The Administration of Federal Research

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THE REPORT BY THE PRESIDENT'S Scientific Research Board points out that the Government of the United States conducts or finances more than half of the scientific research in the Nation. During the fiscal year 1947, public expenditures for these purposes will exceed $600,000,000. Over 30,000 scientists engaged in such activities are using equipment and facilities worth more than $2,000,000,000. This research covers a tremendous range of activities. In fact, in one way or another it touches on the activities of practically every person in the country and has a profound potential influence on the health, welfare, and safety of the Nation. This scientific program is operated under the direction of 52 more or less independent bureaus located within the major agencies of the Government, and the research is carried on in hundreds of laboratories throughout this and other countries.

My remarks here will be based on my experience in administering research in the U. S. Department of Agriculture. Since agriculture covers such a broad field of activities, many of the problems of directing research in the Department are no doubt the same as those encountered by other government units.

Problems in Research Administration

A research administrator must deal with highly specialized personnel who, by their training and experience, are inclined to be more individualistic in their thinking than most members of society. His job is to help provide facilities, a proper research environment, and an organization that will direct their energies into the most productive channels. In many government agencies these problems differ from those of other research agencies in the wide scope of the activities covered and in the great areas over which the operations must be carried out. As an example, the research of the Department of Agriculture is conducted in over 200 laboratories scattered throughout the Nation and in several foreign countries. It is concerned not only with improvement of all the crops and livestock in the country, but with the protection of these crops and livestock—and human beings too—from insects and diseases, better nutrition of man and animals, all phases of soil investigations, including its conservation, the forests, sound farm production economics, the efficient marketing of agricultural products from the farmer to the consumer's shelf, and finding new uses for the products of the farm.

The administrators of government research are, therefore, always confronted with more problems than they can adequately cover with the staff and facilities at their disposal. The basic problem confronting them is that of organizing a staff and providing facilities that will bring to the solution of these problems the best minds and equipment available, with a minimum of duplication. This must be done within the limitations of the various acts of Congress providing funds for these activities and within the framework of such rules and regulations as have been laid down by the Civil Service Commission, the General Accounting Office, and the various other agencies of the Government.

Scientific Personnel

The recruitment and maintenance of a good scientific staff is a most important feature of research administration. The public, for many years, has insisted that those chosen from among the applicants for government work should be the most competent and should be picked without reference to personal favoritism, political influence, or religious connection. The Civil Service Commission was set up for the purpose of carrying out this mandate and has been functioning efficiently for many years. In fact, the recognition of the special qualifications required for scientific work was one of the influences that stimulated the establishment of the Commission.

Scientists in general appreciate the desirability of competitive selection. Nevertheless, our scientific groups have been among those most critical of the procedure that the Government has so far adopted for the selection and promotion of technical personnel. These criticisms have included the delays involved in making selection among applicants, the difficulty in choosing between those having different types of capabilities, the supposed limited opportunities for advancement, even for brilliant and original research workers, and the lack of freedom in choosing projects to be undertaken.

This address, delivered at a special session on Science in National Affairs held on December 29, 1947, in Chicago, Illinois, during the AAAS meeting, considers one aspect of the President's Scientific Research Board Reports.

One of the difficulties that every government research administrator has to face is the job of replacing key people who are enticed away from government research by flattering offers from industry. I am convinced that we shall have to give greater recognition to our scientists—not only in terms of better salaries, but in other ways, such as sabbatical leave.

We expect a research worker in the Department to have spent as much time preparing for his work as though he were going to begin the practice of medicine. After 7 years of college and university work we offer young men and women compensation considerably lower than they could earn if they were skilled laborers. The more competent of them are eventually advanced to the point where they are making as much as a highly skilled mechanic. Others work up to be project and division leaders, but there is room for only a few in these positions, and those who are chosen are often picked for administrative ability rather than ability to do original research. It is just as well that they are, because there is little opportunity to do research in an administrative job. Too often our system promotes the best research people to jobs that are not research at all. We need to invest part of our research funds in financial and professional advancement that will make it attractive for our best scientists to stay in research.

I am happy to report that there is an increased consciousness in governmental research agencies of the importance of problems of scientific personnel. Research administrators are well aware of the fact that the success of their programs is dependent upon the men who are in the laboratories, and many efforts are being made to improve the lot of the scientist in Government. One of the most important steps in this direction was taken about two years ago when an Interdepartmental Committee on Scientific Personnel was established. This Committee has been effective in bringing about many desirable changes affecting such personnel, and I trust that only a beginning has been made.

Planning and Coordinating Research

The studies made by the President's Research Board indicate that the methods used in the planning, evaluation, and coordination of research are as numerous as the agencies conducting it. In some units of Government little effort is made in this direction above the level of Bureaus. In many, however, a definite attempt is being made to plan and coordinate the research carried on by the different agencies within a Department. Examples of this are the Office of Naval Research, the Research and Development Board for the military agencies, and the Agricultural Research Administration. Each of these units was established to assist in the over-all planning and coordination of research in order to make the most effective and economical use of the research facilities and funds. This step, a relatively recent innovation in Government, was greatly stimulated during the war by the need of teams of research men to get quick answers to urgent problems. Its extension since the war indicates that the method is effective, at least for many types of research, and it seems likely that the use of this technique will be increased.

The Agricultural Research Administration of the Department of Agriculture—the example of this approach with which I am most familiar—was established in 1942 by Executive Order, and most of the large Bureaus doing biological, chemical, physical, and engineering research in the Department were included in it. More recently, the Secretary has placed additional responsibility on this agency by requiring that all except economic research be coordinated through it.

The aim of the Agricultural Research Administration is to use most effectively the forces available to the Department in the solution of the many problems confronting agriculture. Broad control over the activities of the various agencies is obtained by the use of a project system which serves not only for research accounting but for financial accounting of the many research activities. These projects are subdivided into three categories: financial, work, and line projects. The first two define broad categories of work and are used principally for financial accounting and for presenting budgetary requests to the Budget Bureau and the committees of Congress. For example, all the research relating to cereal crops and diseases comprises one financial project. Since this covers a very wide variety of continuing activities on many crops and in all sections of the country, it is broken down further into work projects. Three examples of work projects under this financial project are the investigations on corn, on wheat, and on sorghums.

The line projects represent rather narrow phases of research, usually limited as to both time and subject matter. These are used extensively by the Administration in keeping a record of all research in progress and for getting teamwork between the different units of the Administration.

In this process all planning starts with the men who are doing the research. Line projects are developed within the framework of the financial and work projects, and these are submitted to the Administrator's Office for final approval.

The staff of the Administrator's Office is small. Its function is to assist in the over-all planning and co-

ordination of the program to prevent unnecessary duplication, and to stimulate teamwork where it is needed.

Each project is reviewed by a specialist in the Office of the Administrator in relation to all other activities under way in that particular field. If the project represents an entirely new and independent activity, it is approved for such a term as the project leader estimates will probably be required for its completion, but this period may not exceed 5 years without further review and revision. If, however, the project involves activities that tie in with research being done in other agencies, then the administrative specialist handling this phase of the work calls the leaders of the various projects together to work out a program that will result in as little duplication as possible and one that will extend the efforts of our scientists over a wider range of activities.

In the operation of this program we are very conscious that efficiency cannot be achieved by orders, directives, or commands, but that the understanding and cooperation of the men and women who do the work is an absolute requisite for efficiency and real success. Consequently, we are very alert to protect the rights of the individual worker. Our efforts are continually directed toward developing a wider understanding among the research staff of the purpose and advantages of this method of approach.

In general, this approach is more effective for the developmental or applied phases of research than for research of a fundamental character. Planning the latter type of research is much more difficult, since progress on fundamental research depends so largely upon the opportunity for free enquiry by gifted minds. Even here, however, we think that our project system is reasonably effective. In the line project the researcher is required to specify only the objective of his field of work and the general approach he intends to follow in reaching it.

We are ever conscious that the setting in which scientists live and work profoundly affects their productivity, and that the heart of the problem of scientific administration is the large element of self-direction necessary for scientific and technical personnel. It must be the primary purpose of public policy to provide such an environment if we are to expect the greatest benefit from research programs.

Since the research activities of the Department of Agriculture affect the welfare of so many segments of our population, one additional step in the planning of our programs merits mention. This is the use of advisory committees composed of representatives of farmers, industry, scientists, and consumers. Such committees are brought into Washington or to our field laboratories to confer with our scientific staffs. In this way we obtain the suggestions of farm and industry leaders and the reactions of other scientific men to the proposed programs. Obviously, this technique is most useful in the applied and developmental aspects of our research program. It has the further merit of educating agricultural leaders regarding the importance and nature of our program and thus is a valuable tool in the educational process necessary in translating the results of research into practice.

Coordination of USDA Research With That of State Experiment Stations

In addition to conducting a large research program of its own, the Department carries on extensive cooperation with the State Agricultural Experiment Stations. It also administers the Federal-grant funds allocated to the State stations. These funds are administered through the Research Administration by the Chief of the Office of Experiment Stations, who is also an Assistant Research Administrator. The many projects in progress in these experiment stations are also handled on the basis of line projects which must have the approval of the Office of Experiment Stations before work is begun. This furnishes an excellent means of coordinating the federally supported work in the experiment stations with similar work in other states and that of the research agencies in the Department. This system, which has evolved gradually over several decades, is, I believe, one of the most effective methods of large-scale research coordination on record.

The State stations are independent agencies, usually a part of the land-grant college or university of each state. They derive about one-fourth of their funds from Federal grants and three-fourths from State funds.

Much of our cooperation with the experiment stations and other agencies involves problems that are regional or national in nature, as the swine-breeding program in the Corn Belt states, and the soil-salinity investigations in the western states. Since these projects usually involve a number of agencies, an integrated attack on a particular problem requires most careful planning. This is usually done by having a special leader for the program and a group of collaborators from the various agencies who act as a scientific board of directors for the project. This board usually meets at least once a year to take stock of progress and to make additional or revised plans for the next year's program. After a program is agreed upon, line projects specifying the part that each agency will take are drawn up, to be modified as occasion demands. In addition, we use memoranda of understanding for spelling out the over-all rela-

tions between the cooperating agencies. Many of these projects have been very effective in improving agricultural practices and in increasing agricultural production.

Coordination of Federal Research

The Department of Agriculture has cooperative relations with many other Departments of the Government on research matters. This cooperation is purely voluntary and has not presented any major problems in administration.

No mechanism exists to provide for coordination of research among Federal agencies in the way that I have described for the agencies of the Department of Agriculture. The subjects investigated by the various government agencies are so specialized and so diverse in character that I doubt if the degree of coordination exercised by the Agricultural Research Administration would be feasible. However, in the interests of economy and most efficient use of our research manpower and resources, some coordination at this level seems desirable. To bring this about, the President's Scientific Research Board has recommended that these four steps be taken immediately:

(1) That an Inter-Departmental Committee on Scientific Research and Development be established, to consist of the directors of the major research activities in the various agencies of Government.

(2) That the Bureau of the Budget set up a special unit whose function would be to review the scientific research and development programs of the various governmental agencies and to pass upon all requests for appropriations from these agencies.

(3) That a member of the White House staff be designated by the President for the purpose of scientific liaison between the White House, the various research agencies, Congress, and scientific societies.

(4) That a National Science Foundation be established on sound lines.

Such a program no doubt would result in an effective beginning toward better coordination of research activities of the Government and would perhaps serve as the first step in the evolution of an effective system of coordination that would be sufficiently flexible to meet the requirements of sound research without stifling the initiative of the individual worker. In my judgment, any system that is developed must provide for the maximum protection of the individual worker, and research men as a body must be zealous in resisting any moves that may tend to make them subservient to any large administrative system. In the final analysis, any system that is evolved should assure that freedom of inquiry by gifted individuals which has made science such a powerful tool in the advancement of human welfare.

Budgetary Problems in the Administration of Research

The size and the wide scope of the Federal research program requires a rather complicated budget procedure. Obviously, it is impossible for each researcher to have the opportunity to present his request for funds to the Budget Bureau and to the appropriation committees of Congress. Consequently, budget estimates must be prepared first in the sections or divisions, and then be successively reviewed and consolidated in the bureaus, by the Research Administration (in the case of Agriculture), and finally by the Department budget committee, where final selections with respect to increases or decreases for the various activities are made. The final figures are consolidated into an over-all budget for the Department. This, in turn, is submitted to the Budget Bureau, where the estimates are again reviewed and are finally consolidated into an over-all budget for the Government. This is the budget upon which the committees of Congress must act and which must be defended before these committees by bureau chiefs and agency heads of the Government.

Because of the time required for this process and the need for those who must defend these budgets before the respective committees to have the best possible understanding of all research activities, it is necessary to have the fullest cooperation of research men in getting information about their activities, especially those for which increases in funds are requested. For agencies like the Department of Agriculture, in which the research staff is widely scattered, this is a major task.

Two methods are used for doing this. The first is to require rather complete annual reports on line projects, and the second is by conference with the heads of the respective laboratories or field stations. Both are important in helping administrative officials in developing final budgets, as well as being of great assistance in evaluating progress on research activities. So far as is practical, these procedures are supplemented by visits of administrative people to the field stations and laboratories—a process that has great value not only in informing administrators regarding research activities but in giving the workers in the laboratories a better understanding of the problems confronting administrators and their staffs.

Continual study is being given in Agriculture to ways and means of simplifying this process. This becomes increasingly important as the size of our program increases. I believe the recommendation of the President's Scientific Research Board to set up a special unit in the Budget Bureau to handle all research budgets should result in better and more sympathetic consideration of research requests. I should

like to suggest that the key men on this staff be scientists in their own right. In addition, I should like to see within such an agency a small, well-staffed unit that would concern itself entirely with devising ways and means of simplifying and improving the budget process as it relates to research activities.

Another phase of budgetary management was discussed by the Board, and I will quote from its report:

> Current appropriations for scientific research and development in Government laboratories are almost exclusively on a 1-year basis, but few of the Government's research programs can be planned wisely or appraised sensibly in terms of less than 3, 5, or even 10 years of work. . . . All research programs should be presented to the Bureau of the Budget and to congressional appropriation committees on the basis of their long-term ultimate objectives and appropriations should be granted for that part of the program to be undertaken in the next fiscal period. In other words, a program should be projected 3 to 10 years in the future. The projected program should be reviewed, modified to meet changed conditions, and approved each year by the Bureau of the Budget, and Congress.

In concluding this brief statement of some of the problems involved in the administration of the many and diverse programs of Federal research, I should like to restate what I consider to be several essentials to the successful administration of such a program:

(1) The program must be organized to give the greatest freedom and latitude possible within Federal laws and regulations to the scientific staff. This staff is the key to the success or failure of any research program. The staff members not only should have the greatest possible freedom of expression and publication consistent with security needs, but should be given the greatest encouragement to participate in the planning and development of all programs.

(2) The Administrator must encourage teamwork on the part of the scientific staff to obtain results quickly and at least cost. With increasing specialization in science and the pressure to reduce expenditures in Government, this problem must be given more and more attention.

(3) It is necessary that each research agency undertake research on and solve those problems that are of greatest importance to the constituency it serves. Therefore, good relationships must be developed with industry, scientists, and others in order to make possible the best choice of problems.

(4) The Administrator must be sympathetic to basic as well as applied research and must organize his program to allow a large part of the efforts of his research staff to be devoted to the solution of basic or fundamental problems. The President's Scientific Research Board has recommended that the scope of this type of research be increased fourfold by 1957. Provision of opportunities for basic research sometimes requires fortitude on the part of the Administrator in the face of pressure for the solution of the many urgent problems confronting an industry. In the final analysis, however, progress will depend on a continuing flow of new concepts and facts from such research. Each research unit must give increasing attention to its basic research program.

(5) In the interest of securing maximum results from each dollar appropriated for research, each agency must give increasing thought to eliminating "red tape" and "paper pushing." Much has been done in this direction, but I believe that with systematic, well-directed effort more can be accomplished. I am certain that all organizations are alert to this need.

Most of my remarks have dealt with the day-to-day chores of a research administrator. All of us who are engaged in any part of research can see to a greater or lesser extent the long-range implications of our work. Physical and biological science has accomplished miracles in lightening the burdens and prolonging the life of man. But it has advanced far beyond the social sciences. Man's knowledge is badly out of balance. We cannot stop at this point and turn back. The only hope of bringing it into balance and holding to the gains we have made is by pushing ahead on the weak side. We must not do it by holding back on the strong side.