Reelected to lead Academy, Press talks about science issues

As the only candidate for president of the National Academy of Sciences, Frank Press was reelected last January to a second six-year term by a majority of members responding by mail ballot. Though his new term officially starts 1 July, for all practical purposes it begins with his address on the state of US science, to be given at the Academy's annual meeting in Washington, 26–29 April.

By custom the Academy's president also serves as chairman of the National Research Council, which functions on behalf of the Academies of Science and Engineering and the Institute of Medicine. Unlike academies in some other countries, the US Academies have no research laboratories or institutes of their own. Instead, the Research Council conducts studies of critical national issues with scientific or technical components, usually at the request of the government and increasingly on its own when the government is indifferent, indecisive or intransigent to the problems.

Over the past 12 months the Research Council organized about 800 committees, on which nearly 8000 scientists, engineers, physicians and other specialists served as unpaid volunteers, sometimes for as long as a year or two. The study panels have recently issued reports and recommendations on a wide variety of disturbing subjects in which government has a major stake, including nuclear plant safety, space science, AIDS, acid rain, export controls on high-technology items and the physical, environmental and medical implications of "nuclear winter."

Mount Press. Born in Brooklyn, New York, in 1924, Press received his PhD in geophysics from Columbia University, where I. I. Rabi's influence, he once said, was "really special." Press has taught generations of geophysicists at Columbia, Caltech and MIT. He was elected to membership in the Academy in 1958 for his original contributions to understanding planetary interiors and the Earth's crust and mantle. He is proud of being codiscoverer of the free oscillation of the Earth and having been among the principal organizers of the International Geophysical Year, 1957–58. As a tribute to his efforts for the IGY and his research in geophysics, a landmark in Antarctica was named Mount Press for him.

His work in seismology, notably in earthquake-producing mechanisms and elastic-wave propagation, proved fundamental in advancing the US capability to detect underground nuclear explosions. This turned out to be critical to President Kennedy's decision to sign the nuclear test ban treaty in 1963.

While Kennedy was in the White House and during the early years of the Johnson Administration, Press served on the President's Science Advisory Committee. President Nixon appointed him to the National Science Board in 1970 and in the Ford Administration Press was a member of two committees, headed respectively by Simon Ramo and William O. Baker, that proposed giving statutory authority for a White House Office of Science and Technology Policy. Ironically, within months after the National Science Act was passed, Press became OSTP's first director, appointed by President Carter. With that post goes the unofficial title of science adviser to the President.

In an examination of Carter's domestic policy staff, completed in 1984, Walter Williams, a political scientist at the University of Washington, found that "Press's White House peers saw him exactly as he presented himself—that is, as a scientist, not as a politician." While other heads of analytical offices at the White House came in for criticism, wrote Williams, Press alone emerges unscathed from the recollections of Carter aides.

Competence. According to Stuart Eizenstat, who worked on the Kennedy and Carter White House staffs, Press was "possibly the most effective Presidential science adviser—even more so than Jerry Wiesner, because Frank involved himself in a whole range of issues, from acid rain and arms control to mineral resources and space studies, while Wiesner concentrated on the nuclear test ban issue." In his experience, Eizenstat told PHYSICS TODAY, "Science advisers tend to be fifth wheels around the White House, largely out of the mainstream of political problems. The fact that President Carter was an engineer with some scientific background undoubtedly enabled Frank to have a greater voice amid all the factions at the White House. Frank spoke with a quiet assurance and earned respect because of his competence."

BACHRACH

PRESS

Some around the Carter White House, however, argue that Press never gained the complete confidence of the President's inner circle. "He didn't get along with the aw-shucks, downhome know-it-alls from Georgia who surrounded the President," says a government staffer who then held an executive office job.

After his election as Academy president in 1981, one of Press's first acts was to hold a convocation of some 100 academic and industrial scientists, di-

0031-9228 / 87 / 0400 47- 06 / $01.00

rectors of national laboratories and government policymakers to discuss the actual and proposed cuts in Federal R&D funding by the Reagan Administration (PHYSICS TODAY, December 1981, page 47). The scientific community's litany of woes from the Administration's announced intention to reduce government R&D budgets by 12% angered at least one participant, George A. Keyworth II, the President's newly appointed science adviser. Keyworth said he found the meeting "confrontational and self-centered." Though there were initial fears that the complaints had "fallen on deaf ears" and "might make matters go from bad to worse," since then the Administration's record of increasing support for R&D and, especially, basic research attests to the good sense of calling the convocation.

Brouhaha. Unlike his Academy predecessor, Philip Handler, who often used his office as a "bully pulpit" and was therefore considered an irrepressible witness before Congress, Press is low-key, soft-spoken and self-effacing. In the past year, though, Press has appeared on Capitol Hill more frequently, expressing his own views on science and technology.

Handler's presidency was characterized by several controversies at the Research Council. In one, a 1979 study of radioactive waste disposal, the Academy withdrew the report in its final draft when the Department of Energy and an independent laboratory under contract to DOE objected to its publication on the grounds that it contained errors. The first six years of Press's presidency had almost no such problems. The worst one involved the tenth edition of *Recommended Dietary Allowances*, which a review committee refused to approve. After heated arguments between the study group and review panel, Press stopped the brouhaha by refusing to issue the report.

In fairness to Handler, some of the Academy's controversies occurred because many academic scientists opposed the Vietnam War and viewed most military matters with suspicion or downright abhorrence. It was also a time when environmental issues brought together many scientific and political problems. By contrast, the last six years have seen few bitter scientific battles. The Academy has not examined many military topics, avoiding the scientific debate over the Strategic Defense Initiative, for instance, while the environmental front has been relatively quiet.

Like Handler before him, Press reorganized the Research Council. Where Handler formed four major disciplinary groupings called "assemblies," including the Assembly of Mathematics and Physical Sciences, Press made the lines of demarcation clearer by regrouping the fields into "commissions" and remaking certain special purpose units into "offices" and "boards." There is now a Commission on Physical Sciences, Mathematics and Resources. He also instituted the Government–University–Industry Roundtable and Academy Forum, which have concentrated on the kinds of science and public policy issues that the Academy once shunned.

In the history of support of basic science over the past few decades, the Reagan years may rank first—or certainly near the top.

'Granddaddy.' The cost of the Research Council's program activities amounted to nearly $75 million the year Press was first elected, 1981. By 1986, the budget had reached $103 million, two-thirds of which came from government contracts. During fiscal 1987, which begins in June, the Research Council budget is likely to hit $110 million. The proportion of nongovernment funds for projects continues to increase in the Press era. The Academy's experience, prestige and credibility are the hallmarks that make it, as Ralph Nader calls it, "the granddaddy of all think tanks in America."

In an interview with Press in his Academy office on 20 February, PHYSICS TODAY's Irwin Goodwin asked about the work of the Research Council and the views of its leader. Excerpts follow:

Q. What do you see as your principal accomplishments in the past six years?

A. Consistent with our traditional interest in maintaining the health of American science, we have made a number of effective studies in several disciplines—astronomy, chemistry, physics, mathematics, materials facilities. These have had an impact in terms of government support for the best ideas and the best people in those disciplines. In addition, we've helped individual agencies function better by reviewing their plans, the way they allocate resources and their priorities. This work is, of course, what the Academy charter calls for us to do. In terms of support for the American people I think our reports, such as our recent ones on AIDS and technology transfer, are making an important mark on government policies and public awareness.

Some of our studies have been made possible by the growth of independent funds at the Academy—funds subscribed by industry, by philanthropic foundations and by individuals. This enables us to select topics that we think are important, independent of government support or interest. We don't want to change our traditional relationship as a friend of government, but we feel that our public service to the government and the American people is enhanced by these self-determined, self-sufficient projects. We have undertaken such studies for many reasons—for instance, when government officials have said, "We can't examine that issue; it's too hot politically" or "It's a concern that's too long range for us to care about right now because we view things in Washington at short range." So we will take on such an issue with nongovernment funds. In this way we can be more effective in examining broad, controversial questions about such global and national issues as the "nuclear winter" theory or government controls on exports. That's how we can best use our independent funds.

Q. Do private funds enable you to do more policy studies, some of which may be antithetical to government programs? Do they give you far more independence to do the kinds of studies you might not be able to do otherwise?

A. I wouldn't call it antithetical to the government. I would say it enables us to do things that the government is not ready for, that are too far ahead for the government's immediate concern. Government people have to know what to do tomorrow and the next day. And also those issues that for one reason or another may have some political sensitivities—the development of a national strategy for AIDS, for instance, or the export of advanced technology with possible dual commercial and military uses [to the Soviet bloc], the problems arising with the increase of nursing homes and their regulation, the dilemma of adolescent pregnancy or the exchange of scientists with the Soviet Union and China and other countries. For one reason or another, in a cyclical way, the government becomes intensely interested in these matters, then loses interest. Private funds give us a way of providing a stable, farsighted approach to these issues, which, in the long run, the government has to be concerned about.

Q. The Corson report and, more recently, the Allen report, dealing with government controls on sensitive scientific knowledge in one case and on high-

technology exports to Warsaw Pact countries in the other, have raised hackles in some government circles, particularly at the Pentagon. Would you have been able to do these studies without a variety of funding sources?

A. No, we couldn't have, because intensive staff work by our best people is needed to prepare the panel for its examination of those kinds of topics. Those are very good examples of reports that make deep impressions on high government policies and find responsive chords within government agencies. The reports are often used in interagency discussions. Many of the findings in those particular reports became ascendant and were adopted by the Administration. We're pleased with that outcome. What we had in both of those cases were balanced, sensible blue-ribbon panels that nobody could accuse of being soft on the nation's security or ignorant of the need to maintain the nation's scientific and economic strengths.

Q. What's been the reaction among members of the Academy to reports of that nature? Has there been support from Academy members?

A. I meet each year at half a dozen regional meetings in different parts of the country with members of the Academy—this is separate from the annual meeting—where the question you just posed is the very first question I raise with them. "This is what we've done this year. Are you comfortable with what we've done? Do you think we had an impact? Do these issues make you nervous? Do you support studies of those issues?" I find that I take their advice very seriously because the members are the core of the Academy's credibility. By and large I find support for what we've done.

Q. Is there a closer relationship among scientists in the world today? Or is there more rivalry because international competitiveness and government concerns with that topic now tend to make scientists more aware of national, parochial interests?

A. A number of foreign scientists visiting here have expressed concern that for reasons of either national security or economic competition, walls are gradually being built around American science, preventing international access. I would say that the American scientific community, those who do the work, are against this, because any working scientist will tell you that he builds on the concepts and findings of scientists everywhere in the world by reading the journals and discussing the research. American scientific progress is not based solely on the ideas of Americans. If we were to erect barriers to the exchange and communication of research, we would be damaging American science and not protecting American interests. There are some in government who believe otherwise for one reason or another, but I'm pleased to say that by and large good sense has prevailed. Up to now we have not experienced restrictions that would damage American science.

Q. Does the greater influence of the Defense Department in supporting scientific work, as in, say, the Strategic Defense Initiative, create a threat to the independence and possibly the integrity of basic science?

A. I haven't seen it as yet. By and large, the core of American science is still free, unfettered and able to communicate. It's a matter of vigilance on everybody's part because there are those—mostly non-scientists in the government who don't understand the nature of the scientific process—who think in terms of protecting intellectual ideas, especially in science and technology. We're fortunate that we have been able to make our case in public, as in the reports by the Corson and Allen panels. Science remains unregulated.

Q. Did our withdrawal from UNESCO at the end of 1984 create any inherent problems for science in the global sense or for the freedom to practice science across borders?

A. Our withdrawal from UNESCO was a decision based upon the financial situation at UNESCO, and equally, if not more important, its politicization. Our action followed UNESCO attempts to license journalists and possibly undercut the free flow of news and information, as well as efforts to kick certain countries out of UNESCO on political grounds. I actually support the American withdrawal. I would like to see us return to UNESCO, but before that happens the organization would need to be restructured, with a new director general and a new charter that prevents politicization. What's unfortunate about UNESCO's current crisis is that its best programs were in support of important international science. It hurts the world's scientific enterprise when our country and the United Kingdom no longer participate in the UNESCO process.

Q. Is there anything we can do in the interim to promote international cooperation in science?

A. We had hoped—and we worked very hard—for a separate US contribution that would not go to support UNESCO, but would go directly to international scientific organizations. We proposed an amount that the US had previously contributed to UNESCO, but instead the government gave only a fraction of what was needed to international organizations and to global research—unfortunately.

Q. Hadn't the US alone been providing about $14 million a year to UNESCO's science programs before we pulled out?

A. Yes, but in 1985 and 1986 the State Department provided only about $2 million each year for all the international scientific organizations we deal with. Not much.

Perhaps our current concern for international economic competitiveness, which may be a modern metaphor for Sputnik, will spur us to make the necessary reforms at all levels of education and cause us to allocate the necessary resources.

Q. The Japanese seem to have an enormous interest in science and technology—in some instances probably greater than ours. It was I. I. Rabi who once described science throughout the world in terms of a series of boat races, with one country's boat ahead at times in space science, say, or particle physics and another country's on a course that was bound to overtake the leader. The US, Rabi said, should not expect to win every event or every race, though it would be possible with the right training and technology to regain leadership once we had fallen behind. In other words, scientific predominance may be just as cyclical as any other human or natural phenomena. Is it likely, then, that Japan or some other nation may wrest scientific leadership from us in one or more fields?

A. The Japanese recognize that the formula for their success during the 1970s—taking technology and improving on it and turning out high-quality, low-cost products—may not be sufficient for their future. They now must move ahead in basic science as well as technological innovation to compete with a reawakened America, so to speak. We are improving our manufacturing and productive skills. So the Japanese are now making greater investments in basic science. You may have seen the recent Royal Society study of citations to each country's scientific literature. In this report citations of Japanese work show a steady rise. Based on citations alone, which is a traditional indicator of where good science is being done, Japan is approaching the level of Western Europe. Unfortunately, the United Kingdom, once a leader in scientific

research, shows a steady decline, and that's a great tragedy.

In consequence of our substantial investments in science since World War II the United States remains well ahead of all the other countries for citations in the world literature. Science operates in a global community, and we should support scientific excellence wherever it appears. We need to encourage the growth of basic science in Japan and elsewhere as a way of paying back to the world knowledge bank, with compound interest, what scientists and technologists of all nations have taken out of it over the years. So we should be happy to see the growth of Japan's support of basic research. On the other hand, we have to maintain our own scientific strength, and I applaud the proposal to double the NSF budget over the next five years. That's a terrific thing.

Q. When you became president of the Academy six years ago, one of your first actions was to cast a baleful look at the Federal budget. This was done in a public forum, which was critical of the Reagan Administration's cuts in basic science and education for fiscal 1981. Are you now pleased with the way the Administration has turned around its treatment of scientific research? To what do you attribute the turnabout?

A. The first Reagan budget for science was not a good one, and there was widespread worry. At the urging of the scientific community the Academy called a convocation to highlight the effects of the reductions. Every subsequent Reagan budget for science has been good. In the history of support of basic science over the past few decades, the Reagan years may rank first—or certainly near the top. The increases have been large during a period of low inflation. So the result has been real growth. The reduction in overall civil sector R&D during this period must be noted, though.

The motivation? I don't really know. Maybe it was his advisers. It may have been the strong support in the agencies, from such people as Erich Bloch at NSF, Jim Wyngaarden at NIH and now Bill Graham at OSTP. It may be that the President believes that a strong scientific enterprise is essential to our national security. This year the theme will be competitiveness. And even though many scientists like to think that they are engaged in an intellectual activity, history has shown that the growth of American affluence and productivity is due to the knowledge created, essentially, by its scientists and engineers. Congress now understands this. This is not to say that we should proffer proof of utility with each proposal. We understand the serendipity factor in basic research—the accidental and useful discovery that nobody anticipated.

Whatever the reason, we have seen a real growth in science, with widespread political support. In my conversations with members of Congress, I find that their attitude today is that science is good for the future of the country, its economic growth and prosperity, its defense and its culture. When I used to testify before Congress, maybe a decade or 15 years ago, the attitude of the members was that support of science was in the nature of a charitable gift. Congress used to say in effect: "Accept this contribution to university science from a friendly Federal government. We don't expect anything useful to emerge. This is pure philanthropy." Now, science is held to be important to the country for a complex of reasons: health, affluence, jobs, national security, as well as intellectual attainment. Today, science matters. I think that's promising.

Q. Is it discouraging to you that the Defense Department is getting as much as 75% of our R&D funding?

A. The Defense Department's funding of R&D—not the D part but the R—is not that big. Defense plays a minor part in the basic science scene—less than $1 billion a year. The technical people at DOD would like to do more, but Congress and the DOD controller whittle away at the Pentagon's science budget. The D part includes the development of the B-1 bomber, for instance. The "Stealth" bomber is D, as will be much of the SDI program.

The role of the government in the civilian D of R&D is a very controversial one. I'm not sure that the civil sector should have a major part of Federal funding. Why shouldn't that be left mostly to industry? Perhaps the government should take all the development funds that we used to spend in the civil sector and put this into basic and applied science and allow them to grow even more rapidly. Then industry could transform the results, when appropriate, through the development process into commercial products. Industry knows how to do this better anyway. But where the government is the sole customer for a product, as in the Stealth bomber, it is proper that the government is wholly responsible for development. The question is not whether Defense is taking too big a bite out of total R&D but whether our Defense budget is too big.

Q. In that connection, the Academy has not done any studies of SDI, or "Star Wars." Has the Academy made a conscious decision not to undertake any studies of Star Wars?

A. Yes and no. We feel that we could build on The American Physical Society's study of directed energy weapons and do an even more comprehensive study, taking into account cost–benefit analysis, vulnerability, the effects on arms control, alternative measures of security. We could do all that. And I say we could do that because within the broader scientific community there are people with great experience in all of those matters. But we want to be asked. SDI is the President's initiative, and therefore we want to be asked at the highest levels of government, either by the Congress, by a Cabinet officer or by the President himself. Furthermore, we could not do a credible study without authorized access to the compartmentalized and classified information about SDI. Our panel, therefore, would be subject to the accusation that "You don't know what you're talking about," and we should protect our panels from that. The House of Representatives passed a bill last year to commission the Academy to do precisely this kind of study, but it did not pass the Senate. The Senate switched the study to the Office of Technology Assessment. OTA is certainly very competent to do the study. Our procedure and perception would be different from OTA's. But SDI is an important enough issue that perhaps more than one organization should examine it.

Q. A survey of Academy members found last year that a portion of the members opposed SDI. Is it likely that the Defense Department would request the Academy to undertake a study of SDI, arguing perhaps that the Academy could not undertake a balanced, objective study because of the views of many members?

A. Many of our members would be the first to say that, although they would support a credible panel that would be absolutely unpredictable in terms of the outcome. By that I mean nobody would know before the panel issued its report, by the kinds of people, their backgrounds and specialties, what the outcome would be.

One can cite cases of a single minister of science or research whose mistakes have devastated a country's scientific capability for a decade or longer.

Q. You do suppose that the Academy members might oppose such a study?

A. From what I know of the membership, they would not.

Q. Have Academy members ever turned down the study of an issue they thought was inappropriate to undertake?

A. The Academy members, through their elected officers and counsel, may have done that. But our 1863 charter makes it very difficult to turn down anything we're requested to do by Congress or the executive branch. Very often we have held that certain requests are inappropriate or that we don't have the expertise. Sometimes there are insufficient data for us to reach a conclusion, and when that's the case, the requesting agency or Congressional group honors our concern about the ability to handle the issue and withdraws or modifies the request. So there's never been a constitutional crisis over our reluctance to study a question. Congress and the executive branch understand our position.

Q. Since World War II, scientific research has become institutionalized. Some experiments involve dozens of researchers and some instruments require vast centers costing millions or even billions of dollars. The Superconducting Super Collider, which may run up a bill of $5.3 billion or more to build, is the latest but probably not the last big hunk of scientific equipment. Then there are the space station, the Hubble Space Telescope and several synchrotron light sources. With all that money going to large instruments, what are the implications for scientific research that does not require such costly apparatus? And what does it mean for equipment in university labs? Is it possible, in your view, that the Congress and the Administration together will contribute much more money to science?

A. Let's set aside the space station. That's a separate issue that centers on maintaining spaceflight opportunities. Let's talk about the SSC and the light sources, which are "big science" projects. When you come right down to it, on the issue of big scientific projects, including ocean drilling, for instance, and the Space Telescope, the scientific community is sharply divided. There really is no special wisdom that says we should do these things or we should not do these things. You have to take into account a number of factors to reach a conclusion. Nobody would disagree with the intellectual merits of various projects. We need to ask, Are the funds fungible? In other words, if we did not do the SSC, would the money that is not spent be made available to "small science" or would it go to something wholly outside physics or even science? At about the same time the Administration announced the SSC, it also announced the doubling of the NSF budget. Even though the NSF supports some big-science projects, by and large most of its funds go to small teams of individual scientists. Even the engineering and science centers that the foundation is setting up are basically small scale. So apparently, and luckily, we're a nation that is able to support both large-scale and small-scale scientific projects. That is a very sensible outcome.

We need to come up with standards, a reaffirmation of ethics in the scientific method, and instill this in the next generation.

Q. The same day the President announced the SSC, he also vetoed a bill for clean water, which is a major health and environmental issue. Later his veto was overridden by Congress. These two actions suggest an ambivalence in the Administration about the priorities for science and for health. Does this upset you in any way?

A. Well, we elect an Administration for the priorities that they hold out to us, and a lot of us don't agree with those priorities and don't vote for that particular Administration. I would say that in applauding the Reagan Administration for what they've done for science, both big and small, it doesn't mean that we applaud everything else that it has done—that we approve of their priorities in environmental health or defense or anything else.

Q. Another subject that causes some ambivalence within the Administration is that of education. When the Administration first took office, their announced intention was to do away with the Department of Education. At the NSF in 1981, the education program was virtually jettisoned. Education still carries a low priority in the Administration. Have the members of the Academy taken any stand on scientific education?

A. I think I can speak for all the members of the Academy, if not most members of the American scientific community, in saying we decry the state of pre-college education—not only the training of scientists and engineers, but the training of a literate public that will be qualified to sit in judgment on science and technology. It's a serious problem. As a nation we have underinvested in all education, and the investments we have made have not been too wise. There's lots of room for more resources, more carefully allocated, and for better solutions. We just have to come to grips with the problem of education if we have any interest in the future vitality and productivity of our country.

The Administration's proposal to reduce its support of university students is of great concern to us, because we had reached a point where almost any student could go to any university in the country, supported by grants and loans. The competency of our pre-college science and math teachers is very poor. We must raise their standards and pay them better salaries. In our tradition, state and local governments play the major role; they must be blamed along with the actions and inactions of the Federal government. There's enough blame to go around—school boards, parents, government at all levels. It's a serious problem. Perhaps our current great concern for international economic competitiveness, which may be a modern metaphor for a new Sputnik, will spur us to make the necessary reforms at all levels of education and cause us to allocate the necessary resources.

Q. Do you and members of the Academy see education as perhaps the top priority issue?

A. All of our members at all of our regional meetings agree that we have to do more in education. We have now invested our own resources in our efforts to try to get government and private sector support to do a number of things. Our new Mathematics Science Education Board is setting up a network of contacts in every state and community in the country to disseminate knowhow and wisdom in how to teach mathematics and what to expect of teachers, examinations, procedures, curricula and so on. We are taking an international view in trying to get the best that's happening all over the world and disseminate this knowledge to this network. That's just one year old and it's moving very rapidly. We have great support from the Federal government, not just the National Science Foundation, but all the basic science agencies—Energy, NASA, the DOD. We're pleased with that.

With the Smithsonian Institution we're setting up a National Science Resource Center in Washington to serve all of the pre-college math and science teachers across the country—again, through a network that we established, making available new approaches for science in all grades, including software packages, curricu-

lum units, recommendations of equipment and summer training centers for teachers, who will then disseminate this material. This is just getting established now.

Q. Does this suggest more new science curriculum programs like the ones launched after Sputnik—for example, the high school physics course devised by Jerrold Zacharias and his group?

A. We're not going to develop expensive, formal curricula in physics, biology, chemistry, mathematics. Somebody should do a study of the post-Sputnik science education projects. Some of them succeeded beautifully; others did not. Why? Why did some projects cause such controversy? Was the content right? Was the dissemination adequate? Did we teach it sensibly? Why were so few students enrolled?

Q. Good questions.

A. We need an analysis of what happened, because we're about, I think, to embark on new national experiments in science education, and we could profit from knowing the successes and mistakes of the past.

Q. A few years ago there was talk about a Cabinet-level Department of Science and Technology that would embrace all government scientific enterprises. There is precedent for this in some other countries—France and Britain, for example. Would this work in the US? Or do you believe that decentralization of scientific research, as exists now, in effect provides more funding and better resources for science?

A. You're referring to the report called *Global Competition: The New Reality*, written by a Presidential commission headed by John Young, president of Hewlett-Packard. It was an excellent report, and I'm glad to see that it's now getting second wind. It had some terrific recommendations relating to education, scientific progress, macroeconomic government policies and other methods to improve productivity and advance competitiveness. But it also had a proposal for a Federal Department of Science and Technology, which may have diverted our attention from more important matters in the Young report.

Q. Perhaps the idea for a Science Department crept in because George Keyworth II, President Reagan's science adviser, served on the commission.

A. Maybe that's the source. I find very little support in the scientific community for a Department of Science. Some administrators might like it. But, by and large, the scientific community, looking back at the postwar growth and ascendancy of American science, attributes this success to decentralized, multiple sources of funds. One can cite examples of a single minister of science or research whose mistakes have devastated a country's scientific capability for a decade or longer. To put that much power in the hands of one Cabinet official can lead to dire consequences. To make American science that vulnerable would be a serious mistake. At the present time if a policy mistake were to be made at a single agency—NSF or NIH or the Department of Energy—it would be damaging but not devastating. Our system was designed to support the work of the best scientists in large numbers across the country, so it is not surprising that our scientists are essentially skeptical, if not negative, about a Department of Science. This is to say that the President's science adviser might be elevated to the level of Assistant to the President, not Deputy Assistant, or possibly be made a member of the Cabinet. The President, with all the complex decisions he faces, so many of them with scientific and technological underpinnings, should have expert advice in the White House at a senior level on such matters.

Q. Besides giving the position a better title and giving the science adviser Cabinet rank, how would you restructure the job?

A. I think there is a generation of American political leaders that will be ready to take over the Presidency—if not in 1988, then for sure in 1992. I won't mention names, but there is a new generation of governors and members of Congress who understand the nature of this country's future in a way that few of their predecessors did. I have talked with many of these political figures in both political parties. I believe that many would be willing to accept the concept of a science adviser who might be a member of the Cabinet or an Assistant to the President. Not many people know that the science adviser's current statutory position in government is in the Executive Office of the President, not in the White House. I would put him in the White House as well, either as a member of the Cabinet without portfolio, or as an Assistant to the President. This would be eminently justifiable, I think, in terms of this nation's priorities—economic, defense, health, global environment and so forth.

Q. In the past few years there have been a couple of cases of fraud or misconduct in science, particularly in the biomedical sciences. How do you account for this? Has this belittled the public's view of scientists? And why do such malpractices seem so prevalent in the biomedical sciences?

A. It's a matter of growing concern. By and large the number of cases is minuscule compared with the total number of practicing scientists. Everybody realizes that if the fraud relates to a significant experiment, it will be uncovered. People repeat experiments if they are important and try to reproduce the results, and then take off from there. Nevertheless, the situation causes deep concern among scientists. We have to ask some basic questions that go beyond the issue of fraud. To what extent do values get communicated to our graduate students—values of ethics as well as the history of science and the scientific method? What do scientific honesty and openness imply? Have we lost these things in our graduate education? To what extent does the growth of team research—which is driven by science itself these days in certain fields—lead to compartmentalization, so that individuals cannot attest to the reliability of the whole paper but only to the data or paragraphs that they know from personal experience? To what extent does that lead to an unevenness in content and disparities of honesty? To what extent does the overburdened review process of journal articles break down, so that errors and dissembling are not caught? In terms of responsibility, there are enough problems to go around—for department heads, team leaders, journals, societies.

Q. And to individuals as well in their own senses of values and ethics.

A. That may be the greatest problem—inculcating individual values to our graduate students. At first I thought it was unimportant because it was too small an issue in the large scale of events, but I now feel that we have to meet this problem squarely. Professional organizations, like The American Physical Society or my own organization, now have to examine this moral dilemma in science from a broader point of view. The ethical issue, the impact of team research, the overloaded journal reviewers, all of these things need to be examined. Somehow we need to come up with standards, a reaffirmation of ethics in the scientific method, and instill this in the next generation, and take it from there.

Q. Is the Academy inclined to do anything?

A. We've started. In the biomedical area, the Institute of Medicine—which is part of our Academy structure—is going to start a study of the broader issue as I've outlined it. There are some additional cases in chemistry and elsewhere, so it may be more widespread than the biomedical fields. A much larger effort may be necessary. □