SESSION 1

PRESIDENTIAL ADDRESS

Science, politics, and computers

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This address briefly traces post-1940 U.S. science policy from the science policy agenda set forth by Vannevar Bush in 1945 through the recent congressional task force on science policy. Although there are many factors influencing science policy, the focus here is on presidential influence. The effects of U.S. science policy on science are traced by looking at funding patterns in general, as well as at those for behavioral science. The influence of politics on the ability of scientists to freely communicate scientific information is examined. Finally, the role of politics in scientists' access to computing resources is explored. Presented here is a side of science not often seen by those at the bench.

I have just returned from a long journey from the ivory tower at the second oldest university in the United States to Capitol Hill in Washington, D.C., and back. My four years in Washington (as Executive Director of the Federation of Psychological, Behavioral, and Cognitive Sciences) taught me much about our nation's science policy, and this knowledge serves as a basis for this paper. I begin with a look at the history of U.S. national science policy, followed by an examination of the pattern of federal support for science. Then I address three specific science policy issues: funding for behavioral science, scientific communication, and computing resources.

SCIENCE POLICY

Vannevar Bush

The first and most well-known discussion of federal science policy, *Science—The Endless Frontier*, was written by Vannevar Bush in 1945. This essay was based on the work of several committees assembled by Bush to answer specific questions put forth by President Franklin D. Roosevelt. Bush had persuaded Roosevelt in 1940 that the national defense effort would be enhanced by adequately funding basic research at universities. After the war, few needed convincing that he was right. In his science policy essay, Bush presented many of the arguments still used today for the support of federal funding of basic science.

Bush (1945) argued that science was indispensable to our nation's military and economic security. He also stated that basic research was important to the war against disease and for the welfare of the public. Let me quote: "Progress in the war against disease results from discoveries in remote and unexpected fields of medicine and the

underlying sciences" (p. 9), and "More and better scientific research is essential to the achievement of our goal of full employment" (p. 13). He insisted that federal funding of basic science should be substantial, available on a continuous basis, and at a stable amount. He worried about the supply of trained scientists, noting that such training was a "long and expensive process" (p. 3), and wanted the federal government to encourage larger numbers of men and women to look at careers in science by providing funds for graduate education. He believed that scientists should control the distribution of federal funding. He emphasized the importance of "free intellects, working on subjects of their own choice, in the manner dictated by their curiosity" (p. 7). He stated clearly that scientists should participate with government leaders in the shaping of our national research and development policy.

Although Bush (1945) felt that government laboratories had an important role to play in applied research, he encouraged funding of scientists at universities, where basic research could "furnish both the new scientific knowledge and the trained research workers" (p. 14). He was worried about the cloak of secrecy that had covered government-funded research during World War II. He called for the immediate removal of security restrictions, broad dissemination of scientific information, and policies that would encourage publication of scientific material. In addition, in a note of warning, Bush said "it would be folly" to enhance research funding in natural and medical sciences "at the cost of the social sciences, humanities and other studies so essential to national well being" (p. 18). Through careful reading of Bush, one discovers other flags to wave as well: the promotion of industrial research through tax deductions, exchange of scientific information internationally, and removal of economic barriers to higher education.

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Science Policy Through the Years

Beginning with George Washington, many presidents have expressed interest in science. Jefferson is well known for his interest in science and for his inventions. But as in more recent times, interest in basic science has waxed and waned (see Katz, 1978, for a brief summary). Federal funding for science before 1940 was sparse, usually nonexistent. Greenberg (1967) wrote, "Against the contemporary background, it may be difficult to realize that prior to 1940, not only was there mutual aloofness between the federal government and . . . the scientific community, but there were strong feelings on both sides that the separation was desirable" (p. 51). World War II was a major turning point in federal funding for scientific research.

Though each administration since Roosevelt's has had at some level a national science policy, none has been so clearly stated as Bush's (1945) views. Often the policy takes the form of federal regulation, which may have been developed without specific consideration of the ramifications for science. Federal funding levels are a clear manifestation of science policy and are discussed below. (For a concise history of science policy from 1945 to 1983, see Dickson, 1984; a longer tale is told by Katz, 1978.)

Federally funded science after World War II was dominated by defense research, with the Office of Naval Research (ONR) providing basic research grants and graduate fellowships following the Bush model. The first attempt to establish the National Science Foundation (NSF) ended in 1947 with a presidential veto because Truman insisted that the NSF could not be "divorced from control by the people" (Greenberg, 1967, p. 121). Although poorly funded at first—\$225,000—the NSF was founded in 1950. Dickson (1984) suggested that the second NSF bill was not vetoed because Truman's attention was drawn to the Korean War, but it was the cost of the Korean War that members of the House of Representatives pointed to when they told NSF officials that funds and manpower were not available.

Budget reduction was not a priority for the Eisenhower administration, and increases in the federal commitment to scientific research funding were not consistent with this priority. Efforts were made (Executive Order 10521) to increase research coordination among various federal agencies, which the administration hoped would reduce duplication and increase efficiency (Averch, 1985). The Russians' launch of Sputnik brought about many changes. A new post, that of special assistant to the president for science and technology, was established. Federal commitment to civilian research dramatically increased. Fears of Russian domination of science increased federal support for science education as well. I found it interesting that at the end of his presidency, Eisenhower expressed deep concern over the dominance of the military in science (Kistiakowsky, 1976).

The relationship between President Kennedy and science has been called a "love affair" (Dickson, 1984).

Kennedy showed a curiosity about science and publicly supported the goals of unencumbered basic research. It was a time when scientists were highly respected—even venerated—by Congress as well as the White House. In 1961, *Time* magazine named 15 scientists as its group "Man of the Year."

But the times became less favorable when Lyndon Johnson became president. Johnson was determined to launch his Great Society and wanted research tied to societal needs. He outwardly questioned the value of spending more and more on science. He demanded a direct payoff. A White House press release stated: "A great deal of basic research has been done. . . . The time has now come to zero in on targets by trying to get our knowledge applied" (cited in Dickson, 1984, p. 29).

The Nixon years saw the continuation of this unfavorable atmosphere, with continued emphasis on the role of science in solving societal problems. Even the process of advising the president on science was abandoned by Nixon in 1973.

Although Ford may not have had a natural curiosity about science, he had served on several committees concerned with research and development, which gave him both knowledge and interest. Early in his presidency, Ford appointed a science advisor. According to Katz (1978), "the Ford administration also represents a major first step in the codification of federal rationale and presidential plans for science policy" (p. 222).

Carter's background in engineering enhanced his understanding of research and development issues. Scientists were clearly favored once again. A strong federal commitment to the support of basic research, especially to meet the needs of corporations searching for their futures in high technology, was bolstered.

The Reagan years have been quite favorable to science in general, although, as I discuss below, this favorable view has been differentially applied to various federal agencies and scientific disciplines. Although a historical view is often informative, the present and future at least seem most tantamount; therefore, I will expand my comments on the current administration.

The Reagan Administration and Science

George Keyworth, science advisor to Reagan from 1981 to 1985, stated the Reagan administration's national science priorities before the American Association for the Advancement of Science's annual Colloquium on R&D Policy in 1984 (Keyworth, 1984). He argued that funding of basic science by the federal government was appropriate because it would facilitate the training of new scientists, challenge intellectual frontiers, and stimulate new technologies. In addition, he acknowledged that the role of the federal government is important not only because research involves a long-term investment but because the benefits are "so broadly distributed" (p. 9). He further argued that new scientific knowledge "drives economic growth, improves the quality of life and underlies our national defense" (p. 9). He set as his priorities

(1) the development of new scientific talent; (2) the pursuit of excellence; (3) partnerships among researchers in universities, federal laboratories, and industry; (4) encouragement of "leapfrog technologies"; and (5) ensuring consistent federal funding. The focus has changed only slightly since Keyworth's address. The watchword in Washington in 1987 was clearly "competitiveness."

Fuqua's Science Policy Task Force

Two years before leaving the House of Representatives, Congressman Don Fuqua (Democrat, Florida), initiated a task force to study our national science policy and make recommendations for the future. The agenda set forth was comprehensive (62 pages). The goals of the task force were to examine the "goals and objectives [set forth in Bush, 1945], the assumptions underlying them, and how well they are being achieved" (Task Force on Science Policy, 1985a, p. 7). Fuqua prefaced a hearing in June of 1985 by saying, "The tradition of leaving priority setting within science to science is just that, a tradition" (Task Force on Science Policy, 1985b, p. 1). Clearly, no stone was to be left unturned.

The agenda was organized around 10 issues, including goals of federal science policy (e.g., history of science and policy, payoff from scientific research, accountability in research), institutional framework (e.g., role of universities, government laboratories or industry, big vs. little science), manpower, and funding levels and mechanisms (including peer review)—quite an ambitious undertaking. Questions were addressed through a series of Congressional hearings and numerous commissioned reports. Although the final report has not appeared at this writing, hearing records and commissioned papers are available, and Fuqua's (1986) remarks on leaving Congress reflect much of the task force's deliberation. Although its discussion of the peer system of reviewing research proposals and its emphasis on geographical distribution of research funds may bring fear and trembling to the hearts of many, most will find comfort in the task force's strong support for stable funding of basic research, improving university facilities, and unhampered communication between scientists.

HISTORY OF SCIENCE FUNDING

There are many influences on the federal budget and on science funding. The president can set the tone, but there are many other important players, such as the director of the Office of Management and Budget, the staffs of agencies, and members of Congress. And, of course, scientists and scientific organizations have played wide and varied roles, but that is another story. Other pressures on the budget, such as war, inflation, or large deficits, can limit spending. The issues are obviously more complicated than can be presented in one paper.

Information about science funding prior to 1950 is not well documented (see Katz, 1978). Some statistics on fed-

Figure 1. Federal obligations for research and development. (Based on data from National Science Foundation, 1985, pp. 222, 223, 224)

eral funding for years prior to 1960 exist, but comprehensive statistics are not readily available prior to 1967.

Despite Eisenhower's desire to contain the federal budget, increases in research and development (R&D) funding rose steadily. For example, between 1945 and 1955, research funding rose from \$920 million to \$3.45 billion, with 80% of all federal R&D funds going to the Department of Defense (DOD), 2% to the Department of Health, Education and Welfare, and .1% to NSF. The Russians' launch of the Sputnik satellite stimulated increased spending for basic research (more than doubling the NSF budget in one year) and science education and the creation of the National Aeronautics and Space Administration (NASA) (Dickson, 1984).

One can clearly see the attitudes toward science discussed above in the overall level of funding, in inflation-adjusted (constant) dollars, for R&D since 1960, displayed in Figure 1. Development funding was increasing steadily through the early years of the Vietnam conflict, then dropped below the 1960 level in 1975 (in constant dollars). Expenditures for basic research reached a peak in 1969 and then fell in real terms, not returning to that level until 1978. Both basic and applied research, which were down below 1960s levels in the early 1970s, began to increase under Ford and Carter. Applied research is much

Figure 2. Federal research and development authority for defense and nondefense. (Based on data from National Science Foundation, 1985, p. 226)

Figure 3. Federal obligations for basic research by selected agencies. (Based on data from National Science Foundation, 1985, p. 228)

Figure 4. Federal obligations for basic research to college and university performers by selected agencies. (Based on data from National Science Foundation, 1985, p. 281)

less popular today, although support of the development part of R&D has been unprecedented. Between 1980 and 1985, obligations increased by 27% for basic research, decreased by about 9% for applied research, and increased by 34% for development (National Science Foundation, 1985). Because of the Reagan administration's emphasis on "privatization," several incentives were implemented to boost industry R&D.

Attitudes toward science influence not only the total number of dollars spent, but how they are allocated among agencies and research fields. Defense and nondefense budget authority for R&D are contrasted in Figure 2. During the Johnson era, with his emphasis on solving civilian problems, nondefense spending was at an all-time high. In recent years defense spending has dominated the picture. In 1984, 66% of R&D funds went to defense, 11% to health, 6% to space, and 5% to energy.

In expenditures for basic research, the National Institutes of Health (NIH) have been the leaders, in terms of both budget size and increases, as shown in Figure 3. In terms of constant dollars, NIH's basic research budget has doubled between 1967 and 1984. Although NSF's budget for basic research doubled (in constant dollars) be-

tween 1970 and 1985, the 1985 budget is only 30% greater than its 1967 budget.

This audience is most likely more interested in the ebb and flow of basic research funds to colleges and universities (see Figure 4). Except for a few lean years in the early 1970s, federal support of university-based basic research has been stable, increasing recently (in constant dollars). The picture for NIH funding of university research is much the same as cited above: doubling, in constant dollars, between 1967 and 1984. About 50% of the funds going to universities for basic research are from NIH (steadily increasing from 33% in 1967). NSF funded a slightly bigger share of university-based basic research in the mid-1970s, and currently funds about 25%. Although DOD was a major purchaser of such research in the 1950s and 1960s, DOD currently funds (and has for many years) about 11% of all federally funded university-based basic research.

Attitudes, perceived national needs, and a variety of other factors influence federal funding of research. Let us look specifically at funding for behavioral science in recent years.

FUNDING PATTERNS FOR BEHAVIORAL SCIENCE

Between 1959, the first year NSF separated out funding information for psychological sciences, and 1965, funding for basic research increased by an average of 25% per year in constant dollars. However, beginning in 1966, funding was stabilized in real dollars, although buying power was reduced by rising inflation (see Figure 5). In constant dollars, funds spent on basic research in the behavioral sciences in 1976 were about the same as in 1962, and returned to that level in 1985. While the total federal basic research funding in constant dollars did not change, psychology lost about 9%. Figure 6 displays funds for basic research going to colleges and universities. The now

Figure 5. Federal obligations for basic research by selected disciplines. (Based on data from National Science Foundation, 1985, pp. 249-250)

Figure 6. Federal obligations for basic research to college and university performers by selected disciplines. (Based on data from National Science Foundation, Division of Science Resources Studies, personal communication, January 11, 1988)

infamous 1982 reductions in funding for psychology are reflected here—a drop of 23% between 1980 and 1982 in constant dollars. Had it not been for a few friends in Congress and the efforts of many scientists and scientific organizations, this administration's wish of "squashing" the behavioral and social sciences would have had an even more critical effect.

To most it seemed that the bottom had fallen out. But this is not the whole story (see Figure 7). NSF budgets for basic behavioral science research dropped (in constant dollars) by about 45% between 1980 and 1982. Navy funding increased by nearly 38% at the same time, while funding for the Alcohol, Drug Abuse and Mental Health Administration (ADAMHA) was down by 31% and for NIH by 14%. However, by 1985, basic research funding for behavioral sciences at universities was up 9%, in constant dollars, over 1980. NSF was still below 1980 levels, ADAMHA and NIH had recovered, and DOD was up well over 50%.

Figure 7. Federal obligations for basic research in psychological sciences to college and university performers by selected agencies. (Based on data from National Science Foundation, Division of Science Resources Studies, personal communication, January 11, 1988)

If we dig a bit deeper we discover that the funding of certain areas of psychology changed as well. For example, it has become extremely difficult to fund much of social psychology. ADAMHA has shifted its emphasis away from social aspects of behavior (although, with the AIDS epidemic, it is becoming interested once more), and the ONR is no longer seeking proposals in this area. Some opportunities may be opening for a few researchers at NIH, but mainly only NSF remains a source of funding for social psychologists. Funds for research in cognitive psychology and cognitive science are available almost everywhere. The Air Force Office of Scientific Research has started a new program, and other programs are expanding. As in the past, the priorities of a variety of players in science policy have changed the funding of science.

SCIENTIFIC COMMUNICATION

My first official meeting in Washington was with the Federation's Forum on Research Management. The evening's speaker from the DOD discussed policies relating to the presentation or publication of results from DOD-supported research. He carefully explored the problem of foreign access to sensitive research. "Sensitive," although difficult to define, was beginning to apply to many areas of research. It was clear that this had become an important science policy issue.

Let me briefly explain the background (see Wallerstein, 1984). With the growth of new technologies for national security came concerns that our nation's open research community could become a source of critical knowledge for the Warsaw Pact nations. There are many sides to this issue. Those concerned with maintaining our national security fear loss of military advantage. Many see the economic disadvantages to us of other countries' being able to profit from our R&D without the expense. Members of the scientific community argue that free exchange of scientific information speeds discovery, eliminates errors and duplication, and allows for evaluation. They point out that secrecy will only slow down our technical advances. Others point out that limiting access to information will cut our access to research results from other countries, an important source of knowledge. Because it is nearly impossible to separate research and training, secrecy can only hinder education. But on the other hand, how much are we giving away through our foreign students? Of course, industry has its own security issues, but must have access to scientific and technological information to adapt to the marketplace.

The National Research Council established a panel, chaired by Dale E. Corson, president emeritus of Cornell University, to review evidence on the loss of technical information, to examine the current methods for controlling loss, and to suggest a national policy to meet the needs of science and national security. After extensive briefing, the panel concluded that American university

sites were targets of foreign intelligence efforts, but found little evidence of damage from leaks of scientific information.

Aside from the obvious method of making certain research classified, other controls have been used to limit access to scientific information, such as the Export Control Act; the Arms Export Control Act, with its International Traffic in Arms Regulations; and the Export Administration Act. The DOD, for example, has forced the withdrawal of papers developed under DOD contracts from scientific meetings. Note that when access is limited, the category "foreign nationals" usually includes all other nations.

This issue is not limited to research on weapons or cryptography. The Corson panel reported that in the period 1979 through 1983, the DOD imposed restrictions on 4% of reports coming from universities, or about 900 of 23,000 reports. Of the total of about 10,500 reports (from all research institutions, not just universities) categorized as behavioral or social sciences, 20% were subject to restrictions. Concerns clearly revolve around sensitive military research, but should research that might be sensitive because of its economic potential be controlled as well?

The Corson panel acknowledged the existence of a gray area, those so-called sensitive research areas—unclassified research that warrants dissemination restraints. They stated a very specific list of criteria and recommended that controls be made explicit in the research contract (see Wallerstein, 1984).

The government delayed responding to this report with explicit plans, although information about the process and some of the alternatives considered had many in Washington watching closely. With information that the DOD's sensitive list was to be a comprehensive and long one, fears of loss of control of the communication of scientific results abounded. At the Forum on Research Management meeting mentioned above, we were told that areas such as robotics were on the list. It was not clear whether the list could or would be limited by the government.

The hearings I attended in Washington that concerned science were not media events like Watergate, Irangate, or recent Supreme Court confirmation hearings (except perhaps, for the day Poindexter pleaded the Fifth Amendment in a hearing on security controls for databases, but that, too, is another story), but I remember one particular hearing. The topic was the control of scientific information. The first panel was made up of scientists, including Corson. They talked eloquently of the need for free communication for the health of U.S. scientific enterprises. They iterated their concerns, especially about the DOD's intentions to further limit communication, always emphasizing basic research at universities. (The DOD's plans seemed to be an open secret.) Then a panel of representatives from industry echoed the scientists' concerns.

The final panel included Edith Martin, then Assistant Undersecretary for Research and Development at the DOD. During the presentations of the first two panels,

Martin and her colleagues from the DOD passed back and forth papers covered in red felt-tip pen. Several times one of her assistants left the hearing to go to an anteroom where there was a phone. Sitting two rows behind them, I watched as these sheets of paper moved back and forth as changes were made.

The hearing dragged on as there were interruptions for votes on the floor of the House of Representatives. It was clear from the questions and comments that the members of Congress were sympathetic with the needs of basic science for open communication and were ready to take the DOD to task. I am sure many wondered, as I did, how the DOD could support its position against this back-drop. The answer became clear when Martin began to speak. She read a new policy from those papers written in red, and not her distributed text. In a brief statement, she said that the DOD had a policy that would not limit the communication of basic research funded by the DOD at colleges and universities. Doug Walgren (Democrat, Pennsylvania), who chaired this hearing, looked down at the questions he and his staff had carefully prepared for Martin. None applied. Walgren inquired as to how long the policy had been in effect; it was clear that it had been finished while the hearing was in progress that morning. The incident was later described by some as a "bomblet."

Although it took quite a while, the DOD released in the Federal Register, February 12, 1986, its new policy regarding the communication of research results. The policy was consistent with Martin's statement: Basic research at universities would not be controlled. If there were to be contract limitations, presubmission reviews of papers would be done within fixed, limited time periods. But security issues for science have not ended; issues such as access to computerized databases and supercomputers are in our future.

COMPUTING RESOURCES

It is clear that the advances in computers over the last 40 years have changed how we do science, and for psychology the computer has served as a metaphor for certain cognitive processes. Let me spend a bit of time discussing how politics has enhanced our access to computational resources.

In the 1950s and 1960s, NSF provided substantial funding to colleges and universities for state-of-the-art college-wide computational facilities. Such support dropped dramatically in the 1970s. One factor was the general shrinking in research resources as science lost favor; another was the use of laboratory computers, often supported by research grants. According to Lax (1982), this reduction of support limited the access of scientists to needed large-scale computing. The argument that researchers needed bigger and better computers was warmly received by Congress and the Reagan administration.

On the 14th of April in 1982, Japan announced its Fifth Generation computer project, and, as we had at the launch of Sputnik before it, we feared losing our leading posi-

tion. The Fifth Generation project promised to develop within 10 years a computer that would be three orders of magnitude faster than the current supercomputer technology, use a natural language interface, use knowledge-based software, and include inference and pattern recognition capabilities.

The Defense Advanced Research Projects Agency (DARPA) responded with a \$600 million plan to develop advanced computer technology. A special panel called to advise the National Science Board said that NSF should spend \$500 million over three years to improve computing resources on campuses. The panel report stated that U.S. leadership in supercomputing was "seriously undermined by the lack of broad scale exploration . . . and a slowdown in the introduction of new generations of supercomputers" (Lax, 1982, p. 4). Congress listened. The House Energy Subcommittees of the Committee on Science and Technology held hearings in November of 1983. In his opening remarks Congressman Fuqua stated, "To date . . . federal funding agencies have done little to help universities either extend their resources or acquire access to existing [advanced computer] resources" (Committee on Science and Technology, 1983, p. 1). Witness after witness reiterated the needs. Fierce economic as well as scientific competition was cited.

Edith Martin of the DOD talked of "Star Wars" as one probable use for advanced computing technology. She talked of highly parallel computer architectures in the future. In addition, she clearly recognized that access would not solve all problems without extensive software development. George Keyworth talked of meeting national security needs and responding to the Japanese challenge. Speaker after speaker described the lack of access, funding, software, networks, and trained computer scientists.

Curtis (1983), in a report of the NSF Working Group on Computers for Research, stated that "there is unanimous agreement that important science is not being done in this country due to lack of access to adequate supercomputer capacity" (p. 16), and ventured that there was an urgent need for two supercomputers and as many as ten would be "required to have any impact on the total unmet need" (p. 16).

These presentations caught the imagination of Congress. This fit well with the Reagan administration's goals of stimulating new technology, meeting economic challenges, and improving our national defense. Although Congress, under budgetary constraints, could not appropriate money at the suggested levels, many agencies could get into the act. NSF began with a \$20 million initiative, buying access for numerous scientists to already existing facilities and planning to support several national centers on university campuses. DARPA was providing access to current supercomputer technology while encouraging the development of newer machines. NASA and the Department of Energy already had Class VI machines that their researchers could access.

In 1984, Bert Green and I organized a conference sponsored by NSF to explore the use of advanced computing

by psychologists. The results of this conference were the basis of this society's first symposium on supercomputing (Green, Null, Furnas, Hagen, & Rumelhart, 1985). As scientists at the conference talked of their computing needs, it was clear that some needed Class VI supercomputer power, but others needed machines of this size specializing in symbol processing and others were looking toward parallel architectures. At the time, NSF was looking only at providing access to current supercomputer technology. Until I attended a similar conference for biologists, I was under the impression that psychologists were the only ones with other needs. I soon discovered there were scientists from a variety of disciplines wanting (needing) supercomputational power, but from other architectures. At the time, we put great emphasis on high bandwidth networking and software. NSF, although a bit slower than some had hoped, is building a national network.

NSF is now entrenched in five centers that it has promised to keep state-of-the-art. When NSF's commitment draws to a close, there will be plenty of Congressional pressure on NSF to continue support—members of Congress work hard for the benefit of their constituents. The supercomputer facilities, where NSF bought time for the first couple of years of this initiative, are gathering Congressional support for continued funding as well. It will be very difficult to maintain these computing centers at the promised state-of-the-art level when advances are coming along faster than anyone could have predicted in 1983. As costs decrease or as other architectures are developed, I believe the need for national centers will decrease. Near supercomputers are available at reasonable cost. A recent advertisement suggested that supercomputing had moved to a new level—departmental—with the introduction of a compact, faster than its mainframe brother (CRAY-2), for under \$1 million. It is clear that my department will not have \$1 million to spend on a computer, but some will.

Captivating arguments about the need for access as the Japanese were challenging our computational superiority piqued the interest of Congress and enhanced the federal government's role in supporting advanced computing. In his farewell to Congress, Fuqua (1986) devoted several pages to computing, ending by saying: "Today's supercomputers will help us travel those inaccessible avenues [complex scientific problems not yet tackled]. Tomorrow's machines may well bring us to presently unimagined terrain" (p. 93).

CONCLUSION

I have attempted, by tracing a bit of the history of science policy and funding in this country and by highlighting three specific science policy issues, to show you a side of science not often seen from the vantage point of a university bench scientist. Fuqua argued that although scientists often see Congressional decisions about science as influenced by what are called "narrow political con-

siderations," members of Congress believe these considerations are an integral part of their jobs. He suggested that "the issue before us is really . . . how decisions involving both science and politics are made" (Task Force on Science Policy, 1985b, p. 2). My experience in Washington leads me to say that this is the current reality.

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