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The National Institutes of Health Yesterday, Today, and Tomorrow

DONALD S. FREDRICKSON, MD

IT IS A PRIVILEGE TO CONTRIBUTE to *Public Health Reports* in its 100th year. Like *PHR*, the National Institutes of Health looks back on almost a century of history, having had its start some 91 years ago in a one-room laboratory in the Marine Hospital on Staten Island. There Dr. Joseph J. Kinyoun, founder and director of the Laboratory of Hygiene (it became the Hygienic Laboratory in 1891), introduced scientific research into the Marine Hospital Service. His work in bacteriology and isolation of the cholera organism laid the groundwork for the present biomedical research programs of NIH.

Growth Before the Present Decade

The National Institutes of Health is the principal medical research arm of the Public Health Service. It is today one of the largest medical research centers in the world. For its first 60 years, however, its function was purely intramural as it served essentially as the laboratory for PHS operations. It began with activities in nutrition and microbiology, and early in this century it was made responsible for biologics standards in the country (subsequently transferred to the Food and Drug Administration in 1972).

Over the years the responsibilities of NIH grew slowly. It had its first big spurt of activity immediately after World War II. The Public Health Service Act of 1944 gave NIH the legislative basis for its post-war programs and began the major Federal commitment to the support of biomedical research—something unprecedented in the history of this country.

Few people realize that before World War II the support of science was not regarded as a responsibility of the Federal Government. Those of us who



Joseph J. Kinyoun, MD (1860–1919), who joined the Marine Hospital Service in 1886, was director of the Hygienic Laboratory from its establishment in August 1887 until April 30, 1899

remember the excitement that followed the successful splitting of the atom can recall vividly the national mood it inspired: that brains and money could accomplish miracles. In common with other science agencies of the Federal Government, NIH was a beneficiary of this national spirit.

The advent of space flight in the mid-1950s gave a further boost to science and technology. NIH entered a period of unprecedented growth. Each year from 1957 to 1963 the NIH budget increased by an average of 40 percent annually; appropriations grew from \$98 million in 1956 to \$930 million in 1963. There was a 12-fold expansion in grants to academic insti-

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tutions as the result of a deliberate congressional policy to expand the U.S. capability for biomedical research by rapidly increasing

- Funds to support research projects
- Federal assistance for the construction of research facilities
- Fellowships and training programs for research manpower
- Support for research abroad—to a limited extent.

By 1963 the United States was preeminent in biomedical research. NIH made grants to foreign institutions and had offices in Paris, Tokyo, and Rio de Janeiro, from which the seeds were sown for a renaissance of biological research in the developed countries of the world. But the geometric progression of 40 percent annual increases clearly could not be continued—in another 7 years it would have brought the NIH appropriation to \$8 billion.

The growth of NIH slowed markedly. In fact, the latter half of the decade of the 1960s has been characterized as an era of no growth. The average increase in funding was a little less than 6 percent in those years, construction funds ran dry, foreign grants were sharply curtailed, and the number of research grants began to fall.

The Current Decade—Selective Growth

The 1970s have had a different character, marked by narrowly mandated and selective growth. The decade began with a widely heralded campaign to mount a war on cancer. After enactment of the National Cancer Act of 1971, appropriations for the National Cancer Institute trebled in 4 years. This funding permitted needed growth in several basic disciplines then ripe for expansion: genetics, immunology, cell biology, and virology—all areas relevant not only to cancer but to all of the life sciences and medicine.

This legislation was followed by the National Heart, Blood Vessel, Lung, and Blood Act of 1972, an act reflecting the new and expanded interest in diseases of the lung and of the vascular system. In that year also, new legislation emphasized further support for research and training in digestive diseases and added a new title—the National Institute of Arthritis, Metabolism, and Digestive Diseases—to an old institute. The Research on Aging Act of 1974 brought an 11th institute into the NIH complex. The new National Institute on Aging was authorized to support not only biological research, but also social and behavioral research related to the aging process and the special needs and problems of the aged, thus adding a new dimension to the programs of NIH.

This era continues to be one of intense public and Congressional interest in specific diseases. Laws have been enacted that call for increased research on Cooley's anemia, multiple sclerosis, sudden infant death, diabetes, arthritis, Huntington's chorea, and certain communicable diseases. Congress has thus become more closely involved in the setting of research priorities.

Although this kind of interest is welcome, it can also be unsettling. Support for some areas that are not so visible or that do not command popular appeal (for example, endocrinology and metabolism, kidney research, and hematology) tends to decrease. The National Institute of General Medical Sciences, set up to fund basic medical sciences, and also the National Institute of Allergy and Infectious Diseases, have lost about 10 percent of their purchasing power in recent years.

Recent Innovative Actions

This brief historical glance at the evolution and direction of NIH offers very limited opportunity for useful speculation about the future. Nonetheless,

some recent developments at NIH related to administration, programs, and policy will certainly influence its course in the years ahead.

For example, NIH has been intensively reviewing its peer review system—at one time a unique experiment in self-discipline and quality control in the distribution of public funds. For 35 years this system has served the scientific community and the public well. Neither excellence nor sound stewardship has been compromised, and the return on the public investment has been substantial. Nor has there been any real challenge to the system, only a certain discomfiture with it.

As most readers of *Public Health Reports* are aware, the system originated at NIH in the late 1940s. It consists of a two-tier peer review system. The first review is conducted by specialty scientists, who assess the technical quality of research proposals. Then advisory councils, which include members of the public as well as health professionals, judge the proposed project in terms of its potential contribution to the prevention and cure of disease.

In recent years the system has come into question on such issues as possible conflicts of interest, the reappointment of distinguished people by an alleged "old boy" system, favoritism to investigators at distinguished institutions so that the rich get richer, the secrecy of deliberations, and the finality of a system that provides for no intercession and no appeal.

In 1976 NIH undertook its own internal review of the peer review system. Public hearings were held in Chicago, San Francisco, and Bethesda, Md., and written comments were obtained from present and former non-Federal members of review bodies as well as from applicants, grantee institutions, and the general public.

The peer review study team submitted 69 recommendations. After consideration by a small working group of senior staff members and program heads, 33 of the recommendations received outright approval, and 9 others were approved with minor modification. Action on 19 proposals was deferred pending additional examination and discussion, 3 recommendations were rejected, and 5 required no action.

One set of recommendations that was adopted is designed to improve communication with applicants. It requires NIH advisory councils and boards to promptly provide all applicants with the complete summary statements or critiques of their proposals, including priority scores, once final action is taken.

Another set of proposals that was adopted is aimed at opening up the process for nominating and selecting non-Federal advisors for service on councils and

initial review groups. NIH is also committed to assuring that women and members of ethnic minorities who qualify as experts have maximum opportunity to serve on advisory groups.

Pending further study of a group of recommendations to establish a formal grants peer review appeals system (to include an ombudsman), decision was withheld to enable further evaluation of the implications of such a system vis-a-vis legal, financial, and personnel resources. Meanwhile, interested members of the scientific community, including readers of this article, are free to offer further recommendations and suggestions.

As to program developments, the public continues to make known its concerns about unsolved problems or areas in which scientific knowledge is scanty. One such area that has caught the public's attention is nutrition. Leaders in Congress have been especially vocal in their call for more concentrated efforts in nutrition research.

Reflecting this national interest, NIH has mounted a number of specific programs in this area. The National Institute of Child Health and Human Development is launching a new program on clinical nutrition and early development. At the other end of the age spectrum, the National Institute on Aging has begun its own program in clinical nutrition and at



In a laboratory in the National Institute of Child Health and Human Development, an atomic absorption flame spectrophotometer is being used to investigate nutritional abnormalities

a 3-day conference in June 1978 brought together some of the nation's outstanding clinical nutrition experts to discuss the nutritional needs of the aging adult.

Also in June 1978, the NIH Nutrition Coordinating Committee sponsored a conference on the "Biomedical and Behavioral Basis of Clinical Nutrition: A Projection for the 1980s." Leaders in nutrition research in this country reviewed biomedical and behavioral nutrition research, related this research to current clinical practice, and helped project the future frontiers of nutritional investigation. Participants from other government agencies, academic authorities on nutrition, members of congressional staffs, and consumer advocates affirmed the need for new knowledge about nutrition and wide dissemination of that knowledge.

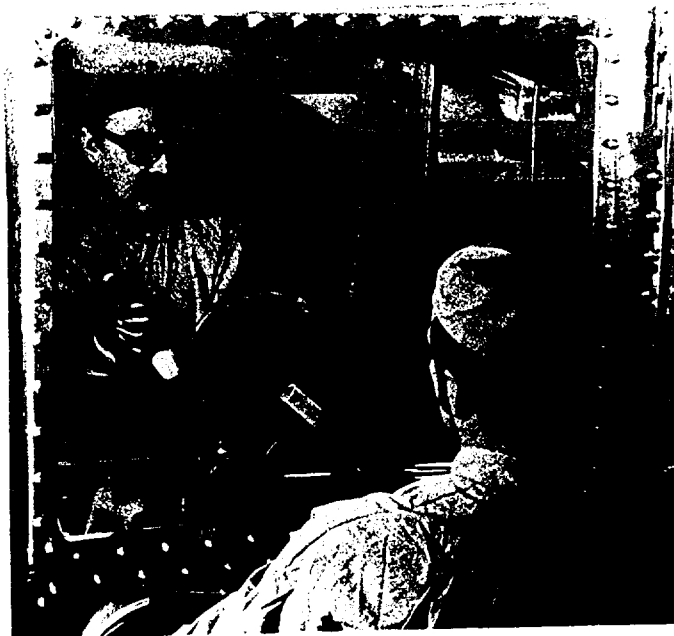
A "consensus development" conference on the surgical treatment of morbid obesity is scheduled for late in 1978; another such conference also is planned to draw up recommendations on total parenteral nutrition and hyperalimentation—subjects of great interest and some controversy at present.

Subsequent consensus conferences will provide a mechanism for seeking professional agreement upon the clinical significance of new medical procedures. The idea is to bring together a variety of points of view on new or controversial procedures and to have an open and extensive discussion of their advantages and drawbacks. In this way it is hoped to speed the transfer of technology from bench to bedside and thereby to assure that pertinent and valid information is put to work as promptly as possible in improving patient care.

In fact, NIH held its first consensus development conference last year. At that meeting, which focused on the use of mammography for breast cancer screening, consensus was reached that routine use of mammography should be limited to women 50 years of age or older. The success of that conference has encouraged NIH to make subsequent use of this device to speed health policy decisions.

In some areas of science and research, particularly those with important social and ethical implications, the public must share in the planning and development, right from the beginning. An example is the advent of DNA recombinant techniques in microbiological research. And almost from the beginning, the public has been involved in helping NIH formulate guidelines for the conduct of such research.

Concerns about the safety of recombinant DNA research were called to the attention of the scientific community and the public by scientists themselves—



Researchers at NIH's P-4 containment facility at Fort Detrick at Frederick, Md., use shoulder-length rubber gloves to move and control all materials. The facility is the first recombinant DNA research laboratory certified to meet NIH guidelines

I know of no similar situation. Some of those who originally expressed misgivings about such research have now concluded that their fears were exaggerated and, in an about-face, have come to oppose government regulation of it. But it is to their credit that they freely shared and aired their doubts and in the process of doing so, made a historic contribution to the public governance of science.

With the participation of many individuals and groups—scientists, lawyers, ethicists, environmentalists, and consumer advocates—in June 1976, the NIH formulated guidelines governing the use of DNA recombinant techniques. These guidelines are at the present writing undergoing revision. It is hoped they may (a) exempt from regulation certain classes of DNA experiments, (b) strengthen institutional authorities in determining compliance with the guidelines, and (c) for the first time make provision for private industry to register voluntarily its recombinant DNA activities with NIH. It is still uncertain whether legislation will be enacted that will provide the regulations with the force of law to govern such experiments. Nevertheless, whatever happens, the conduct of the scientific community in this matter has been responsible and in the best public interest.

Planning Future Research

There is no doubt that this nation is firmly committed to basic biomedical research. Both President Carter and Secretary Califano have reaffirmed that

commitment, as have leaders in the Congress. But policymakers and administrators alike are faced with the enormous dilemma of maintaining the momentum of research in an era of shrinking resources.

Maintaining that momentum will take skill and patience and prudent planning on the part of all concerned. In a wide-ranging and very supportive speech earlier this year, Secretary Califano suggested the development of a multi-year plan for health research. By the time this article appears, we at NIH will have held the first of what may be a series of conferences—shared in by scientists, health professionals, and the public alike—to define the principles on which such a multi-year effort should be based. We have already been giving thought to directions for the future, being well aware that we must constantly hone both the form and function of our programs.

One of the problems is defining basic research. There is considerable confusion and disagreement, even within the scientific community, as to its character and boundaries. In an effort to avoid this impasse, and for ease in planning, we have classified our activities under four major headings: science base, clinical application, training, and transfer. We are using these concepts in both program planning and budget development.

Science base. Under the science base umbrella, we include all those elements that contribute to the search for new knowledge about fundamental processes—grant support for research projects (NIH has about \$800 million in research grants) and program projects, some center-based activities, some intramural research efforts, some research contracts, and some special resources.

Clinical application. Clinical application involves the further development and assessment of knowledge for immediate practical purposes. Clinical trials, the largest element in this category, are prospective research activities undertaken to assess the value and effect of agents, devices, and procedures on human subjects (NIH has some \$200 million in this activity). In addition, research on the development of vaccines, other biologics, drugs, and devices also qualifies, because the outcome of such research yields knowledge immediately applicable to human beings.

Transfer. The transfer sector of the research continuum includes five activities—demonstration, control, education, consensus building, and dissemination. Part of the responsibility of the research

community is to transfer new knowledge promptly to the health professionals who can put it to work.

Training. Without a consistent flow of new investigators, the future of biomedical research would surely founder. Promising young people must be found, motivated, and trained for careers in biomedical science.

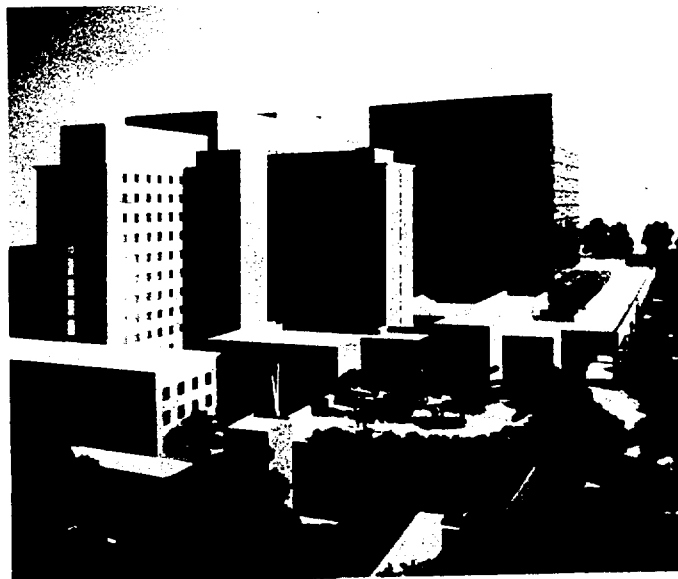
At a meeting of the NIH Director's advisory council at NIH June 16 and 17, 1978, major issues emerged that the Department of Health, Education, and Welfare may wish to address in future long-range planning of health research and in arriving at principles suitable for guiding such a plan. The outcome of this activity—in which other Public Health Service agencies have also been engaged—will help set the planning agenda for health research in the future.

Future Funding of Research

Consideration of what the economics of biomedical science will be tomorrow evokes a beautiful illustration of what Voltaire was talking about in his *Dictionnaire Philosophique*, when he stated, "It is said that the present is pregnant with the future." We can never be sure what era we are bringing to birth, but we want to assure that the capacity for exploration is kept strong and that the ultimate development will be in the public interest.

Three questions about biomedical science may pertinently be asked at this point:

1. Is it likely that we will return to a parochial period in which resources will be derived primarily from private sources?



When completed, the new Ambulatory Care Research Facility being constructed on the NIH campus at Bethesda, Md., will accommodate an estimated 300,000 outpatient visits each year

The answer is assuredly negative. The Federal Government has not become disenchanted with nor disinterested in research. But research must compete with other desirable health programs and goals. And some of these other programs, because the problems related to them are perceived as being more immediate or more serious (the costs of and access to health care come to mind), may have a higher priority at the moment.

2. Are we headed for another period of exuberant growth or unselective expansion?

The answer is almost surely just as negative, partly because there is greater competition for limited Federal funds. Also, a drop in school-age children will curtail university expansion. Moreover, there are also clear signs that the always small fraction of medical school graduates interested in research as a profession is, at least temporarily, diminished, in part because of deep concern about the stability of support for such a career. And we are groping for ways to attract bright young minds into scientific inquiry.

At the same time, it is worth noting that at this writing, the NIH reservation is reverberating with new construction, which in itself is a foreshadowing of things to come. The new 13-story Ambulatory Care Facility will expand and strengthen the combined laboratory and patient care programs of the Clinical Center, our research hospital. When completed in the early 1980s, the new addition will be able to handle an estimated 300,000 outpatient visits each year, nearly 3 times the current figure.

At the other end of the NIH campus, the 10-story Lister Hill Center building will be a part of the National Library of Medicine. When it is completed in 1980, the building will house the communications technology and network programs of the new National Center for Biomedical Communications and the closely related functions of the National Medical Audiovisual Center, presently located in Atlanta, Ga.

Finally, there is a third question that should be asked:

3. If maintenance implies increasing selectivity, what are the future funding strategies?

The answer is compound: one part concerns the political imperatives; the other, the allocation of resources within institutions for the conduct of scientific inquiry.

First, biomedical science is preeminently humane in its objectives, and it must consciously adjust to its patrons' expectations and needs in every way that does not destroy the process of discovery. There must

be practical, useful results emerging: that is the essence behind the labels "technology transfer" or "consensus development."

Science must prove itself capable of self-governance in regard to laboratory safety and other issues in which the public has a vital stake. The controversy that has swirled around the subject of recombinant DNA research has been a profound experience for scientists, for NIH as an institution, for the Congress, and for the public as a whole. If science fails to govern itself, regulations and laws will descend upon the laboratories, and science may find itself tragically fettered.

At the same time, within scientific institutions there must be adaptation and accommodation, and there is a rather narrow limit to the rational management of science through the allocation of resources.

Conclusion

Society will continue to set mandates for biomedical research—as patron, that is its right. Those who administer the research funds have to arbitrate and interpret. The rate of scientific progress is determined by the interplay of such factors.

Problems that presently admit no speedy or tidy resolution will be addressed with all the energy and zeal we can command. In its first 90 years, NIH has added enormously to man's store of knowledge and has measurably enriched the nation's health. There is every reason to believe that when *Public Health Reports* celebrates its 200th anniversary, a future director of the National Institutes of Health will look back with pride on another century of outstanding progress.

The National Institute of Health was established in 1930 and became the National Institutes of Health in 1948. Following are the years in which the Institutes and the National Library of Medicine were established.

National Cancer Institute	1938
National Heart, Lung, and Blood Institute	1948
National Institute of Dental Research	1948
National Institute of Arthritis, Metabolism and Digestive Diseases	1950
National Institute of Neurological and Communicative Disorders and Stroke	1950
National Institute of Allergy and Infectious Diseases	1955
National Library of Medicine	1956
National Institute of Child Health and Human Development	1962
National Institute of General Medical Sciences	1962
National Eye Institute	1968
National Institute of Environmental Health Sciences	1969
National Institute on Aging	1974
