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The Research Associations.

THE Report of the Department of Scientific and Industrial Research for the year 1927-28 (Cmd. 3258) devotes considerable attention to the position, in the national economy, of the research associations set up in Great Britain under the ægis of the Department. Since 1918, when the first three associations were established, some twenty-six research associations in all have been formed. Two of them, relating to the glass and cement industries respectively, have been wound up, and of the twenty-four associations still in being, one, the British Iron Manufacturers' Research Association, has not received grant aid from the Department, and its operations were suspended at the close of the first quinquennium and have not, up to the present, been resumed. The British Colliery Owners' Research Association, founded in December 1924, has not received grant aid from the Department, and three other associations (Motor and Allied Manufacturers, Motor Cycle and Cycle Car, and Scottish Shale Oil) ceased to receive Government grants at the end of their first quinquennium.

It will be remembered that the original scheme of the Department of Scientific and Industrial Research provided grant aid from the million fund, set aside by the Government to promote scientific and industrial research, on the basis of annual grants equivalent to the annual subscriptions of members of the associations. The scheme further provided that the grant-in-aid should be limited in each case to the first five years of the association's life. It was assumed or believed that a period of five years would be sufficient to demonstrate effectively that co-operative research was of value to industry, and that, as a result of that demonstration, the several industries that had embarked on the experiment would be willing to shoulder thereafter the whole financial burden of maintaining their respective research associations. In fact, as the report of the Advisory Council to the Department states candidly, "five years proved too short a time for most of the Associations to establish their reputation by the results of their work".

There need be no surprise at this conclusion, for the first two years of an association's life are necessarily spent mostly in setting up the organisation, gathering together the appropriate scientific staff, securing the buildings and equipment, and planning a comprehensive research programme. It would be more than remarkable if, in the remaining three years, the results of any association's

work should be sufficiently striking to convince manufacturers (presumably having little or no previous experience of research applied systematically to their respective industries as a whole) that co-operative research was of such immediate and valuable service to industry that it would be a 'business proposition' for them to bear alone its necessarily high expense. St. Paul may have been amenable to quick conversion, but the average British manufacturer is, shall we say, less impetuous. Indeed, even now, after some ten years' experience of the work of the research associations, the report of the Advisory Council to the Department says: "It cannot be denied that most of the Associations find it difficult to get the financial support they deserve. A subscription to a Research Association is still regarded in many cases as a charitable gift, to be paid with public spirit and private reluctance, and to be withheld when funds are scarce."

At the end of the first quinquennium, therefore, the Department, looking the facts in the face, agreed to a continuance of State aid, though on a smaller scale, for a further period of five years. The scale of grants was not only smaller but also, in general, it was a descending scale, calculated so that at the end of this second quinquennium the grants would sink to zero. The stipulated grant-earning subscriptions were correspondingly based upon an ascending scale so that the total income of the association should remain about the same and the association be self-supporting at the end of this second period of five years. But again, in fact, it was found impossible by many, probably by most, of the associations to fulfil the conditions of this carefully planned, if still heroic, scheme; and the Department, again facing the facts realistically and sympathetically, consented to modify in a more generous direction the conditions on which a number of the associations might continue to receive grants during this second quinquennium. To the associations, however, the problem remained of what was to happen to them on the termination of this second quinquennium. It was doubtful, to say the least, whether the majority of them could become financially self-supporting, on an adequate scale, immediately this second grant period ceased.

Accordingly, nineteen of the research associations during the past year submitted by deputation a reasoned memorial to the Lord President of the Council, the Earl of Balfour, praying for a continuance of financial assistance by the Department on the pound for pound scale. The Lord President

was unable, on behalf of the Government, to accept the proposals of the memorialists, but he announced a new policy which goes some way to meeting the difficulties with which the associations are faced. When the existing contracts for the second quinquennium come to an end, each association is to be considered on its merits and a subscription income fixed, which it will be necessary for the association to obtain from other sources before it is eligible for any grant from the Department. Funds obtained from approved sources in excess of this minimum subscription income will be augmented by a grant equal in amount from the Department up to a limit depending on the circumstances of the association.

That, stated briefly, is the substance of the Department's policy, in the near future, with respect to grants in aid of the research associations, and it is further evidence of the willingness of the Department, to which attention has already been directed, to modify and adapt its policy to new facts and changed circumstances. The inflexible attitude of "What we have said we have said" has been wisely left to political heroes. The Advisory Council has been mindful throughout that it has a fiduciary duty to ensure, so far as it may reasonably do so, that scientific and industrial research, in close association with industrial effort, plays its essential part in national recovery.

The next few years will show whether the new policy is sufficient to enable the research associations to weather the difficulties of the long period that must still ensue before the indifference and inertia, in this matter of research, of the general body of manufacturers (more particularly perhaps of those engaged in industries that have been hitherto largely run on rule of thumb) can be overcome. Obviously, very much will depend, in each case, on the minimum subscription income fixed to qualify for grant. The Advisory Council states: "We do not, in any case, intend to fix it lower than an amount which, in our opinion, would be sufficient to maintain the Association in being as a useful nucleus of research. The State's contribution would then be used to assist in transforming the nucleus into a well-nourished adult and productive organisation." The associations must take hope from the biological fact that nuclei are generally small, and that it should be well within their powers to provide the funds necessary to maintain an organisation that can satisfy the Department's idea of a useful nucleus. The Department has of course a duty to the taxpayers not to put the limit too low: it has a corresponding duty to the

cause of industrial research, which its own inclination will prompt it to fulfil, not to put the limit so high as to make it prohibitive.

Before or at this point the question naturally arises whether the work already done by the research associations has justified their foundation and the money expended by them. On this point the Advisory Council—and it is in the best position to know—says categorically: “The main purpose has, in our opinion, already been achieved. Co-operative research has proved its value, it has come to stay, and we agree with the views expressed in the memorial on the importance of consolidating now the financial position of the Associations.” The final report of the Balfour Committee on Industry and Trade, issued on Mar. 11, emphasises the importance of progress in scientific research and a clearer line of demarcation between the function of the State and that of industrial undertakings either singly or in co-operation. In particular, the Committee urges that there should be no relaxation or curtailment of the efforts of the Department of Scientific and Industrial Research, and no withdrawal of financial support on the part of the Government.

In connexion with this last recommendation it is worth notice that the late Prof. Alfred Marshall, the distinguished economist, in his “Industry and Trade”, first published in 1919, specifically recommended public grants to research associations on other and perhaps unusual grounds. After pointing out that the research associations are “wholly constructive”, he says: “But the experience of the ages shows that Associations set up for constructive purposes are in danger of being turned to destructive ends: and therefore it may perhaps be to the public interest that some limited contribution should be made from public funds to the support of such Associations, partly in order to facilitate the intervention of public authority in case an association should develop anti-social tendencies.” The reader may find it interesting to make speculations on the character of these “anti-social tendencies” presumed to be latent in the research associations.

There is a great area of British industry occupied by numerous medium-sized and small firms, directed by strongly individualistic owners, too small to enable industrial research to be prosecuted, on any adequate scale, on an individual basis. Despite the modern tendency towards larger aggregations of capital by the fusion of smaller firms, it is likely that a very great field of British industry will continue for long to be represented

by these medium-sized or small manufacturing units. For them the only practicable scheme of industrial research, on a sufficient scale, is co-operative research, *i.e.* the organised co-operation of groups of firms to provide the funds and the equipment, both personal and material, for the needed research. In this field it is most important to find for Government action the golden mean between policies of *laissez-faire* and spoon feeding.

Geometry and Relativity.

Philosophie der Raum-Zeit-Lehre. Von Prof. Dr. Hans Reichenbach. Pp. vi+380. (Berlin und Leipzig: Walter de Gruyter und Co., 1928.) 18 gold marks.

THE appearance of a work on the philosophy of a branch of mathematical physics by a trained philosopher, who at the same time has a thorough knowledge of mathematical and physical methods and principles, is an event as rare as it is welcome. This book by the Berlin philosopher Reichenbach, well known to mathematical physicists by his writings on relativity, is unique and should be in the library of everyone interested in geometry and relativity in their philosophical as well as mathematical and physical aspects, fully deserving a place beside the standard treatises of Bertrand Russell and Whitehead. It is divided into three sections, the first on space (120 pages), the second on time (45 pages), and the third on space-time (155 pages), whilst there is an appendix (42 pages) on Weyl's extension of Riemannian geometry and the geometrical interpretation of electricity, which forms the basis of a recent paper by the same author on Einstein's new field theory of gravitation and electricity. In the brief space available here it is impossible to do full justice to the author's argument, but the following summary may be useful as an indication of the character and scope of this very important work.

In the first section the argument proceeds as follows: there is no pure intuition *a priori*; all intuition is determined by past experience. Non-Euclidean geometry is just as intuitive as Euclidean, but one must not expect to be able to imagine non-Euclidean geometry by means of Euclidean elements. Experience decides which geometry is valid in actual space, but the decision presupposes an arbitrary correspondence definition (*Zuordnungsdefinition*), which defines the unit of length in a given place and permits of a definition of congruence of lengths in different places by means