connexion with its international treatment and its further development in Britain, for both industrial and military purposes. This Committee is not intended to deal with policy, which no doubt will be fully considered not only by the Government itself, but also, if not by the Executive Committee of the Preparatory Commission of the United Nations, then by the Security Council, as Mr. Bevin's statement on August 16 indicated. The exchange of scientific information and of scientific co-operation is thus again to the fore, and the ideas put forward last year by Dr. Joseph Needham for the organization of an international science co-operation service acquire fresh significance.

The choice is in fact not between secrecy and disclosure, but between co-operative and competitive knowledge. It might be held a sensible precaution for the United States to hold her secret until agreement has been reached upon the form of the new world control and until the appropriate machinery has been built into the United Nations organization; but that control must be based on the pooling of knowledge, upon the recognition that, as the Archbishop of Canterbury pointed out, it is the duty of men of science to explore and to find out with all the abilities they have, and to extend the knowledge of this universe. That duty can only be discharged while there is the fullest communication between scientific men of all countries; and although there may be room for much discussion as to the form the control now required should take, it must be recognized from the start that full freedom of scientific

intercourse is a first condition. Without that there can be neither effective control in seeing that this discovery is not turned to destructive ends, nor the best use made of it for peaceful purposes.

One of the first steps to be taken is thus, as Sir Henry Dale suggested in his letter in *The Times*, the encouragement of the fullest possible publication of the results of scientific research and of the full freedom of science for which he pleaded. It is not merely that progress in science really depends on such freedom of intercourse; from the point of view of world order and security, such freedom would also be a useful means of indicating danger points. Restrictions or refusal to participate would not be easily concealed from the scientific community; and once the existence of such an attitude was established, the world organization should be able to deal appropriately with the situation before it became unmanageable. Furthermore, the historical survey of the scientific discoveries which led to the idea of the atomic bomb contained in the Statement issued by the Department of Scientific and Industrial Research on August 12, 1945, well illustrates the truth that scientific effort proceeds on parallel lines in different countries, and effective contact and intercourse between the scientific men of the United Nations should in itself be a safeguard against any sudden advance elsewhere, the application of which might endanger the peace of the world.

Dr. J. Needham, writing from Chungking, has now prepared for private circulation a memorandum on the place of science and international scientific co-operation in post-war world organization, in which he reviews the reception of his earlier proposals and discusses their incorporation in a United Nations organization such as that which was recently considered by the Conference of Allied Ministers of Education. Prof. A. V. Hill's address on "Scientific Co-operation within the British Commonwealth" before the Royal Empire Society on January 31 (see *Nature*, 155, 373; 1945) elaborated proposals for a more limited field, but with their bearing on international scientific co-operation clearly in mind. The recent visit of British and other men of science to Moscow for the anniversary celebrations of the U.S.S.R. Academy of Sciences has provided further evidence of the concern and desire of scientific men everywhere for fuller and free international contacts.

The dependence of all modern world civilization on applied science must find its expression in the sphere of international relations, and Dr. Needham notes that this desire is more strongly expressed the further one goes away from the great scientific and industrial centres of Europe and the United States. One reason for this is, as he shows in his memorandum, that the picture of world science looks very different when seen from Rumania, Peru, Siam or China, where it may be very difficult for one man of science to establish contact with another in a different part of the world. It is particularly the scientific workers and technologists in the far larger regions of the world outside Western Europe and North America who need the help of an international science co-operation service.

Dr. Needham points out that such a service should be directed and limited to doing those things that are not being done, and cannot be done in other ways. It must also avoid the danger of a paper organization incapable of functioning effectively, and undue bureaucracy through failure to select the right staff. Adequate office management would avoid the first danger, and full participation by scientific men themselves the second. He should also have added, however, that no new organization should be established where the development or modification of existing organizations would serve.

Since these proposals were advanced last year, draft proposals for an educational and cultural organization of the United Nations have been published (see *Nature*, Sept. 1, p. 263). The purposes of this organization are "(1) To develop and maintain mutual understanding and appreciation of the life and culture, the arts, the humanities and the sciences of the peoples of the world as a basis for effective international organization and world peace". The principal functions of the organization would be to assist the free flow of ideas and information among the peoples of the world through schools, universities and other educational and research institutions, libraries, publications and the Press, the radio and motion picture, international conferences and the exchange of students, teachers and all other representatives of educational and cultural life, with special attention to the exchange of information on major educational and cultural developments, including advances in scientific knowledge. They also include fostering the growth of educational and cultural programmes which give support to international peace and security, and conducting and encouraging research and studies on educational and cultural problems related to the maintenance of peace and the advancement of human welfare.

The activities thus contemplated cover most of the twenty-four specifically listed in the draft cited in Dr. Needham's memorandum, and scientific activities are more implicitly covered, though the restoration of physical facilities including laboratories and equipment and scientific libraries in the liberated and ravaged countries is not mentioned. Since, however, the word 'culture' does not possess in all countries the wide connotation it has in the United States, Dr. Needham is on firm ground in insisting that the word 'science' should appear in the actual title of the organization, and in suggesting that it should be termed the United Nations Educational, Scientific and Cultural Organization. Moreover, the Organization should cover both pure and applied science, which cannot be separated.

Dr. Needham sets forth thirteen aims for the scientific division of the new Organization which overlap with those already mentioned but cover the field of science more adequately, and have much in common with the agenda Prof. A. V. Hill suggested for the Empire Scientific Conference. First, there is the general aim of promoting international scientific co-operation in all its aspects. Next, he puts organization of the better exchange of scientific information and research services between scientific men and their

organizations in the different countries. Here Dr. Needham refers to the enormous task of seeing that the information actually published by government scientific organizations reaches those who need it, both far and near. In this connexion his work in China has clearly impressed upon him the need for increasing the availability of scientific periodicals, both current issues and the back runs of the more important periodicals. Besides the question of reproduction which may be involved here, there is the exchange of reprints, and Dr. Needham suggests that a central stockpile might be of great value to scientific workers by facilitating distribution.

In elaborating this point, Dr. Needham ventures into a highly technical field; but it may well be argued that some such organization as he advocates would prove the best means of securing an objective study of the problems and encouraging, not the development of a number of new *ad hoc* organizations, but rather the expansion of existing organizations so that they could serve adequately the needs of to-day. He also suggests in the same connexion that much help could be given to scientific workers by arranging for the wider use of special apparatus only available at certain places, while a specific aim should be that of assisting the free flow of essential research apparatus, chemicals and equipment across national frontiers. This function would involve assisting a wide distribution of the catalogues of firms producing scientific equipment, and possibly some assistance in the matter of customs dues and procedures. Some of these points have already been emphasized by the Committee on Scientific Equipment of the Conference of Allied Ministers of Education. As one of three short-term aims, Dr. Needham mentions the elaboration of a plan for utilizing surplus war material and equipment suitable for use in research and its transfer to the more scientifically backward countries.

Another aim would be the maintenance of contact between government organizations concerned with science, pure and applied, when necessary, and advising government and diplomatic personnel on scientific matters. This applies to the smaller Powers particularly, for even if the practice of appointing scientific attachés in the embassies of the larger Powers becomes established, the smaller Powers may well lack the personnel to make such appointments. Again, the need is stressed for assisting the free flow of scientific books, periodicals, manuscripts for publication, translations, abstracts, etc., across national frontiers, and especially between world regions of widely different linguistic pattern. Here he has in mind both encouraging the publication of scientific results in the major scientific periodicals in the better-known languages, and also the rationalization of the present system of abstracting scientific publications. An International Science Co-operation Service should be able to do something to prevent the dissipation of scientific publication on purely nationalistic grounds. It might assist the effort which the British Commonwealth Science Committee contemplates in its report for a common abstracting service for the English-speaking nations, and develop this ultimately into a central abstracting organization issuing the abstracts

in the three or four main world languages simultaneously.

Realization of such plans at present lies far ahead, but progress is scarcely possible except through an organization of the type Dr. Needham has in mind. Even within a single country, there is still much parochialism among scientific workers to be broken down before co-operative enterprises in such fields as abstracting can achieve full success. Probably Dr. Needham's next objective, assisting the free flow of scientific workers across national boundaries, is one where the organization he suggests might function with more immediate effect. Dr. Needham quotes Sir David Rivett, Dr. Coumoulos and Prof. J. B. S. Haldane to illustrate the importance of this objective, and refers also to such matters as the preparation of scientific expeditions in zoology and astronomy, and for the investigation of the natural products of interesting parts of the world where local effort would be unable to finance such projects. Dr. F. W. Went's proposal for the organization of temporary research groups in specific topics in fields such as genetics, cytology, physiology and morphology is a further example of how valuable such an international science co-operation service might prove.

Overlapping with this aim, Dr. Needham suggests the promotion of plans for international collaboration in research, and has in mind both close contact with the international scientific unions which, in such sciences as astronomy, geophysics, geodesy and radio physics, have been outstandingly successful in the past, and the establishment of similar bodies for other sciences, as well as encouraging the activities of such organizations as the International Committee on Zoological Nomenclature. He illustrates his point by showing how an international science co-operation service could help in rapidly supplying contacts needed in research and by rendering the dissemination of scientific information less haphazard. This aim would also cover the preparation and maintenance up to date of a register of scientific institutions of all kinds and of their staff members and specialities.

Again, the new organization would support all international activities of the various national academies of science, and assist the work of other international organizations, such as the United Nations Food and Agriculture Organization and Relief and Rehabilitation Administration, the International Labour Office, etc., in scientific questions. Such development would be greatly facilitated by the development of the expected science co-operation service of the British Commonwealth after the War and like bodies, the International Resources Office, or the International Development Authority called for at the Bretton Woods Conference. On the other hand, the organization suggested by Dr. Needham might be able to combine into one body some of the smaller international scientific bodies such as the United Nations Standard Co-ordinating Committee, the World Power Conference, the International Fisheries Board, and also provide central secretariat facilities for the international scientific unions and congresses.

From Dr. Needham's experience with the British Council Scientific Office in Chungking, and from the work of the United States Interdepartmental Committee of Cultural and Scientific Co-operation with the American Republics, he is able to supply concrete examples of the kind of work which the organization he suggests might do. Furthermore, while the work of the organization would chiefly be related to that of the Social and Economic Council of the United Nations, in one matter at least it would be related to that of the Security Council. Dr. Needham suggests that the organization should be concerned with the control of the activities of scientific workers in the ex-Axis countries so as to prevent the building up of war potential while permitting the renaissance of scientific thought which must have a place in the re-education of these peoples. With an international science co-operation service, it should be almost impossible for the significance of such developments as the Haber ammonia synthesis to be overlooked, and this factor has a vital bearing on the elaboration of any plans for the control of atomic energy.

As to further association of the organization with industrial activity, Dr. Needham is a little vague. He thinks that some help might be offered in the simplification of world patent law and that by means of such an organization the maximum goodwill could be focused on the development of the backward countries. Dealing with the probable cost and structure of the proposed organization, from the cost of the British scientific office in Washington and in China and the United States Cultural Division of the State Department (Far East Section), he suggests that the annual budget should be about three million dollars, providing for a liberal number of field offices. It is essential, however, that the scientific organization be not radically understaffed or starved of funds, and the headquarters' secretariat must be supported by a resident staff in the more backward countries, where the prestige of science is weak and the influence of local politicians with no understanding of science is strong. Not more than two or three of the scientific representatives in such a field office need be of outside nationality, and for some regions a field office could cover several national entities or domains.

Dr. Needham is not pessimistic as to the possibility of securing the right staff, and points to the fund of wisdom and experience which could be drawn upon by utilizing men in the five-year period after retiring age. The business of the scientific liaison officer, he emphasizes, is not necessarily to know the answer; but to know where the answer can most probably be obtained. He also emphasizes the need for assuring the officials of the organization of some kind of diplomatic status, with guaranteed facilities for transport and communication.

Dr. Needham has been at some pains in formulating his scheme to avoid the weaknesses in the International Institute of Intellectual Co-operation, but although it may be assumed that the principal place for science in the international scheme is the United Nations Educational and Cultural Organization, with the title modified as suggested, many scientific men will be working with other functional organizations,

such as the Radio Communications Organization, the Civil Aviation Board, the Food and Agriculture Organization, the International Health Organization. Accordingly, it has been proposed that a scientific body might be introduced at a higher level than any one of the functional organizations; so Dr. Needham suggests that the United Nations should include, as a counterpart of the Economic Commission and the Social Commission, a Scientific Commission and a Scientific Secretariat. The Commission might consist of about a dozen eminent men of science of the older generation, and the secretariat of a score or so younger men of science, mostly on a short-term service basis. This Scientific Commission of the Economic and Social Council would provide an easy means of linking the work of all scientific men in the functional organizations; but Dr. Needham himself appears to lean rather to the idea of an Educational, Scientific and Cultural Organization, functioning on the lines already indicated, and worked out in detail by a world conference of science; such a conference has already been recommended by the National Academy of Sciences of the United States. Nevertheless, although most of Dr. Needham's suggestions are to be found in current discussions on problems of scientific relations, it may well be open to question whether the time is really ripe for such a world conference. So far as the British Commonwealth is concerned, these questions will largely be covered by the Empire Science Conference to be called next summer by the Royal Society, and the improvement of scientific co-operation and communications within the British Commonwealth is an essential factor in promoting any wider schemes.

What appears to be of the first importance at the present moment is to see that the full fruits of war-time experience are reaped, and that machinery for co-operation for war purposes, whether within or without the British Empire, which has proved its value, should not be thrown away. To develop and utilize fully existing organizations rather than to elaborate fresh organizations should be a guiding principle. It is true we may well hope for the establishment of an Indian Scientific Office with an Indian Scientific Liaison Service, and the position with regard to the Middle East Supply Centre may require careful watching if the valuable scientific work already initiated under it is not to be jettisoned. That in itself is a matter for international collaboration, and the Empire Science Conference is unlikely to disregard the work of the British Central Scientific Office in Washington, the Scientific Office of the British Council in China, or the experiment with scientific attachés which Australia has initiated. Furthermore, those considerations of imperial defence to which Prof. A. V. Hill referred in his address to the Royal Empire Society on January 31 have been powerfully reinforced by the advent of the atomic bomb; and policy in this matter cannot be worked out in isolation. Dr. Needham's proposals may appear premature in some respects, but between now and the meeting next summer of the Empire Scientific Conference there should be clear thinking among scientific workers of the Commonwealth as

to the precise ways of improving means of communication and co-operation within and without the British Empire, and the extent and delimitation of any new organization to be established for such purposes. Such consideration must necessarily take account of the draft proposals for a United Nations Educational and Cultural Organization, and a decision reached as to how far such an organization can serve the needs of science, what modifications, if any, are required in title or in structure, and whether or not scientific organizations can usefully co-operate. Dr. Needham has at least challenged the constructive thinking which is essential in order to seize the opportunities of the post-war world.

PROTEINS, AMINO-ACIDS AND PEPTIDES

Proteins, Amino-Acids and Peptides as Ions and Dipolar Ions

By Edwin J. Cohn and John T. Edsall, with chapters by John G. Kirkwood, Hans Mueller, J. L. Oncley and George Scatchard. Pp. xviii+686. American Chemical Society Monograph Series. (New York: Reinhold Publishing Corporation, 1943.) 13.50 dollars.

THE misfortunes of war have rendered this impressive book, published in 1943, inaccessible in Britain until recent months. No shorter description is possible than to say it is worthy of those great men to whom it is dedicated, Bate Hardy, Loeb, Osborne and Sørensen.

The book is wholly devoted, except for one chapter, to physico-chemical aspects of proteins and their simpler constituents, and, until very recent times, such books have been exceedingly few. The earlier ones by Robertson (1920), Loeb (1922), Pauli and Valkó (1933) were of classical calibre (this one no less), and they were for the most part an interpretation of those properties of proteins directly dependent upon the ampholytic character of the molecule; little was known of the size and shape of the protein molecule. In the last decade, however, we have seen the fruition of Svedberg's monumental researches in this latter field, researches which reoriented the type and scope of physico-chemical research, and we now mark a point at which much is known of what we might call the morphology of the protein molecule, and almost nothing of its fine structure. The present volume incorporates this newer knowledge, yet the emphasis, like that of its antecedents, is upon those properties of proteins arising from their dipolar ionic character. This does not imply a bias: it merely recognizes a fundamental character which makes the protein molecule the great architect of biological reactions.

The outstanding feature of the book is that it presents, both in trend and treatment, the individual approach which Prof. Cohn and his colleagues have consistently followed in the long series of papers from the Harvard laboratories; that is, the properties of proteins reflect in large degree the properties of the simpler peptides and amino-acids, and are explainable, also in large degree, from the more straightforward studies on these simpler compounds. The

first part, therefore, is devoted to amino-acids and peptides, thus: spectroscopy and dipolar ionic structure; thermodynamics and simple electrostatic theory; dipolar ions and acid-base equilibria; relations between acidity and chemical structure; dielectric constants and dipole moments; apparent molal volume, heat capacity, compressibility and surface tension; solubility in water and in organic solvents; interactions between organic solvents and dipolar ions; interactions between amino-acids and peptides, etc.; interactions between ions and amino-acids; theoretical interpretation of the properties of dipolar ions in solution.

The second part is devoted to the proteins: structural basis from analysis and proteolysis; X-ray diffraction studies; amino-acid composition; density and apparent specific volume; osmotic pressure and molecular weights; translational diffusion; sedimentation and diffusion; proteins as acids and bases; rotary Brownian movement; electric moments and relaxation times; solubility of proteins; interactions of proteins with ions and dipolar ions; theory of electrophoretic migration.

It must be admitted that the book, though lucidly written, will not be readily assimilated except by the physico-chemical expert, and no review can dismiss that large section of less specialized readers who must enlarge their more purely chemical or biological interests. For the broad mass of workers in the biochemical field—and there are few aspects of biochemistry which do not touch upon and require some knowledge of the properties of proteins—may be deterred by the rigorous mathematical treatment which a book of this nature must embrace. Yet it is important that this section of biochemists should understand, to take one obvious example, the factors governing the solubility of a protein, a knowledge facilitating all preparative and purification techniques in the field of proteins 'proper', hormones, enzymes, viruses, immuno-chemistry and the rest. How far then does the book fulfil the needs of this class of reader? Certainly, Chapters 3 and 12 by Scatchard and by Kirkwood (thermodynamics and simple electrostatic theory; properties of solutions of dipolar ions), and Chapter 25 by Mueller (theory of electrophoretic migration) will not be appreciated and their usefulness must be rather limited. On the other hand, most other chapters are characterized by an unassuming approach and show the adaptation of simple laws to the study of complex problems. Of this, Chapter 4 (dipolar ions and acid-base equilibria) and Chapter 6 (dielectric constants and dipole moments), both by Edsall, are two examples. The authors do indeed create an awareness that they have been sensible of the needs of the less specialized reader, and strike a nice balance between descriptive and mathematical formulation. With a little perseverance, therefore, this class of reader will reap a rich harvest.

We have noted the main emphasis of the book, namely, the dipolar ionic character of proteins. One of the most important sections here is the interaction of proteins and ions, and Chapter 24 reveals that some aspects are not fully understood; particularly the extreme insolubility of some protein cations in presence of mere traces of salt. Again, the interaction of protein with protein must be of great importance in physiological systems, yet few studies have been made. Among other chapters, protein structure is summarily treated, and only a few aspects of denaturation. The treatment of the amino-