NSF Plans Help with Big Computer Problems

New program intended to give university researchers better access to supercomputers that are now out of reach

A $20-million initiative for scientific computing in the new National Science Foundation (NSF) budget would underwrite a revival of an NSF role of the late 1950's and the 1960's. In those years NSF and other federal agencies funded university computers and computing in a style that enabled U.S. researchers to establish a clear lead in scientific computation. In the 1970's, federal agencies drastically reduced such support at the same time that rapid advances in computer technology produced the so-called supercomputer. The result was that many U.S. researchers were cut off from large-scale computing and the kind of research that it makes possible.

Not all university scientists found themselves priced out of the market. The main exceptions have been researchers holding grants and contracts with agencies that bought supercomputers to meet their own research needs, mainly the Department of Defense, Department of Energy (DOE), and National Aeronautics and Space Administration. These agencies make time on supercomputers* available to those of their university clients who can make a case for it (*Science*, 6 May 1983, p. 581). NSF has done the same for one group of its researchers, those in the atmospheric and ocean sciences.

The NSF budget initiative is designed to broaden access to advanced computing facilities for researchers not eligible to tap into the federally subsidized networks. Much of the money in the 1984 NSF budget installment will be used to buy time on existing machines. Because resources are obviously limited—$20 million would scarcely buy two supercomputers. NSF action on more ambitious proposals, such as that to create new supercomputer centers of its own, will be deferred. The delay gives the foundation time to ponder some of the difficult issues that beset scientific computing.

In the 1970's, tensions developed on many campuses between researchers with advanced computing requirements and university computer centers. Development of the minicomputer and, particularly, of the so-called supermini by several computer manufacturers made it feasible for many researchers who had previously relied on mainframe computers in campus computer centers to purchase computers adequate to their needs. Not only did the superminis offer convenience and something of a status symbol but in many cases freed researchers from a resented relationship with the local computer center. A commonly expressed complaint was that the centers overcharged researchers, whose grants included funds for computing, in order to serve faculty and students lacking computer funds.

The widespread commitment to individual computing, however, tended to cut off researchers from the problems which could be handled only on supercomputers. And other factors contributed to limiting access to supercomputers. Agency program officers trying to stretch research funds frequently regarded a paring of funds for computation as a way to reduce the size of individual grants. Principal investigators faced with tight budgets often shifted funds from buying computer time to paying personnel. DOE has probably been the most explicit among agencies about treating computer time as a distinct element in considering grant and contract proposals and in awarding computing time on a competitive basis. In doing so, the agency has bypassed many of the problems that festered in the 1970's.

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A salient question facing the policy planners, of course, is how great the need for access to supercomputers really is. What sort of problems necessitate the very large number of calculations performed very fast which is the supercomputer's forte? A recent report on supercomputers sponsored by the Institute of Electrical and Electronics Engineers noted that industry routinely employs supercomputers in analyses for oil exploration, in aircraft design, and for the design of integrated circuits and computers. In government, a prime use of supercomputers has been in work on nuclear weapons and in research on fusion energy and on climate-oceans interactions. In general, supercomputers are viewed as essential in simulating complex events in nature. Fields in which supercomputers were claimed to be particularly useful were materials research, structural mechanics, chemical engineering, atmospheric sciences, physical oceanography, and theoretical physics.

In drawing a comparison in computational speed between a supercomputer and a widely used supermini, NSF staff at a National Science Board meeting last May estimated that a typical climate simulation would require 30 days on a Digital Equipment Corporation VAX and 30 hours on a Cray-1.

Exponents of NSF's program to increase access to advanced computing facilities stress the effect of a generation of university students and faculty being excluded from state-of-the-art advanced computing. The loss is seen as likely to adversely affect not only research but computer development. Kenneth G. Wilson of Cornell, who won the 1982 Nobel Prize in physics for his theoretical work and phase transcriptions, has been one of the university scientists influential in shaping the NSF effort on advanced computing. In the disciplines where activity in large-scale computing lags, Wilson sees diversion of talent. In such areas he thinks that able students note the weakness and go into other lines of research.

Wilson is sharply critical of what he sees as neglect by U.S. manufacturers of the scientific and engineering computation market. He notes that makers of the widely used minicomputers have not come up with updated product lines for years and that much of the software and hardware available for accessing supercomputers are not ideal for many types of research. He believes that the market as well as the need for products for research is substantial and argues that U.S. manufacturers should come up with a machine with many of the attributes of a supercomputer but which would sell for about a half-million dollars.

NSF has not produced a fully developed plan for advanced computing. The $20 million requested for the coming

*Two U.S. companies, Cray and Control Data Corporation, have dominated the supercomputer market. Recently, the Fujitsu and Hitachi companies in Japan have introduced supercomputers. By some accounts, these are faster and more adaptable than the U.S. models now on the market.

fiscal year represents a substantial increase over the $6 million available this year, but pales against the rough estimates made in a major NSF staff report last year that a total of over $400 million would be required over the next 3 years to deal adequately with the problem.

NSF officials, however, expect to use the $20 million in ways that will increase the agency's "leverage." The portion of the funds earmarked for buying computer time is expected to make the equivalent of one supercomputer available to university researchers next year. The balance of the money will go into what NSF terms local facilities—such things as minicomputers, personal workstations, and even assistance to campus computer centers to help researchers plug into large-scale computing facilities more effectively. In addition, NSF says it will be stressing cost sharing to boost the buying power of its grants, working to improve coordination with other federal agencies concerned about advanced computing, and also promoting cooperation with industry and encouraging donations of funds and equipment from it.

To help fashion a grand design, NSF has formed a blue-ribbon advisory committee for advanced scientific computing. The committee is chaired by Neal F. Lane of Rice University and has a membership, which includes Wilson, of computer knowledgeables from industry, the national laboratories, and universities. After its organizing meeting in late January, the committee issued a statement that put clearly on record its view of the importance of the issue. Setting things in broad perspective, the committee observed that "science is undergoing a structural transition from two broad metholodogies to three, namely from experimental and theoretical science to include the additional category of computational and information science. A comparable example of such change occurred with the development of systematic experimental science at the time of Galileo."

And in a concluding reference to budget considerations, the committee dismissed the projected funding levels as inadequate and boldly asserted that "we believe that computational science and information science should eventually have about equal priority and funding levels with experimental and theoretical science."—JOHN WALSH

Despite Doubts RAC Moving to Widen Role

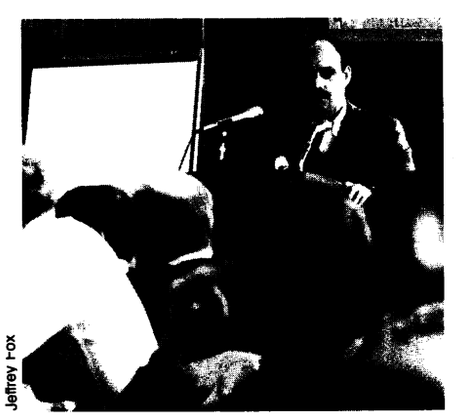
An odd mix of harsh criticism, legal maneuvers, and eulogies gave the latest recombinant DNA meeting a nostalgic air

The recombinant DNA Advisory Committee (RAC) of the National Institutes of Health faces a mixture of supporters and critics that change as fast as the technology it oversees. Their collective clangor during the 6 February meeting conjured memories of circus-like sessions a few years ago.

But something more serious is afoot, as evidenced by who is voicing concerns for RAC's future role. For example, NIH director James B. Wyngaarden has asked the committee to consider more closely limiting its sphere of interest (*Science*, 6 January, p. 35). Representative Albert Gore, Jr. (D–Tenn.), in a recently completed report, suggests that the Environmental Protection Agency should take over NIH's de facto regulatory authority in dealing with many biotechnology issues. And activist Jeremy Rifkin has been barraging RAC with manifestos and legal actions, questioning the committee's legitimacy but also trying to use its offices to slow the pace of biotechnology.

Despite these challenges, RAC not only decided to maintain its current responsibilities but to enlarge its sphere by reviewing proposed genetic engineering experiments in humans. In so doing, RAC took its cue from the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research, which concluded in 1982 that oversight in this field was "desirable" and that an appropriately constituted RAC might fill that need. Concluding that no other national body is dealing with the ethical questions involved, RAC will expand its expertise to review voluntarily submitted proposals on a case-by-case basis.

Most visible among RAC's current critics is Jeremy Rifkin, president of the Foundation on Economic Trends in Washington, D.C. Accompanied by the foundation's attorney, he came before RAC to raise issues ranging from the wording of subheadings in the DNA guidelines to RAC's alleged lack of formal procedures in handling environmental matters under the National Environmental Policy Act. He also charged that RAC members are "personally responsible" for any war crimes arising from use of biological weapons whose development they indirectly abet (see box). Although RAC gave Rifkin many opportunities to voice his opinions and make suggestions, it consistently voted against most of his recommendations.



Jeffrey Fox

Rifkin: a barrage of criticisms

Nonetheless, Rifkin registered at least one important legal victory over RAC. On the day of the meeting, the U.S. Court of Appeals reversed a District Court decision and stopped RAC from discussing a proposal from Advanced Genetics Sciences to release genetically modified bacteria into an agricultural test field. The court said NIH must demonstrate "fully and prospectively" why any portion of the RAC meeting should be closed. (The court ruling was limited to the technical matter of justifying why part of the meeting should be closed.)

The company's proposal is similar to experiments planned by Steven Lindow and his colleagues at the University of California, Berkeley. Lindow's experiments, which are funded by Advanced Genetics Sciences and which seek to protect crops against frost damage using engineered bacteria, have been approved by RAC but were postponed indefinitely by the university after Rifkin threatened legal action to halt them (*Science*, 21 October 1983, p. 309). If the company's