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Editorial and Publishing Offices :

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.

Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

NO. 2928, VOL. 116]

Co-operative Research.

AT the first meeting of the British Association, held in 1831, the Rev. W. Vernon Harcourt proposed that the Association should "employ a short period of every year in pointing out the lines of direction in which the researches of science should move; in indicating the particulars which most immediately demand attention; in stating problems to be solved and data to be fixed; in assigning to every class of mind a definite task; and suggesting to its members that here is a shore of which the soundings should be more accurately taken, and there a line of coast along which a voyage of discovery should be made." This early suggestion adumbrating the organisation of scientific research met, apparently, with no response, and academic research continued to be conducted entirely on individualistic lines until a few years ago, when a Government department undertook the organisation of certain investigations which were realised to be of fundamental and national importance. In applied science the picture is a different one. Whereas the field for academic research is so vast and so ever-widening that the fear of duplication or mutual interference seldom arises, the problems of applied science, though very numerous, are more restricted in range, and therefore more amenable to organisation. For a long time past, organised research has been carried out by a few large manufacturing firms, but it was not until the British nation recognised, early in the War, that its existence depended upon certain industries which were based upon science, that steps were taken by Government to organise industrial scientific research.

If our ancestors, who were reared on the doctrines of *laissez-faire* and self-help, could see us to-day, they would marvel at the developments which have sprung Minerva-like from the bitter experiences of the War. As Sir Thomas Holland recently reminded us in his excellent address to the Royal Society of Arts on "The Organisation of Scientific Research throughout the Empire," the seeds of State-aided organisation of science were sown well back in the nineteenth century, but the credit for having transformed "an amorphous mob of scientific workers" into something resembling "an organised army" belongs to the Department of Scientific and Industrial Research. This Department, acting under a committee of the Privy Council, has never looked back since it was established in 1915, and the annual record of its activities has become a document equally important and interesting to the man of science and to the student of public affairs.

The latest report, covering the year 1924–25, of

which a summary is given elsewhere in this issue, deals with a large variety of topics, which are far too numerous to discuss in a single article, and it is therefore proposed to confine attention mainly to a matter which is becoming more and more important: the position of the research associations. These associations, it will be recalled, were founded with the direct object of assisting the industries of the country; a sum of 1,000,000*l.* (called the Million Fund) was allocated for this purpose, and disbursements from it were planned on the excellent principle that the State should help only those industries which can help themselves. Grants were to be made on the basis of 1*l.* for every pound subscribed by the industry concerned, and they were to be continued for a maximum period of five years, after which, it was anticipated, the associations would be self-supporting.

Experience has shown not only that this basic idea was thoroughly sound, but also that it has been admirably applied by the Department. The only rift in the lute is the general conviction that the limitation of State aid to a period of five years was a miscalculation. To what extent this error is admitted by the authorities, we do not know, but the fact that grants to many of the associations have been extended on a reduced scale (block grants of diminishing amount) seems to show that they share the general conviction. There is no doubt that the five-year period is inadequate. Devising a programme of research and planning its details, collecting an efficient staff, providing laboratory and other accommodation, are all slow processes; but the time required for these purposes is in most cases almost insignificant compared with that required to convince the manufacturer of the value of scientific research both to him and to the nation. It must, however, in fairness be stated that many manufacturers came in promptly. The success achieved in this direction can only be surmised, and it is to be hoped that the Department will publish figures showing not only the percentage of firms in each industry that have joined its association, but also the percentage of capital invested in the industry that is represented in the association.

Of the twenty-one research associations now in active operation, those connected with scientific instruments and photography have probably obtained the greatest measure of numerical support from the manufacturers concerned, and these are followed by the associations attached to the cotton and woollen industries; but the comparative non-success of other associations in no way reflects upon their management or upon the Department. Conditions vary very widely in the different industries, and some associations have encountered more opposition or reluctance than others from firms the refusal

of which to co-operate has been matched only by abiding faith in empiricism and trade secrets. No one can envy directors of research who meet with opposition of this kind, and the fault lies with the supineness of the nation to science in general rather than with individuals.

The Department, we understand, has been very successful in directing the choice of directors of research, upon whom so much depends, and in allowing them a free hand. The director has not only to organise and direct research, to conduct the business affairs of his association, but also everywhere to be in contact with the human factor, in the handling of his own staff, and in maintaining amicable relations with the personnel of his constituent firms: it is all-important that he should be on the best terms with the scientific heads of these firms, for this is a vital link in the chain of efficiency. His task is also influenced by the composition of his subscribing firms: an association of which the membership consists of one or two powerful corporations and a few small firms is much more difficult to direct than one of which the constituents are homogeneous, and the difficulties may be said to vary directly with the disproportion between the percentage of invested capital represented in the association and the percentage of firms in the industry that have joined it.

As we have said above, experience has shown that a research association cannot become self-supporting in five years; in view of this fact, of the comparatively small cost incurred (about 100,000*l.* per annum), and of the success already achieved, it is unthinkable that Government will cease to give adequate support after the exhaustion of the Million Fund. At the present and prospective rates of expenditure, the balance that remains (518,200*l.*) will not last for more than a few years. The interest on the unexpended balance has recently been spent on other projects—a possible point of criticism—but it has now been decided to carry forward for future expenditure the sums accruing under this head, although the precise way in which they are to be spent is not specified. Sir Thomas Holland (*Journal of the Royal Society of Arts*, Nov. 20, 1925) has done good service in showing how small, in comparison with the values of the trades concerned, are the sums required to continue the work of the associations; thus, the annual cost of research on cotton, wool, and rubber would be covered by adding  $\frac{1}{4}$ *d.*, 1*d.*, and  $\frac{1}{2}$ *d.* respectively to each *l.*'s worth of imported raw material. Given adequate support on existing lines, there is every prospect that the research associations will establish themselves as indispensable adjuncts of the industries with which they are connected.

Of the more distant future, one can speak with less assurance and with less optimism. For years past there has been a marked tendency for industrial firms to amalgamate, or to pool their resources and interests in other ways, the latest development in this direction being the unification of all the large German chemical companies into a huge corporation with a capital of about 32,000,000*l.* To what extent such aggregations are desirable from the points of view of the home consumer and the nation is a matter of opinion, but there is no doubt that large corporations can, and do, dispense with extraneous aid in carrying out all the research work they require, whether it be fundamental or incidental.

An interesting feature of the annual reports of the Department are the occasional references to matters of wider import than those which come strictly within its purview. In the present report it is stated that "the embarrassments and losses that the staple industries of the country are suffering are, in our belief, not primarily due to the neglect of science." Approval or disapproval of this statement will depend upon the connotations of the words "science" and "primarily." Most of our recent troubles, including unprecedented taxation, can be traced directly to the War, the occurrence and persistence of which were strongly favoured by lack of scientific foresight and scientific knowledge (*e.g.* of the basic materials glycerin, cotton, etc.), and not least by the impotence of science, and other purely intellectual disciplines, to restrain or subvert those primitive instincts of pugnacity and accretion which are "primarily" responsible for war.

There will be less diversity of opinion concerning the truth of the Prime Minister's statement (quoted in the report) that our trade will never be able to cope with unexpected emergencies, at home or abroad, until scientific method and scientific men occupy a better position in industrial affairs. Why the position of the scientific man is inferior to that of the financier and administrator, to what extent he himself is responsible, and how far it is due to the inherent and uncorrected perversity of others, are questions outside our present scope, but they all seem to centre around the larger problem of how to bring home to the people a sense of the actual and potential value of science in the maintenance and perfection of human life. Much of that value lies in research; and just as Malebranche declared that if he held truth captive in his hand, he would let it escape, so that he might pursue and capture it again, so we may say that if we held world supremacy in science and industry, we would let it go, so that we might be forced to use research in the struggle to regain it.

### The Question of Race and Hormones.

*Process of Physical Growth among the Chinese.* By S. M. Shirokogoroff. Vol. 1: The Chinese of Chekiang and Kiangsu, measured by Dr. V. Appleton. Pp. vi+137. (Shanghai: The Commercial Press, Ltd., 1925.) 6 dollars.

THIS well-printed volume, dealing with a comparison of the process of bodily growth in two groups of Chinese, is one of a series of valuable studies of eastern Asiatic peoples undertaken by the anthropologist of the Museum of the Russian Academy of Sciences. Before he left Russia in 1917, Mr. Shirokogoroff was investigating the non-Chinese population of northern Asia: but when the circumstances of the times created obstacles that made it impossible for him to measure the children of Tungus, Manchu and Mongolian peoples, he transferred his attention to China. Dr. V. Appleton not only placed at his disposal her observations and measurements of 900 children made in the mission schools of Ningpo and Hangchow in Chekiang province, and at Shanghai in Kiangsu province, but also provided technical assistance for making the laborious statistical calculations. Dr. Appleton examined and measured the children of both sexes, and girls up to twenty years of age. Mr. Shirokogoroff made the measurements of adult men, for the interpretation of the process of whose growth he used the figures relating to the boys in his colleague's series.

The bulk of the volume is a collection of data rather than an argument that a reviewer can summarise. The author claims that the process of growth in the Chinese differs from that of other "ethnic groups"—he objects to the use of the word "race" and protests against the phrase "Mongol race" as "a baseless hypothesis." According to him, the Chinese differ from all other ethnic groups in the very pronounced and abrupt retardation of growth at the age of fifteen to sixteen years, and an equally distinctive acceleration four years earlier. His arguments are backed up by many tables of measurements and comparisons with data relating to other peoples, and statistical studies of the figures.

As Mr. Shirokogoroff explains in his introduction, the problem of interpreting the nature of physical growth is the real aim of his treatise; and he sets out to solve it by claiming that the "process is regulated, on one hand, by the interaction of the glands of internal secretion and metabolism which depend on heredity, and on the other hand, by the conditions of environment." He has made no observations of the endocrine glands. The argument is: the Chinese differ from other peoples in certain physical characters and mental aptitudes; therefore their ductless glands must be functioning in a different way from those of other people; hence