2. In the study of particular policy problems, this limitation bears reexamination. If colleges and universities are in fact undergoing rapid changes in the distribution of activities in which their faculty and staff engage, then ignoring the differences among persons at different levels within the *E*-box could lead to serious errors in the resulting analysis.
3. "Doctorate Production in U.S. Universities 1920–1962," *Natl. Acad. Sci.–Natl. Res. Council Publ. No. 1142* (1963).
4. Because of interdisciplinary research activities, and even interdisciplinary teaching activities, we have classified the fields of science quite broadly. We use conventional fields of science because no satisfactory alternative exists. Throughout this article, fields of science are divided into successive levels of classification categories and are distributed as follows: *Science*: physical, life, and social sciences. *Physical sciences*: engineering, mathematics, chemistry, and all other physical sciences; this last category includes physics, astronomy, and earth sciences. *Life sciences*: biological sciences, agricultural sciences, health sciences, psychology, and social sciences; this last category includes sociology, anthropology, archeology, economics, geography, and political science; it does *not* include history.
5. The full-time-equivalent number is the hypothetical number of persons working full time who would contribute the same total effort as that contributed by the persons in the survey, some of whom work part time in education; it is obtained by summing all full-time and part-time efforts, measured in the proportion of time spent by each person.
6. Paul H. Kratz, now employed at the National Bureau of Standards, compiled the tables of survival rates.
7. Use of a median age of 30 years yields essentially the same results [see *3*, p. 44, and "Investing in Scientific Progress" (*8*)].
8. "Investing in Scientific Progress," *Natl. Sci. Found. Rep. NSF 61–27* (1961).
9. If 68 is taken as the retirement age, then attrition due to retirement alone is 0.4 percent.
10. "Scientists, Engineers, and Technicians in the 1960's," *Natl. Sci. Found. Rep. NSF 63–34* (1963).
11. M. Levine and W. L. Koltun, unpublished. We are grateful to Dr. Levine, study director of the National Register of Scientific and Technical Personnel, Office of Economic and Manpower Studies, National Science Foundation, for his assistance and for making the data available. See also "Report of the Select Committee on Government Research of the House of Representatives, Study Number VI, Impact of Federal Research and Development Progress" (Government Printing Office, Washington, D.C., 1964), p. 74.
12. "Reviews of Data on Research and Development," *Natl. Sci. Found. Publ. NSF 63–4, No. 37* (1963).
13. The expression "staff members with doctorates" at colleges and universities includes all persons holding a doctorate, not just traditional faculty members. One impact of research funds is the employment by colleges and universities of many doctoral scientists and engineers to do research and not to teach.
14. "Profiles of Manpower in Science and Technology," *Natl. Sci. Found. Rep. NSF 63–23* (1963).
15. L. R. Harmon, private communication; the series of studies "Teacher Supply and Demand in Universities, Colleges and Junior Colleges," published by the National Education Association, also provides relevant data. We used the National Academy of Sciences–National Research Council data because (i) the NAS–NRC survey concerns the individual doctoral-degree candidate, not the institution, as the NEA survey does; (ii) it is conducted on an annual, calendar-year basis, in contrast to the NEA survey, which is made on a biannual, academic-year basis; (iii) the NAS–NRC survey provides a time series compiled annually since 1957, whereas the NEA time series starts in 1959; (iv) in the NAS–NRC survey, data relevant to the feedback ratio are divided by type of activity in such a way as to yield full-time equivalents, and the data are given in greater detail than are the head-count data provided by the NEA survey; and (v) the NAS–NRC survey is related to the survey that provides the data on doctorate production of our study. In spite of these differences, however, the two sources of primary data yield values for feedback ratio that are in close agreement.
16. The specific survey question on which this determination is based was, "Is your postdoctoral activity *primarily* research, teaching, administration, professional services, fellowships, other (explain)." If an individual indicated more than one activity, we divided his effort equally among these activities. Thus: research = research + ½ (research + teaching) + ½ (research + administration); teaching = teaching + ½ (research + teaching) + ½ (teaching + administration); other = administration + professional services + ½ (research + administration) + ½ (teaching + administration) + other. Corresponding feedback ratios are, therefore, approximately on a full-time-equivalent basis.
17. The Office of Education has estimated that 18.1×10^3 doctor's degrees will be awarded in 1970 in all fields combined. We take 65 percent of this number, which is the average percentage of doctorates given in science and engineering during recent decades; actual annual numbers have departed from this average by only a few percentage points except during periods of war. This first estimate, then, is 11.8×10^3. The National Science Foundation has made a projection of 12.9×10^3 as a likely number. Discussion of these projections lies outside the scope of this article; we merely note that we have averaged the two projections cited and have used the result, 12.4×10^3, as a reasonable "projected" number for illustrating the feedback method.
18. "Meeting Manpower Needs in Science and Technology, Report Number One: Graduate Training in Engineering, Mathematics, and Physical Sciences," *Rep. President's Science Advisory Committee* (Government Printing Office, Washington, D.C., 1962).
19. Our study underscores related recommendations contained in the report "Toward Better Utilization of Scientific and Engineering Talent" (National Academy of Sciences, Washington, D.C., 1964) and enlarged upon by A. O. Gamble in an accompanying paper, which discusses the need for "data organized to show interrelationships among different factors such as . . . characteristics and output of systems for education . . . often expressed usefully as ratios or percentages."
20. The research described in this article was started when R. H. Bolt was associate director for planning and head of the Science Resources Planning Office, National Science Foundation; W. L. Koltun was a staff member of the Science Resources Planning Office; and O. H. Levine was a staff member of the Office of Economic and Statistical Studies, National Science Foundation. Bolt conducted part of the work while a Fellow of the Center for Advanced Study in the Behavioral Sciences, Stanford, California, during 1963 and 1964.

News and Comment

NSF Budget: Cuts by House Group Leave Little Leeway for Growth in Support of Research Projects

The National Science Foundation and its budgetary overseers in the House had a friendly set of hearings this year. The transcripts and report*, released last week by the Independent Offices Appropriations Subcommittee, revealed few quibbles or sharp exchanges at the customarily closed sessions, which were held in March. And in its report the committee took the unusual step of commenting that the top management of NSF is "doing a tremendous job." But the committee's financial verdict was to cut by about one-half the increased funds sought by NSF; and through its accompanying directives the committee made it plain that the scientists and the politicians hold some very different ideas about the role of NSF and the needs of American science.

The gap between the sums requested and the sums voted tells part of the story, but the problem runs considerably deeper than a mere difference of opinion over how much money the Foundation should have at its disposal in the next fiscal year. Briefly, the administration asked Congress to appropriate to NSF $530 million—an increase of $109.6 million over the Foundation's current budget. The size of the requested increase represented a victory for those within the executive who contended that the Foundation should be considered the keystone of federal support for basic research. It

* Independent Offices Appropriations for 1966, part 2, hearings, available without charge from Appropriations Committee, U.S. House of Representatives, Washington, D.C. 20515. (The report is available from Document Room, U.S. House of Representatives, Washington, D.C. 20515.)

appears that toward the end of last year, when the budget was nearing completion for presentation to Congress, a decision had been made to ask for a considerably smaller sum, in line with the administration's economy efforts. But at the White House level it was successfully argued that the Foundation's growth should be accelerated to compensate for the tapering off of basic research expenditures by other agencies. And out of this there came the decision to seek the $109.6 million increase. Of this sum, about $66 million was earmarked for basic research projects grants, a category in the NSF budget that has remained fairly static over the past few years. Another $40 million of the increase was budgeted for NSF's Science Development Program (*Science*, 10 April 1964), which is intended to give striving institutions a push to higher quality and simultaneously satisfy congressional demands for broader distribution of research and education funds. The response of the Appropriations Committee was to allow an increase of only $59.6 million over the current budget. At the same time, however, the committee directed that the Science Development Program was to receive the full $40 million budgeted for it, which means, in effect, that outside of that program the committee was allowing NSF an increase of only $19.6 million. In addition, the committee directed that NSF was not to award more than 10 percent of its fellowships to residents of any one state. Since the Senate is yet to act on the NSF budget, the final version may be modified, but if past performance is any guide, the House verdict is likely to be the dominant influence.

An examination of the dialogue between NSF officials and the House committee members shows that, in general, the proceedings were affable and the members displayed none of the hostility that they showered on the NSF witnesses 2 years ago, when NSF was denied any fund increase at all. But the scientists who appeared before the committee were speaking of NSF in terms of the place they see for it in the grand design of federal support for basic research, while the committee members appeared to reflect a feeling that NSF is simply another federal agency in the science business. And while the scientists came close to saying that it is sinful to neglect scientific talent or promising research opportunities, the members seemed to be concerned principally by the question of whether the available resources are being evenly distributed around the country.

> The first grants under NSF's Science Development Program were announced last week—awards of $3.5 million to $4 million each to Washington University (St. Louis), the University of Oregon (Eugene), Case Institute of Technology, and Western Reserve University.
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> In a statement accompanying the announcement, President Johnson said, "In the past a relatively small number of universities have provided the most advanced training for students and have led the way in research. . . . Since too few of our people and too few areas of our country are served by such institutions of the highest quality, it is of the greatest importance that new centers be encouraged to grow where the will, imagination, and the need to do so exist."
>
> Johnson said that about 60 proposals have been received by NSF and it is expected that four to six additional development grants will be made this year.

For example, in an exchange with Eric Walker, chairman of the National Science Board and president of Pennsylvania State University, Representative Charles R. Jonas (R–N.C.) said, "About the only criticism I hear of the Foundation is that . . . a few institutions get most of the grants." To which Walker replied, "There is no point in putting money where there isn't competence to use it, and so we have a dual problem here, to build up the competence of some of these universities so that they can get more NSF funds." Walker pointed out that the Science Development Program was designed to do just that. And the subject was dropped at that point. But not long after that the committee returned to the distribution question, with Chairman Albert Thomas (D–Tex.) engaging the NSF witnesses in some of the sharpest exchanges of the entire proceedings. When Henry W. Riecken, Jr., NSF associate director for education, observed that it was NSF's aim to provide fellowships for the top 5 percent of graduate students in science, mathematics, and engineering, Chairman Thomas inquired, "Where do most of these top five percent come from?" Riecken said he would assemble the information and supply it to the committee, but Thomas then went on to say:

"That is one of the defects of the program, in my own judgment. That you pick them from half a dozen universities to the exclusion of everybody else. I do not think there is that much difference in fundamental intelligence and human nature. You give these people an opportunity to spread their wings and fly and they will do it."

Riecken then pointed out that by statute NSF was required to award its fellowships "solely on the basis of ability."

"What about putting a limitation in here that no more than 10 percent of the number you select may come from any one state?" Thomas asked.

"I simply don't know how to answer that," Riecken replied, "except to repeat what the National Science Foundation Act provides; namely awarding fellowships on the basis of ability alone."

To this Thomas said: "We will answer it for you"—which is what the committee did with the 10-percent limitation that it wrote into the appropriations bill.

If the limitation survives in the final version of the bill, it probably wouldn't have too much effect on the Foundation, outside of making NSF highly conscious of the fact that the committee has the means to get tough about its desire to see a spreading of the wealth.

NSF awarded a total of 9367 graduate and cooperative graduate fellowships covering the years 1962 through 1964. During this period, by one possible interpretation, the 10-percent limitation was exceeded only by Massachusetts, with a total of 1098 recipients, and New York, with 1360. California, the envy of the have-nots, turns out to have received only 913, and Illinois had only 524.

The treatment afforded NSF by its appropriations subcommittee in the House stands in sharp contrast to that received by the National Institutes of Health when it discussed its budget

with the Labor and Health, Education, and Welfare Appropriations subcommittee, chaired by Representative John Fogarty (D–R.I.). The NIH hearings and report*, both released a few weeks ago, are saturated with Fogarty's berating of NIH and the administration for not seeking more money. In the present fiscal year, NIH received an appropriation of $1.058 billion. For the coming year the administration requested $1.146 billion. Describing the request as "seriously deficient," Fogarty's subcommittee added $11.7 million to the administration figure. Fogarty's counterpart in the Senate, Lister Hill (D–Ala.), will probably recommend an even larger addition.

Under prodding from Fogarty, NIH officials conceded that it was their professional judgment that a good deal more money could be used for research and training, but they explained that they were required to work under a budgetary ceiling set by the administration. Fogarty declared that the new budget was inadequate to absorb increased costs, let alone provide for expansion of NIH's programs. NIH director James Shannon sadly agreed, but pointed out discreetly that he wasn't a free agent when it came to making the budget. In questioning Kenneth M. Endicott, director of the National Cancer Institute, Fogarty demanded, "Do you mean to say you can't do any more than you are doing now, if you had the funds and personnel and facilities?"

Endicott replied, "No, sir, I hope I didn't convey that," and he added, "If one could forget all about the budgets and so on—." To which Fogarty responded, "Forget it. Say to yourself, 'The sky is the limit'; now let us go and see what kind of a program we really should have."

To a large extent, the differences in congressional treatment of NSF and NIH can be attributed to the popular appeal of medical research and the general lack of understanding of the significance of nondirected basic research. But there is also an element of luck in the picture.

The vagaries of congressional seniority and committee assignments brought John Fogarty and Albert Thomas to their respective chairmanships, and though both chairmen in many ways reflect the general public's attitude toward research, it is clear that their own tastes and personalities have had a great deal to do with the fortunes of the agencies under their jurisdictions. After all, NSF is yet to be told by its fiscal judge that it should consider "the sky the limit."—D. S. GREENBERG

* Labor and HEW Appropriations for 1966, part 3, hearings, available from Appropriations Committee, U.S. House of Representatives, Washington, D.C. 20515. (The report is available from Document Room, U.S. House of Representatives, Washington, D.C. 20515.)

Heart, Cancer, and Stroke: Bill Based on Presidential Commission Calls for Regional Medical Centers

The Heart Disease, Cancer, and Stroke Amendments of 1965, an administration-backed bill now under consideration by Congress, is one of those cases where the name is the same but the substance has been changed sufficiently to provide the unwary with a few surprises. The bill is the only concrete legislative proposal to emerge from the wide-ranging report of the President's Commission on Heart Disease, Cancer, and Stroke (*Science*, 20 March and 25 December 1964). Its lineage is attested by its name and by the fact that it has the explicit backing of several of the most prominent members of the commission, including its chairman, the noted Texas surgeon Michael DeBakey. In many ways, however, the bill and the report differ markedly, not only because the bill reflects only a portion of the commission's recommendations but because, even in the recommendations that have been incorporated, important changes of emphasis have emerged. The confusion between the two seems to have contributed to a near-blackout of serious discussion of a program which stands a good chance of being endorsed by Congress, and which is likely to have a significant effect both on the structure of medical service throughout the country and on the health activities of the federal government.

In many ways the original DeBakey report was an exceedingly diffuse document. Volume 1—the commission's conclusions and recommendations, issued last December—consisted of over 100 pages and dozens of recommendations on topics ranging from the payment of overhead costs on research grants to improved facilities for animal laboratories. Volume 2, a 650-page supplement published late last month, consists of the working papers and reports of the commission's eight subcommittees and contains everything from scientific papers on cancer to original studies of medical manpower and facilities. Within the welter of words two main themes could be distinguished. On the one hand, the commission proposed strengthening all existing resources which contribute ultimately to improved medical care, from community health programs to research facilities. These proposals entail expansion of existing government programs rather than the development of new ones. Secondly, the commission proposed creation of an entirely new system, what it called a "national network" of regional centers, local diagnostic and treatment stations, and medical complexes with the specific purpose of insuring that discoveries made in the nation's major medical centers would rapidly find their way into the treatment of patients throughout the country. This was the proposal that was the answer to President Johnson's charge to the commission to "do something" about the alarming death tolls from the three diseases. And this was the proposal that Chairman DeBakey described as the "major innovative thrust" of the commission's recommendations.

As pictured by the commission, the national network was to consist of 60 regional centers oriented toward clinical research and located in universities, hospitals, and research institutions, and more than 450 diagnostic and treatment stations linked with the regional centers but serving physicians and patients located in more remote communities. As a supporting measure the commission advocated that grants be given to "stimulate the formation of medical complexes whereby university medical schools, hospitals and other health care and research agencies and institutions work in concert." But the heart of the proposal was its call for independent categorical research and treatment units.

In the bill before Congress, the commission's emphasis appears to have been reversed. Its formal purposes are (i) "Through grants, to encourage and assist in the establishment of regionally coordinated arrangements among medical schools, research institutions, and hospitals for research and training and for demonstrations of patient care in the fields of heart disease, cancer, stroke, and other major diseases"; and (ii) "to afford to the medical profession and the medical institutions of the Nation, through such coordinated arrangements, the opportunity of making