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## Science and Leadership.

AMONG the changes which the British Association for the Advancement of Science has witnessed since its formation in 1831 is the gradual disappearance of the demarcation between science and industry. As Lord Melchett pointed out in a recent address, the endeavour to distinguish between pure and applied science has now lost any kind of meaning. No clear distinction is possible between science and industry. The results of research work of the most speculative character often lead to outstanding practical results. Such progressive firms as Imperial Chemical Industries, Ltd., now follow in Great Britain the practice long current in Germany by fostering close contact with the scientific research work of the universities.

The relation of science to industry was a main theme at the discussions of the British Association at Cape Town and Johannesburg last year, and this year's programme affords further evidence of the interpenetration of science and industry. The discussions on the influence of fertilisers on the yield and composition of plants, on chemotherapy, and on the present position of the British dyestuffs industry, and the addresses to be given on recent progress in air-cooled aeroplane development, on investigations on tar distillate washes, on sugar beet investigations, the bearing of research on improved production of apples, Dr. P. I. du Toit's presidential address on veterinary science and agriculture, and Sir Ernest W. Moir's presidential address on the interdependence of science and engineering, are sufficient evidence that the outlook of modern science is essentially practical and related to the requirements of industry. On the other hand, scientific leadership is now a characteristic of all progressive and prosperous branches of industry. The industries in which the neglect of science has been most marked are those which are most stagnant or most acutely confronted by problems of reconstruction.

If, however, it is true that in the last twenty-five years, science has rapidly assumed the responsibility of leadership in industry, a yet wider responsibility is now demanded of it. Under the conditions of modern civilisation the community in general, as well as industry, is dependent upon pure and applied science for its continued progress and prosperity. Under the influence of modern scientific discoveries and their applications, not only in industry but also in many other directions, the whole basis of society is rapidly becoming scientific, and to an increasing extent the problems which

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confront the national administrator, whether judiciary or executive, involve factors which require scientific knowledge for their solution. The road traffic problem of to-day, for example, can be traced directly to the enormous expansion in output of motor-cars, and therefore reduction in costs of production, which resulted from chemical research in the field of lacquer solvents. The introduction of oil-fuel for steamers immediately created a problem of waste-fuel disposal, and the layman could not be expected to predict the serious consequences at many of our coastal resorts of the short-sighted policy of dumping waste-oil at sea.

Problems of atmospheric or riparian pollution are all largely problems which have arisen through society using the results of scientific discoveries and their applications, unguided by scientific and unprejudiced investigation of their reactions on the life of the community. Many such problems need not have become acute had an elementary amount of such foresight and scientific investigation been exercised in the early stages of the development of scientific inventions before vested interests had been created.

It is never easy to envisage the full consequences of a scientific discovery, but it is an imperative need of to-day that scientific workers should attempt to predict the consequences of their discoveries and to suggest means of dealing with the probable situation at the earliest and easiest moment. Much useless expenditure of public money, and many unsatisfactory and makeshift arrangements, might easily have been avoided in the past had scientific workers of sufficient foresight and character taken their share in local and national administration. Again, the control of public expenditure on, for example, the National Physical Laboratory or the Chemical Research Laboratory at Teddington in the final issue must be determined by scientific or technical knowledge, and cannot be regarded as satisfactorily exercised by administrators who are dependent on the advice of others for that knowledge.

In recent years the rapid growth in the rate of all kinds of international communication and transport has forced on industry an outlook and organisation that to an astonishing extent are international. These same forces have, however, enlarged the bounds within which mistaken policies can exert their ill-effects. Recent historical research has demonstrated that the difficult racial problems confronting the Union of South Africa to-day are the result of mistaken policies determined by political prejudices three generations ago. In the modern world the dangers arising from mistakes caused by

prejudice and neglect of impartial or scientific inquiry are infinitely more serious. In an age when nearly all the problems of administration and development involve scientific factors, civilisation cannot afford to leave administrative control in the hands of those who have no first-hand knowledge of science.

It would be easy to adduce evidence that, in spite of all the increased interest in scientific research manifested by Parliament, science is far from exerting its fitting influence on government and administration. To the precarious position of the Royal Veterinary College and government indifference to scientific representations thereon we have recently alluded. Dr. A. C. D. Rivett, in an article in the *Times* of Aug. 7, has pointed out how neglect of soil science has been responsible for the economic ruin of many agriculturists and the failure of settlement schemes, and the indisposition to accord to scientific workers effective representation on a number of committees appointed in recent years to deal with a wide range of subjects upon which scientific workers could be expected to speak with authority tells the same tale.

Under modern conditions, therefore, more is required of scientific workers than the mere enlargement of the bounds of knowledge. They can no longer be content to allow others to take the results of their discoveries and use them unguided. Scientific workers must accept responsibility for the control of the forces which have been released by their work. Without their help, efficient administration and a high degree of statesmanship are virtually impossible.

The practical problem of establishing a right relationship between science and politics, between knowledge and power, or more precisely between the scientific worker and the control and administration of the life of the community, is one of the most difficult confronting democracy. The community is, however, entitled to expect from members of the British Association some consideration of such a problem and some guidance as to the means by which science can assume its place of leadership.

There are certain factors involved in the establishment of such a relation which are worthy of mention. In the first place, recent events, notably the tendency of the Civil Service to encroach upon the functions of the judiciary, have demonstrated to many what Mr. and Mrs. Sidney Webb (now Lord and Lady Passfield) observed in 1920: "The great mass of government to-day is the work of an able and honest but secretive bureaucracy, tempered by the ever present apprehension of



the revolt of powerful sectional interests and mitigated by the spasmodic interventions of imperfectly comprehending Ministers." \* One essential condition of progress, therefore, is such a modification of the conditions of entry or recruitment and of promotion in the Civil Service that a reasonably adequate appreciation of the value of science is ensured in the whole personnel of the service, and, on the other hand, that avenues of promotion to positions of high administrative responsibility are open to its scientific officers.

The factor of education, however, is of importance not only in the production of a type of administrator more in keeping with the requirements of the modern world, but also in its influence in the production of a more enlightened type of public opinion and one more competent to sort out the issues. In such work of education scientific workers must take a much larger personal part. Much benefit may result from the mere presence of and contact with men of science in numerous committees, councils, and public bodies forming the machinery of local and national administration, and scientific workers must be prepared to offer themselves for election in much larger numbers than they have done hitherto.

The tendency for governments to overlook the need for adequate representation of science on important committees is at least in part due to the failure of scientific workers to indicate the contribution which they are able to make to the subject under discussion. In another sphere it is difficult to believe that the absence of scientific representation from the Melchett-Turner industrial conference has any other explanation than the failure of scientific workers to make a corporate approach.

A restatement of the claims of science to the attention of the civilised world, or the relation of science to social as well as to material progress, is required, and opportunities for scientific workers to participate in such a campaign of education are by no means wanting. Moreover, the recently formed Parliamentary Science Committee has made it considerably easier for scientific workers to demonstrate to Parliament the contribution science makes to the security and progress of the State and the directions in which that contribution can be expanded with advantage to the community.

The extent of the opportunities and the efficacy of such a campaign are largely determined by the representative character and the political strength

of the professional organisations of scientific workers. For this reason the development of such organisations during the last decade is full of significance, not only in affording scientific workers wider opportunities of exerting their influence on public life, but also in raising their status to a point that is adequate to discharge the larger functions which the development of society as well as of industry increasingly thrusts upon them.

It is significant that, in contrast to the relative impotence of scientific workers in national affairs, in the international sphere advisory committees of experts have since the War exerted a remarkable and effective influence even when devoid of all legislative authority. To committees of experts organised by the League of Nations, and exercising advisory functions only, is due the credit of the schemes which were successful in rescuing a European State from bankruptcy and chaos and in handling an unemployment scheme which settled a million and a half refugees, following upon the greatest migration in history. These examples sufficiently demonstrate that, given the requisite stimulus and enthusiasm, the scientific expert can already exert an effective influence when normal administrative effort has failed, and when indeed, as in the case of Austria, the problem had been dismissed by statesmen as hopeless.

In truth, scientific workers occupy a privileged position in society as well as industry, and there are welcome signs that this is now recognised by scientific workers themselves. Thus, in his presidential address to the Chemical Society (at Leeds) last year, Prof. Jocelyn Thorpe suggested that the age is at hand in which the changing majorities of governments will no longer be able to determine major policies, except in directions approved by organised industry, and, in advocating the closer organisation of science and industry, stressed the political strength to be obtained thereby. The paper to be read before the British Association on "The Screening of South-end from Gunfire" is further evidence that scientific workers are accepting the responsibility of leadership in matters of social and industrial safety. Whatever inspiration or encouragement the meetings of the British Association may give to scientific workers in the prosecution of their researches, there is no way in which the Association can more fittingly serve humanity than by calling scientific workers to accept those wide responsibilities of leadership in society as well as in industry which their own efforts have made their inevitable lot.

\* "A. Constitution for the Socialist Commonwealth of Great Britain", 1920, p. 69.