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The Government, the Universities, and Biomedical Research

John W. Gardner

The federal government, the universities, and the research community have developed an extraordinarily successful partnership during the past 30 years; and it is nowhere more creative and productive than in the programs administered by the Public Health Service, particularly the National Institutes of Health.

The passage by Congress in 1937 of the National Cancer Act set a pattern that has exerted a dominant influence on the development of the medical sciences in this nation. Three elements first set forth in that legislation have become key components of all subsequent action: (i) the research project grant as the device enabling the federal government to join in common purpose with the nonfederal scientific community in the support of research activity of broad public interest; (ii) the selection of research activity worthy of public support by nonfederal scientific peer groups and by advisory groups broadly representative of the scientific and public interest involved; (iii) the development of a strong, direct, research operation.

Replication of these elements in subsequent legislation has led to the complex we know now as the National Institutes of Health. The achievements that have flowed from this process have transformed the setting, character, and magnitude of biomedical research; and they have brought into being a national system of medical research, broadly based in the universities and scientific institutions, which exerts a pervasive influence on the whole scene of medical education and health services.

The rapid expansion of federal support for research has created a mutual dependency among the federal government, the universities, and the scientists of this nation. This has come about because of the importance of science to the destiny of the nation on the one hand and, on the other, because of the importance of federal funds to the stability of institutions, the careers of scientists, and the advance of graduate research and education.

Though the federal government, the universities, and scientists have all prospered under this condition of mutual dependence, there are broad differences in their respective roles and responsibilities.

1) The responsibility of federal agencies is the prudent and productive use of funds appropriated to them to achieve the national purpose for which they were made available.

2) The basic obligation of the universities is to the advancement and transmission of knowledge and to the creation of conditions under which the scholar and scholarly activity will flourish.

3) The investigators are committed to maintain the integrity of scientific inquiry and the conditions essential to its pursuit.

The problem is to fashion the terms of the relationship in a manner that acknowledges the mutual dependence among the three parties and, at the same time, respects the integrity of their respective responsibilities—without distortion, without arbitrary subordinaton of one to the other, and without interference in the performance of these primary roles.

This is not an entirely easy assignment.

In the past year or so, concern over the possibility of an absolute decline or a diminished emphasis in federal support for basic research in the biomedical sciences has been widely expressed. Is there a real basis for this concern? To answer the question adequately, it is necessary to deal with four critical issues.

First, has there been a major change in the basis and nature of the federal relationship to fundamental research, graduate training, and expansion of the academic and scientific resources of this country? Has there been a major policy decision to shift resources from the support of the individual scientist on a long-term basis to directed, short-term, research programs aimed at specific targets and to application?

These questions can be answered directly. There has been no change in the policy of the Department of Health, Education, and Welfare concerning the essential role of fundamental science in the pursuit of its program goals, and none is contemplated. Nor has there been any policy decision to diminish the national investment in the fundamental sciences relevant to health and medicine. The development and maintenance of a stable framework for the support and continued advancement of the national scientific effort in these areas is and will continue to be a major objective of the department.

In our practical-minded society, committed as we are to the large-scale, organized pursuit of our shared pur-

The author is Secretary of Health, Education, and Welfare. This article is based on an address, given in Bethesda, Maryland, 23 August 1966, to the Consultants of the National Institutes of Health.

poses, the individual efforts of the basic researcher will always be in danger of neglect, always in need of special encouragement. It would be incredibly shortsighted if we were to conclude, at this time of swiftly expanding horizons in the biological sciences, that basic research should be deemphasized.

The second critical issue that must be dealt with is considerably more difficult. What are the essential conditions for maintaining, and the rate of growth needed to maintain, a healthy fundamental science component in the fields related to health and medicine? What rate of increase in funding can the scientific community expect? What constitutes stable support? Unfortunately, these are not questions that can be easily answered.

During the period of 1956–64, when the broad national base for medical research was being built, the rate of budget growth of the National Institutes of Health approximated 30 percent per year. Now NIH programs involve a budget of $1.3 billion. At this level a 30-percent growth rate is neither warranted nor tenable. The increases in the future must reflect growth that is both rational in respect to the existing base and selective in terms of purpose and need.

Much speculation has been directed to identification of the necessary rate of growth of graduate research and education. Some say that a rate of 15 percent per year is the necessary minimum increase in level of support. But the thorough economic analysis that one might expect to lie behind such a widely quoted figure has yet to be made.

The question deserves to be examined with the same thoroughness and objectivity that we give to other important matters in the field of science. Scientists outside government should join with us in an intensive effort to arrive at a reasonable answer.

The rate of increase in support must reflect the needs associated with the entry of new scientists into the field, the pressure of price and wage changes, the growing complexity of present-day scientific effort, and the emergence of new fields of scientific endeavor.

Even if we arrive at a universally agreed-upon figure for the desirable rate of increase, it would not be possible, of course, to guarantee that figure in an exceptionally tight budget year. Among all human enterprises, biomedical research cannot hope to have the unique attribute of existing in a world without resource constraints.

But systematic analysis will at least enable us to know the standard we should struggle to maintain. The goal is a dynamic biomedical research effort, adequately supportive of the institutions conducting it, responsive to the career requirements of the men and women devoting their lives to it, and capable of healthy growth.

The third critical issue is: How should one view the allocation of resources among (i) basic research, (ii) applied research, and (iii) application of knowledge in a health service setting?

There has been a great deal of confusion and loose definition in public discussions of this subject. It has been said, for example, that NIH is neglecting applied research. But approximately 60 percent of NIH research expenditures are for work that most scientists would describe as applied. The biomedical sciences have always had and always will have a strong component of applied research, and NIH grants reflect that fact.

The question remains whether, over and above such efforts, we should mount large-scale, highly organized applied research or developmental projects with specified short-term goals. The answer is "yes." But in giving that answer we must bear in mind that each such effort is apt to be extremely expensive. Hence we must be highly selective in the items we choose to pursue in that fashion. And we must not imagine that dollars and large-scale organization are an adequate substitute for ideas and a sound scientific base. Where the ideas and the scientific base do not exist, it is possible to waste vast amounts of money under the banner of practicality.

It is regrettable that current apprehensions and cross currents force us to talk about basic research, applied research, application of knowledge, and delivery of services as though they were quite separable and perhaps even mutually exclusive interests.

The question of whether one of these activities should be given more or less emphasis is a question that is not unique to the biomedical fields. It is an old chestnut that has been debated in every field of science and scholarship. Most scientists and scholars would say that the problem is not unusually acute in the biomedical fields. On the contrary, the interaction between basic research and final application of knowledge is about as healthy in these fields as in any.

The development of clinical research centers within our university medical centers has provided an opportunity for the closest possible cooperation between basic scientists and clinicians in the solution of some of our most complex and costly diseases. It is said that NIH neglects clinical investigation. But the aggregate number of individuals being studied clinically with NIH support is very large indeed.

The final issue to be dealt with is this: How will the scientific and university community be affected by the growing government interest in delivery of health services?

Some fear that decisions on allocation of resources are (or will be) made in terms of a fixed federal health dollar—that is, that there will be a fixed amount for all health activities, so that if delivery of health services receives more money, research will receive less.

This is an inaccurate assumption. There is no significant segment of opinion in Congress or the Executive Branch that reflects that view.

It seems clear that total federal spending on delivery of health services will increase steadily and rapidly for quite a long time to come. But this most certainly will not (and never has in the past) come out of a fixed health dollar, with research losing what health services gain. The whole health area in all its aspects is on the rise in our national thinking and planning.

The Department of Health, Education, and Welfare is committed unequivocally to the rapid and effective application of new knowledge. The process is carried out in a number of ways and by a number of organizations. In medicine it may involve engineering or drug development, clinical trials, demonstration projects, regional programs and, finally, broad diffusion into the medical care system.

The creation of the Regional Medical Programs, following passage of the Heart Disease, Cancer, and Stroke Amendments by Congress last year, and the reorganization of the Public Health Service which is now taking place, under the direction of the Surgeon General, are explicit in their focus on the need for a more dynamic and effective federal leadership in the application of the fruits of our investment in basic research.

The Regional Medical Programs, by

the way, are an interesting hint of the significant role that the university is likely to have in the application of knowledge in a health service setting. Most research people—and perhaps university people generally—see the university's role as relating chiefly to inquiry and on-campus instruction. But it now seems certain that the future of one or another form of university extension activity in the medical field is going to be very lively indeed.

These observations have necessarily been limited to a few central questions concerning biomedical research and the relationship between government and the universities. There are other urgent questions.

Science as a social and intellectual enterprise faces some crucial and difficult issues today—issues relating to large-scale organization, to institutional vitality, to institutional vested interests, and to the conditions surrounding scientific creativity. These issues will not be resolved by good will or good intentions. They will not be resolved by any communication from a government official. They will not even be clarified to the point at which resolution is possible unless the leadership within the scientific community examines them with unsparing honesty.

Few if any fields of human endeavor are able to look at themselves with any measure of objectivity. But scientists must try.

In the meantime, communication between the Department of Health, Education, and Welfare and the university-based scientific community must be open and effective. To facilitate such communication, the department will establish a special Advisory Committee on University Relationships. This committee will work with a departmental task force and with various government bodies such as the Federal Council for Science and Technology and the Interagency Council on Education, as well as with the President's Science Advisory Committee and the newly appointed National Advisory Commission on Health Manpower.

The programs of the National Institutes of Health represent an extraordinary and fruitful partnership between the federal government and the universities; and they have achieved a high level of excellence.

The department is proud of the partnership and proud of the excellence, and it will do everything possible to preserve and enhance both.

Milk Production of Cows on Protein-Free Feed

Studies of the use of urea and ammonium salts as the sole nitrogen source open new important perspectives.

Artturi I. Virtanen

The cow has a key role as a producer of protein and also of many vitamins. Both milk and meat proteins are of high biological value. If the vegetable diet, containing mostly cereals, which is the normal diet of most of the world's population, could be supplemented by half a liter of milk per person per day, malnutrition would very nearly disappear. Since great losses occur when plant protein is changed into animal protein, it has been questioned whether there will be, in the future, any possibility of the production of animal protein in a more and more overcrowded world. In milk production the daily feed has to contain roughly 60 grams of digestible crude protein for each kilogram of milk produced, in addition to the 300 grams necessary for the maintenance of the cow. This is nearly twice as much protein as there is in 1 kilogram of milk. Because utilization of nutrients by the body in ruminants is very different from the utilization in other mammals, the fermentation processes in the rumen, caused by microbial flora, being of decisive importance, a part of the protein in the feed of ruminants can consist of simple nitrogen compounds—for example, amides or ammonia. This view was presented as early as 1891 by Zuntz (*1*) in Germany, but utilization of nonprotein nitrogen in the rumen is still not well understood. A great number of feeding experiments have been made in different countries to find out how much of the protein can be successfully replaced by urea, which is readily decomposed to ammonia in the rumen. The problem is complicated in the case of normal feeding with plenty of protein. This is due primarily to the fact that the microbes in the rumen more or less decompose the different proteins of the feed to ammonia and that microbial protein is again partly synthesized from the ammonia. There is danger of ammonia poisoning when urea is used as a supplement to normal feed, and thus the addition of only relatively small amounts of urea has been recommended in practice.

In experiments in which the purified feed used does not contain protein, and in which urea is used as the only significant source of nitrogen, the interpretation of the results is much clearer. Experiments of this kind have been carried out especially in the United States, with growing lambs, goats, and steers. The ruminal biosynthesis of all protein amino acids, even of essential amino acids, was demonstrated in these experiments (*2*). In spite of the relatively small amounts of protein which are needed for the growth of young ruminants—for example, for the rearing of a heifer, about 300 to 350 grams of digestible crude protein per day—optimum growth was not obtained with

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