

II. THE DEVELOPMENT OF A NATIONAL SCIENCE POLICY

The most important and fundamental function of the National Science Foundation is the development of a national policy for the promotion of basic research and education in the sciences. The importance of scientific research and the application of scientific knowledge is a matter of history. It was the application of science to practical affairs which gave rise to the industrial revolution of the nineteenth century which ushered in the present era of accomplishment and power of the western world. At first this was done largely by individuals of a practical turn of mind who happened to be in contact with scientists or their work. About the beginning of the twentieth century, industry was first to perceive the advantages to be gained from establishing research departments whose aim was to explore the possibilities of scientific research as leads to future development of the industry.

During World War I the importance of the applications of science to warfare began to be felt, and great progress was made in such fields as aeronautics, communications and chemical warfare. However, the full potentialities of science in its application to the weapons and devices of warfare were not realized until World War II where the assistance rendered by science, now common knowledge, can hardly be exaggerated. This has been fully recognized since the last war by the Department of Defense, which has carried on unprecedented programs of research and development.

Not only has the aid of science been responsible for great advances by industry and by the military, but also in medicine, a subject most important to human welfare, where continually increasing support by public and private means has led to a standard of health and physical well-being which has broken all records in the world's history. Since this field is of such obvious and important concern to the Nation,

the Federal Government has taken an active interest in its support. Evidences of the same interest on the part of the Federal Government are also apparent by its support of research in the Departments of Agriculture, Commerce and, in fact, in most of the Government agencies.

At first the attention of the Government was directed toward the support of research aimed at a definite goal, related directly to the mission of the agency concerned. Thus, maximum support has, in the past, been given to applied research and to development. Gradually, and surely, the realization has come that the applications of science have their roots in fundamental or basic research and that practical accomplishments are limited by the available fund of basic scientific knowledge and this, in turn, is determined by the rate at which our basic knowledge is increased. The question then arises, in the interest of national progress: how can the accumulation of basic scientific knowledge best be increased and its significance utilized?

Fundamental or basic research, historically and traditionally, has been an activity carried on almost completely by educational institutions and institutions of higher learning. Its aims have been entirely the advancing of frontiers of human knowledge and the accumulation of basic information. Since by definition this type of research has no practical aim, from a narrow or short range point of view, it is more difficult to justify in advance from the taxpayer's viewpoint. Again, traditionally, this type of research has been supported largely by private sources and the endowments of institutions of learning. In this country, especially within the last century, however, it has been supported by state and municipal funds as a necessary part of education at their institutions. In other countries there has been an increasing tendency for the Government itself to assist in education and in research of this character.

In the legislative history leading to the establishment of the National Science Foundation it has been clearly apparent that the need for active participation by the Federal Government in the support of basic

research has been recognized and its importance appreciated. At the same time, the Government has wisely seen that proper administration of this type of research is not possible without provision for review of existing research programs, both public and private, and for the development of a national policy for basic research and education which will integrate the research activities of the many separate institutions and activities in which the Government has an interest.

The encouragement and support of basic research and higher education, in spite of their importance, are more difficult to defend than the more immediately practical aims of the Government. The reasons for this are obvious: basic research is unpredictable and one can never guarantee that a particular project will yield important results nor that a particular end will be achieved. This is because basic research is an exploration into the unknown. It should therefore be regarded as an investment, an investment which, if wisely planned, will provide a safe return plus the possibility, at any time, of a really sensational return. When the latter happens it more than justifies many years of financial support. Similarly, with higher education, immediate results in terms of facts and figures are not to be expected. The benefits accrue gradually over a long term of years and become most apparent in succeeding generations. Because a program of basic research and education in the sciences has important intangible aspects, it is all the more important that its support be placed in the hands of a separate agency with the express mission of furthering these aims.

Among the considerations important in the development of a national policy in basic research and education in the sciences are the following:

1. What portion of the total national income should be devoted to basic research and education in the sciences?
2. What are the broad needs of the country with respect to the applications of science? Specifically, what are the needs of the public, national defense, industry, agriculture and civil government?

3. What is the degree of effort currently placed on basic research by educational, industrial and governmental institutions? Is this distribution satisfactory or does it require modification?
4. What are the relative degrees of interest of the Governmental agencies in research? Are these interests over- or under-emphasized?
5. To what extent should Government agencies support research in their own laboratories and to what extent research in non-Governmental facilities?
6. What means of coordination in research exist between universities, industry and Government? What means of coordination exist within each of these three areas?
7. In terms of progress in pure science alone, what are the important lines along which maximum progress in each science may be gained?
8. To what extent is the optimum encouragement and support of research limited by the total number of trained scientists available? To what extent should support be given to especially gifted or competent scientists and to their identification and training? At what point in our educational system should the encouragement and training of scientists begin?
9. What is the proper distribution of support between the different fields of science?
10. What are the probable effects of Government support of scientific research and education on (a) educational institutions (b) industry and (c) the Government?
11. What fields or areas of science require additional emphasis and support? In what areas may there be over-emphasis?

12. What special fields of research are there where progress is of critical importance to the national welfare or security?
13. What is the proper balance between the encouragement and promotion of vital basic research in the hands of the most competent investigators available, and areas in which general research and education in the sciences should be enlarged and increased?
14. To what degree should a given Government agency or a given industry conduct its own basic research? To what extent may basic research be supported and conducted by one agency for the general benefit of all?
15. By what means can the transition period between basic scientific discovery and its practical application be shortened?
16. What are the relative advantages and disadvantages of research effort in large centers as compared with conduct of research by individuals and small groups with a wide geographic distribution?
17. What is our supply of scientific manpower in relation to our needs, both for basic research and education and for applied research and development? What is the demand for men and women with scientific training for positions outside the field of scientific research?
18. What degree of financial support for basic research and education in the sciences may be expected in the future aside from that supplied by the Federal Government?

These and other questions require careful and considerable study in the evolution of a national policy for basic research and education. The National Science Foundation expects to study these matters by a number of different approaches; by staff studies; by the use of consultants and advisory committees in special fields; by visits and discussions at colleges,

universities, industrial concerns and Government agencies. It is expected that some of these questions may require the appointment of commissions to make special investigations.

It is expected that the development and formulation of a national policy will take considerable time. It must be approached with care and thoroughness at the very outset. Furthermore, it is recognized that this policy should be maintained current and take into account such matters as trends in science and changing national needs. Only in this way will the National Science Foundation best serve to promote the progress of science, to advance the national health, prosperity and welfare and to secure the national defense.