fered by aides to President Nixon in 1972, shortly before Nixon decided to abolish the old White House Office of Science and Technology. On that occasion, some members of the President's Science Advisory Committee—which reported to science adviser Lee Dubridge—had publicly expressed their technical reservations about the Administration-backed supersonic jet transport. As now, the knives immediately came out for the bearer of bad news.

In a more general sense, Keyworth may have stepped on some toes merely because his responsibilities for coordination and management of interagency scientific disputes are resented by those who have a rival claim to this role or who have failed to win his support. For whatever reason, one official says that Keyworth's influence and access at the White House has recently been constricted, a charge that he firmly denies. When he is in town, Keyworth says, he attends "three out of the five" White House management meetings chaired by Meese every week. "But it is true that over the last 19 months, I have been on the road a lot, devoting a great deal of my time to the Star Wars effort. As a result, I suppose I've been less a part of the daily process around there. As to the present discussions on tax reform, entitlement programs, and broad domestic spending questions, I certainly do not feel that I have been a very important contributor to that strategy." But when important matters of science and technology have arisen, his office does contribute, Keyworth says.

Some of Keyworth's critics outside the government say that on several major issues, such as Star Wars and the space station, it seems as if the President has influenced Keyworth and not the other way around. Indeed, Keyworth regards his promotion of the President's ideas as one of his primary functions. "No one would fault him for lack of loyalty," says the White House official. "But this Administration likes to manage its media image carefully, and some of his unplanned appearances in the press have sparked resentment." In publicly backing some of Reagan's more politically controversial programs, then, Keyworth has to some extent politicized his own office. As a result, he has become deeply enmeshed in internal White House political squabbles.

Although Keyworth's position seems secure for now, as a result of his meeting with Reagan and his continuing close ties to Meese, his fortunes could decline after Meese's expected departure to become Attorney General. A lot hinges on whether the pragmatic or conservative clique at the White House triumphs. Officials say that if OSTP were indeed eliminated, its work would be divided between the National Science Foundation and the National Security Council, as it was in the early 1970's. Congress reacted to Nixon's decision by reinstating the office through federal legislation in 1975, and so it would have to approve of the office's destruction.

Keyworth believes that OSTP will disappear only if the Administration creates a Cabinet-level science and technology department, which will fulfill much of OSTP's role anyway. At that point, Reagan is unlikely to want an independent source of scientific advice within the White House bureaucracy. One of the principal historical rationales for such advice—a desire to counterbalance technical advice by the Pentagon—has never held much appeal either for Keyworth or his boss.—**R. JEFFREY SMITH**

NIH Proposes Extending Life of Grants

The value of extending the length of research grants from 3 years to 5 or more is being tested selectively by some special programs

A plan to put more stability into the biomedical research enterprise by extending the average length of grants from 3 to 5 years is under active discussion at the National Institutes of Health (NIH). Possible changes, many of which would be implemented through the peer review system, were the sole topic of a recent meeting of the NIH Director's Advisory Committee.

Budgetary constraints cost NIH a 12 percent loss in purchasing power in the period from 1979 to 1982, NIH data show. As a result, grants became increasingly more difficult to obtain. On a scale of 500 to 100, the score or rating one had to achieve to get a grant funded climbed upward, like grade creep in colleges, and researchers began to see more and more applications being turned down for what seemed to be arbitrary reasons. Concern about the way the peer review system operates and unrest about the frequency with which people are forced to spend time writing renewal applications for the 3-year grants they do get have created additional anxiety in an already competitive system.

"This advisory meeting is, in part, a response to that anxiety in the research community," said NIH director James B. Wyngaarden. "We are looking for ways to simplify the application and review process and hoping to find ways of awarding a larger number of grants for 4 or 5 years rather than 3. The fact that we are looking at these issues seriously should 'carry a message' to scientists."

A couple of alternatives are being examined. One would focus efforts at extending the length of grants for first-time applicants. "Many brand new projects don't really begin to produce anything for the first 12 to 18 months because the young investigator is just setting up his or her lab and getting the experiments under way," Wyngaarden notes. "It isn't always realistic to expect these young scientists to be far enough along to be ready to reapply when they have to if they have only a 3-year start up grant." Wyngaarden, who would like to see grant length extended across-the-board, leans toward favoring the young investigator if a choice has to be made.

Others lean toward favoring mid-career or established researchers who need resources to continue good work and to maintain laboratories with some sense of stability. Joshua Lederberg, president of Rockefeller University, attended the meeting as a special adviser to the director. "I would put more emphasis on the 5-year award for established investigators," he said, adding that the peer review of applications should shift its emphasis away from the details of a proposal and toward an assessment of the overall track record of the applicant and the general research strategy put forth in the proposal. "You don't need to review a good researcher as often as every 3 years," he stated.

A change from longer to shorter grant lifetime has entered the system gradual-

ly, but it was accelerated after a 1976 report from the congressional Office of Technology Assessment (OTA) that called for greater "accountability" of the taxpayers research dollars. Persistent feelings that the peer review system was too inbred were being widely expressed at the time. And the debate about recombinant DNA research and the need to monitor experiments to protect society was raging. Translated into practice, the OTA's call for accountability meant that a pattern of awarding grants for 5, or even 7, years gave way to a pattern in which the 3-year grant became the norm.

It has also meant, Wyngaarden observes, a "subtle philosophical shift from the idea that grants are an instrument for investment in research to one that sees grants as a means for procurement of a research product." In Lederberg's words, it has meant a decrease in thinking about "exploratory" research and an increase in "exploitative" research—sure-fire applications often based on data that are already in hand. Referring to his own [possibly somewhat exceptional] career, the Nobel Laureate said the "correlation was just about zero between the content in the proposal and the actual work done in my lab." Implicit in that is Lederberg's view that researchers with demonstrated talent should be given more free rein by the system to do imaginative work, less encumbered by the chores of application writing.

None of these issues that currently trouble researchers would seem nearly as serious if getting a grant were not such a chancy business for all but the very top rank of scientists. A shrinking pool of dollars and an increasing pool of applicants have combined to create a system that seems less and less tractable.

In 1975, NIH received a total of 12,160 grant applications. Forty-six percent were actually funded, and the mean priority score was 195. By 1983, the total application pool climbed to 19,154. Of those, only 33 percent were funded and the mean priority score needed to be in that favored percentage rose to 160. Looking at figures for first-time applicants, NIH data show that about 10 years ago, some 15 percent of the total number of grants were to new researchers; now it is closer to 8 percent.

Another indication of what is happening as the system tightens relates to the "longevity" of NIH grantees. It used to be that, once in the system an investigator was likely to be an active grant recipient for 10 to 15 years. Now, it is not uncommon for people to "disappear" from the system after only 7 years,

Fine-Tuning Peer Review

The NIH has broad discretion in determining the number of years any grant shall run, with decisions based in large measure on the judgment of peer review panels. Not surprisingly, the discussion initiated by NIH director James B. Wyngaarden about extending the average life of grants included a debate about the peer review system itself.

At the top of the list of issues the problem of distinguishing what Wyngaarden called "shades of excellence" among competing grants that are all at the top. For example, in many institutes, there is money enough to fund those grants with top priority scores of 160 to 170, while those rated only slightly lower at 171 to 180 end up in the reject pile. Nearly everyone agrees that there is no objective way the peer review system can make such fine-tuned distinctions about quality. Furthermore, most researchers consider grants with scores "down" to 250 (on a scale of 100 to 500) still to be meritorious. However, even now that the NIH budget is much healthier than it has been in recent years, competition for still limited funds forces this kind of discrimination that excludes many worthwhile proposals. It is rejection of grants at the top that is causing so much anguish. It is the distinction between 160 and 170 and 180 that seems arbitrary and leaves the recipients of rejection slips feeling angry and frustrated.

For years there were complaints that the persons chosen to sit on NIH's peer review panels were members of an old-boy network and that persons whose grants were turned down were never given a full explanation. More recently, complaints mounted that the system was being strained because there were too few reviewers to cope with the growing number of applications. Overworked peers could not do each applicant justice.

In the late 1970's, after an extensive study of the peer review system that was headed by Ruth Kirschstein, director of the National Institute of General Medical Sciences, a policy of giving applicants the "pink sheets" containing reviewers comments was instituted. Within the past year or so, the work-load problem was addressed by increasing the total number of peer reviewers from about 800 to nearly 1400.

Now there is a call to make improvements on the improvements. Arguing that the pink sheets too often reveal that the peer reviewers really lack the competence to adequately evaluate the proposal, the system is being called too "egalitarian."

Whether the quality of peer reviewers has actually declined is nearly impossible to prove, but comments at the advisory meeting made the perception plain. Efraim Racker of Cornell University questioned the expertise of some peer reviewers. Howard Morgan of the Pennsylvania State University at Hershey also spoke about the problems of using "less experienced reviewers" and criticized detailed critiques that focus on minute or trivial aspects of a person's application at the expense of its overall quality. Indeed, as he noted, the necessity of making fine distinctions among grants has led reviewers to "look for what's wrong with an application, not for what's right." This takes a high toll in morale among researchers who worry that their grants will lose out because of some minor point. (These issues have led to proposals that NIH institute a new appeals process, which has come up before, but is something for which NIH officials show scant enthusiasm.)

The sheer complexity of the grant application itself is said to inhibit creativity and encourage peer reviewers to nitpick. It is not uncommon for applications to run to 100 pages (Wyngaarden commented that in Great Britain applications often run in the 5 to 10 range) and, according to NIH reports, writing these lengthy applications often takes 3 to 6 months.

Another issue that preys on the minds of eager grant applicants is that peer reviewers take into account not only the scientific merit of the proposal but also cost factors when awarding priority scores that, in theory, are based on merit alone. "Opinions differ on whether it is reasonable for peer reviewers to think about grant scores in terms of available funds. Suggestions for evaluating these criticisms and implementing proposed remedies are now before NIH.—**B.J.C.**

which means one first-time grant, one renewal, and then they are out. At present there are no data about what happens to this group of researchers—no way of knowing whether the competition in the system is forcing good people out prematurely or whether many are simply opting voluntarily to take their careers in other directions, perhaps in teaching or science administration. This 7-year dropout figure, which many advisory committee members found surprising, is something NIH plans to look into further.

An examination of the peer review system and its relation to dissatisfaction with research funding reveals a mix of concerns based partly on data and partly on anecdotal evidence. Solutions are elusive. The one solution that would really work—increasing the amount of money for research to the point that hard choices would not have to be made—is not within reach. It is easy to say that it would be good to increase the length of grants for first-time investigators; easy to agree that senior researchers with a solid track record would benefit from longer awards; and easy to argue rationally that the entire enterprise would be more productive if these changes could be made. But cost stands in the way. Making broad changes in the average length of grants now would take a toll 5 years down the road with consequences that are hard to fully anticipate, although dollar estimates can be made. If, for example, NIH made a policy decision to extend the length of a majority of first-time grants from 3 to 5 years, by the fifth year it would cost an additional $286 million in 1985 dollars to keep the system in equilibrium. What the cost would really be in 1990 dollars is anybody's guess. Whether the benefits would outweigh the costs that would have to be paid elsewhere in the system is not easily agreed upon.

However, while NIH officials contemplate their options for making policy changes across-the-board, individual institutes within the NIH have begun experiments to see whether changes on a modest scale yield discernible benefits.

For example, the National Cancer Institute (NCI) and the National Institute of Neurological and Communicative Disorders and Stroke (NINCDS) have each initiated new grant programs that take special account of an individual's "track record" in making a longer-term award. The NCI is now reviewing the first set of applications for its Outstanding Investigator Grant. Instituted to provide experienced scientists the stability that would accompany a 7-year grant, it is also intended that the stability will enable investigators to risk taking on projects of "unusual potential" or give them the freedom to shift fields.

In addition to being a 7-year award, an Outstanding Investigator grant allows the carry-over of funds from one year to the next, eliminating the artificial pressure that often exists to spend funds during a given fiscal year. It is renewable (on a competitive basis) and carries no age restrictions. It also represents a major procedural departure for NIH in that the NCI reviewers for these applicants will do there business by mail rather than meeting in Washington as a usual peer review panel does. NCI director Vincent T. DeVita, Jr., says that because reviewers will be basing their opinions in large measure on an applicant's overall career, he would rather have them reviewing material "in the quiet of their home studies." This experiment with review by mail somewhat parallels the National Science Foundation's system. About 200 reviewers have been impaneled to consider the 106 initial applications. NCI has set no limit on the number it will award. However, DeVita acknowledges that if many of these special grants are made, it will reduce the number of new grants from the regular grant pool that NCI will be able to fund.

> The cost to the system of extending the average length of grants needs careful consideration because it could limit funds for new grants 5 years from now.

The neurological institute is taking a slightly different tack with a new grant for mid-career investigators that has been named after former Senator Jacob K. Javits. Like the NCI's Outstanding Investigator Grant, the Javits Award is a 7-year grant made on the basis of an individual's overall record of achievement. But it is not something for which one can apply. Rather, it will be bestowed like manna from heaven on researchers who have applied for an ordinary grant but who the NINCDS staff and advisory council decide warrant a 7-year commitment of support. The beauty of it, NINCDS director Murray Goldstein told the advisory committee, is that because no one can apply, no one need feel turned down.

At the National Institute of Child Health and Human Development, a new "Continuation Research Grant" is being developed, again based on a scientist's track record. Under this scheme, a person who has successfully competed for three research grants through normal peer review channels can apply for renewal the fourth time around by providing sufficient evidence of productivity and a brief statement about future research plans, thereby eliminating the 100 page application.

Yet another approach to extending the life of a grant is to have the institute's individual advisory councils, which have final authority over grant approval, simply decide in select cases to turn a peer review approval of a 3-year grant into a 5-year award. This already is done with some frequency in the National Institute of General Medical Sciences, which has a particularly scientifically competent council. It is also being explored now by the council of the National Heart, Lung, and Blood Institute, which has good scientific representation.

Although the advisory councils have the same mandate, because they are politically appointed, some have a greater range of scientific expertise than others. A summary of an NIH staff meeting on peer review politely suggests that those councils that lack the scientific base for making judgments about grants might think about hiring expert consultants.

Concern about grants and the mechanism by which they are awarded seems to be as integral a part of the research enterprise as scientific experimentation itself. The current set of problems and efforts at resolving them are part of a long lineage. When Joshua Lederberg stated emphatically that despite the need for fine-tuning, the peer review system is still the best there is, he spoke for nearly everyone who has ever advised NIH on the subject. And fine-tuning or moderate changes are what the present exercise is all about. Were NIH to suddenly decide to extend the length of grants across-the-board, for instance, it would create perturbations in the long-range health of university research departments that have not even been fully considered.

Even were people to agree it was desirable—which is anything but certain—that money just isn't there. Still, the consensus was that modification and experimentation is in order. As Paul R. Gross, president of the Marine Biological Laboratory at Woods Hole told the committee, changes won't bring new money but they might help morale in ways that are important.

—BARBARA J. CULLITON