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## Co-operation of State and Industry in Scientific Research\*

ONE of the most valuable features of the annual report issued by the Department of Scientific and Industrial Research is what may be termed the map of research throughout Great Britain which it provides, in addition to the many impressive illustrations contained in the report of the way in which scientific research serves both industrial and social needs. This map of research is of special interest at the present time. Not only does the report indicate the direction which research upon urgent problems as housing and building, road transport, fuel supply and the like is taking, but it also indicates, as few if any other public documents do, the manner in which the resources of the State and of industry are being mobilised for the support of such research.

From its inception, the work of the Department has been conditioned by the support it receives from industry. Grants to the research associations have largely been on a pound for pound basis with contributions from the industry, and a good deal of work has been undertaken on specific problems for which appropriate fees have been paid by the industry or firm concerned. The report of the Advisory Council for the year 1933-34 pays special attention to the various problems of co-operation presented in the work of the Department and to the methods by which effective and sustained research on fundamental and long-range problems is to be encouraged.

Research work of this type is encouraged by the Department in several ways. In the first place, there is a system of research grants to students, a scheme by which the Department is brought in direct contact with some of the fundamental scientific work at the universities. A major advantage of this method is the assistance afforded to promising students to complete their training by a course of post-graduate study and research, and it is accordingly of considerable significance in regard to the recruitment of scientific staff by industry.

In the second place, under the research association scheme various problems of fundamental importance are being investigated, and it is with the object of encouraging such long-range investigations that the Advisory Council is recommending, where circumstances warrant it, and conditional upon support from the industry,

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substantial block grants for periods such as five years. In this way, by stabilising the finances of the research associations, it is hoped to facilitate intelligent planning and prevent the crowding out of vitally important researches, which may not be immediately productive, by *ad hoc* inquiries.

It is not, of course, suggested that even this scale of operations is one with which the industries should be content, and the Advisory Council has indicated its readiness to encourage further expansion by grants based on income in excess of a specified figure up to a prescribed limit. There are, however, practical as well as financial limits to the expansion of the work of a research association, and in the majority of industries it will probably be found that, while the research work carried out by individual firms tends to increase, the activities of the research association tend to be limited to the more fundamental problems and to problems which are of interest to other industries also.

The size of the average industrial unit naturally has some bearing on the future and final functions of a research association, but even when an industry maintains numerous research departments in its individual units and when the invaluable educational work of the research association has been achieved, there should remain a well-defined field of activity for the association, resembling in some respects the field of activity of a number of the research boards of the Department at the present time.

Apart altogether from the suitability or necessity of the research association scheme for every industry, there is a third way in which the Department encourages scientific and industrial research—in actual financial co-operation with industry. The co-operation we are now discussing is distinct from those special investigations or tests which individual firms or organisations ask the Department to carry out in its research stations and notably at the National Physical Laboratory, as a repayment service. The current report refers to the extensive use made of the facilities of the stations of the Department by industrial undertakings in this way, but we are now referring to the encouraging growth in the volume of work undertaken by the Department as a demonstration to industry of the value of co-operation in the conduct of researches or investigations which are either too expensive or too lengthy to be attempted save by some large industrial association or by a group of firms.

The cost of researches of this type is largely defrayed by contributions made by the co-operating firms, either directly or through some industrial organisation, and the balance of the cost is provided by public funds. The expenditure, in contrast to that on a research association, is directed to specific researches, and in this way are handled many problems needing attention which could not be dealt with through a research association. As an example of this type of co-operation the current report cites the researches at the National Physical Laboratory for the practical development of steels for use at high temperatures, financed as to at least one half from funds raised by the British Electrical and Allied Industries Research Association and the British Iron and Steel Federation. Other examples are to be found in the work of the Steel Structures Research Committee, and the investigations to discover British sources of materials which could be used in place of natural pozzolanas to increase the resistance of concretes and mortars to certain forms of chemical attack.

That there is a definite field for this type of co-operative research, even when the industries concerned are run on scientific lines and are conducting independent research on an extensive scale, is indicated by the support of the investigations last mentioned by such firms as Imperial Chemical Industries, Ltd., the Anglo-Persian Oil Co., Ltd. and the Associated Portland Cement Manufacturers, Ltd. The unconditional cash contributions made to the general work of the Department in special fields by industrial firms or associations may be regarded as another indication of the way in which the Department is regarded by progressive industry as supplying the essential staff work of research in fields which are important to many industries but the particular concern of none.

It is, of course, difficult to disentangle work of this type, which finds a permanent place in our national structure of research, from more educational work, which will become less and less necessary as a scientific outlook is developed in all sections of industry and the support of research on an adequate scale becomes general. The encouraging fact that the current report is able to quote three examples of researches which during the year have been transferred to the supervision of industry on the ground that their value to industry has now been fully demonstrated, while illustrating the success of the educational work of the Department, should not be taken as evidence that the need for co-operation between industry

and national research stations in this way will tend to disappear.

There is a further aspect of the work of the Department which should not be overlooked. Among the contributions received against the gross expenditure on the National Physical Laboratory, for example, are large sums from the Air Ministry and other Government departments. As the report shows, the Department is responsible for a good deal of scientific work on problems put before it by various Departments of State.

The Advisory Council's report indicates, moreover, that the influence of the Department is not limited to securing industrial and departmental co-operation in research in Great Britain only. In certain fields such as those of food investigation, both storage and transport, and timber research, it has from the start encouraged scientific co-operation with the Dominions overseas, and in many ways the resources of the Department are freely available for Dominion and Colonial Governments. To this policy may be traced the considerable developments in research organisation in South Africa, Canada, Australia and India, and contributions amounting to nearly £10,000 which have been received from the Empire overseas indicate the way in which the value of this co-operation is appreciated. Every effort is being made to secure scientific co-operation between workers at home and abroad so that ideas and results in parallel inquiries may be freely pooled.

It is clear from this brief review of the essential functions of the Department that its work fills a definite and permanent place in our national research organisation. The relative importance of the research associations and the research stations under the Department and of *ad hoc* investigations in co-operation with industry may vary as the work of encouraging a scientific outlook in

industry and the prosecution of research on an adequate scale succeeds, but each has its own definite place in the national economy.

What is equally clear from any survey of the activities of the Department is the uneven distribution of research through the industries of Great Britain. While industries can be found where expenditure on research may approach in magnitude the whole budget of the Department, there are other industries the expenditure of which in this matter is grossly inadequate and out of all proportion with their expenditure on such matters as telephone or postage. For many years yet, it is highly probable that by means of the research associations and in other ways the Department must continue its work of fostering the support of research by industry itself, both through the evidence afforded of the value of scientific research to industry in the past, in assisting the application of existing knowledge to industrial problems, and by encouraging the use of the scientific method in all branches of industrial activity.

The fullest use cannot be made of the national structure of research, however adequate, unless a scientific outlook and the vigorous and continuous examination of manufacturing practice in the light of available technical knowledge are characteristic of industry everywhere. The assertion of the Advisory Council in its report three years ago has lost not one whit of its force under the conditions obtaining to-day: "Scientific research has in the past made striking contributions to industrial progress and it will make them in the future. But the nation which will enjoy the benefits of science in the day-to-day progress of its industries is the nation which habitually applies scientific method and scientific knowledge; and it is that nation which will be able to seize the more spectacular achievements of science in the industrial sphere".

## Reviews

### Viewpoint and Vision

*New Pathways in Science.* By Sir Arthur Eddington. (Messenger Lectures, 1934.) Pp. x+333+4 plates. (Cambridge: At the University Press, 1935.) 10s. 6d. net.

**T**HIS book is, from one point of view, a revision of the author's "The Nature of the Physical World" (1929); from another, it is a sequel thereto. The subjects treated are, in the main, the same, but the treatment is brought up to date and the underlying philosophy is re-presented so

as to face more directly the attacks of criticism. In a brief review, only passing mention can be made of the purely scientific aspects of the book, interesting though they are; the general outlook demands chief attention.

The first thing that springs to notice is the extreme stability of the author's attitude. His citadel has been attacked by men of science, philosophers of various schools, rationalists, religionists and nondescripts, and after making all due allowance for mutual cancellation in such a variety of onslaught, we should have thought that