Science and Technology in the White House, 1977 to 1980: Part 2

Frank Press

Science and technology have long been important components of our national security and foreign policies. They are particularly so in the current era of sophisticated defense systems and of increasing reliance by developed and developing countries on advanced technologies for food and energy production, resource development, and industrial vitality. In the past 4 years, scientific and technological considerations have necessarily been integral parts of White House policy deliberations on such defense and foreign policy issues as strategic weapons modernization, arms control, technology transfer, the growing bilateral relationship with China, and North-South relations.

Summary. This is the second half of a two-part article on Administration science and technology policy during the period 1977 to 1980. The first part discussed the role of the Office of Science and Technology Policy (OSTP) in the context of the overall federal policy-making framework and institutional structure and described specific activities aimed at strengthening U.S. science and technology, fostering industrial innovation, enhancing relationships among government, universities, and industry, and improving the regulatory process. This part focuses on OSTP activities related to national security and foreign policy, space, energy and the environment, health, and agriculture, and discusses OSTP advisory mechanisms and planning efforts.

International Cooperation

The development and maintenance of cooperative relations between the United States and other countries increasingly involves scientific and technological considerations. The specific nature of the involvement of science and technology in relations between this nation and another country depends on a variety of factors which together constitute the overall foreign policy context within which the two countries interact.

Scientific and technological relations with countries such as China and the Soviet Union, with which we have intricate political contacts, pose special challenges. For example, the President substantially curtailed our relations with the Soviet Union because of its invasion of Afghanistan. In addition, Soviet persecution of dissident scientists led many American scientists to boycott cooperative activities. Yet we recognize the long-term importance of contacts with scientists of the U.S.S.R. and have acted in such a way as to reduce activity but preserve the framework of the bilateral scientific agreements between the two countries.

Other nations, particularly developing countries, often view our scientific and technological expertise as the direct basis of our economic and social well-being and wish to share in the benefits of that expertise. Complementing this desire is a growing consensus in this country that our government can and should do more in applying U.S. scientific and technological capabilities to major global problems and in helping developing countries build their own scientific and technological strength so as to more effectively address their own problems.

Science has tended to bring nations closer together. Traditionally, the international scientific community has sought contacts across national boundaries as a means of sharing and nourishing intellectual pursuits. In fields where global observation of phenomena is important—for example, my own field of geophysics—international mechanisms often have been established to support collaboration. Increasingly, multinational cooperation is important to support high-cost, "big" science projects in areas of major concern to many countries—for example, particle accelerators, space exploration, fusion research, and coal liquefaction process development. The government is deeply involved in funding and, in some cases, negotiating and operating such international projects.

The importance of the role of science and technology in foreign policy was recognized early in the Office of Science and Technology Policy (OSTP), and the President was receptive to our recommendations. The President's Message to the Congress on Science and Technology (*1*) spelled out four themes that have shaped U.S. policy in international scientific and technological cooperation: (i) pursuit of new international initiatives to advance our own research and development objectives; (ii) development and strengthening of scientific exchanges to bridge political, ideological, and cultural divisions between this country and other countries; (iii) formulation of programs and institutional relationships to help developing countries use science and technology beneficially; and (iv) cooperation with other nations to manage technologies with global impact.

With the President's encouragement, OSTP has actively pursued international programs in science and technology in support of these themes. Although we have been involved in many aspects of international program policy-making and implementation, we have given special attention to scientific and technological relations with China; new forms of scientific and technological cooperation with Japan; cooperation with Mexico, other Latin American and Caribbean countries, and several states in Black Africa; and the proposed Institute for Scientific and Technological Cooperation (*2*). President Carter was directly involved in the formulation of each of these international initiatives. Typically, presidential approval of a proposed approach was followed by intensive preparations within the U.S. government and by extensive consultations with the other country or countries involved.

China. The development of the U.S.-China Agreement on Scientific and Technological Cooperation is particularly illustrative of the process of program innovation (*3*). Early in the Administration it was clear that one of its major challenges would be improvement of relations with the People's Republic of

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0036-8075/81/0116-0249$02.00/0

Frank Press meeting with Vice Premier Deng Xiaoping in Beijing, July 1978.

China. At that time, China's renewed modernization drive was just getting under way. This is an undertaking of enormous magnitude and ambition aimed at bringing Chinese agriculture, industry, science and technology, and military strength up to world-class status by the end of the century. China had indicated that, to accomplish its modernization goals, it would seek technology, training, and capital from the Western industrialized nations.

Trade and scientific, technological, and academic contacts with China had been taking place through private channels since the Nixon-Kissinger initiatives of the early 1970's. The Committee on Scholarly Communication with the People's Republic of China played an important role in building scientific relations during this period. Beijing had refused to deal directly with the U.S. government in such areas, ostensibly because of the absence of diplomatic relations. It was our view in 1977 that, in light of China's new interest in technology acquisition from the West, formal government-to-government relations might be possible. Without them, our ability to aid China would be seriously constrained.

It was our conviction that U.S. interests would be served by China's stable growth and by its ability to remain self-sufficient in, and perhaps become a new exporter of, energy and nonfuel mineral resources. We also saw major benefits for the United States in the long-term individual and institutional relations that would evolve through contacts, in the expansion of trade, and in the insight we would gain into the extraordinary process of China's modernization and its impact on the Pacific region and the world.

Accordingly, the President asked me to develop proposals for cooperation with China in such areas as space, energy, academic exchanges, agriculture, and health. An interagency group convened by OSTP devised proposals for nonmilitary, government-to-government, scientific and technological relations consistent with stated Chinese modernization plans. These proposals were in areas where the government, rather than the private sector, had a leading role.

Within 2 months of the completion of our work, the President's national security adviser, Zbigniew Brzezinski, was in China discussing a wide range of consultative arrangements, including the concept of governmental cooperation in science and technology. An associate director of OSTP accompanied him and held preparatory discussions with the Chinese on such cooperation.

Two months later I led to Beijing what was very likely the most senior delegation of U.S. government scientific officials ever taken abroad, comprising the presidentially appointed heads of the major research and development agencies except the Department of Defense. The aim of this delegation was to establish a framework in which a broad range of government and private relations could flourish. During this visit it became clear that—even in the absence of diplomatic relations—China desired scientific and technological cooperation with the United States. The Chinese openly discussed their scientific and technological deficiencies, the difficulties of offering benefits in kind, and their willingness to pay for U.S. assistance where this assistance would not be matched by scientific or technological gain by the United States. During discussions with members of the U.S. delegation about possible areas for cooperation, the Chinese expressed special interest in purchasing a U.S. telecommunications satellite, in reimbursable U.S. technical assistance for energy resources development, and in exchanging students and scholars.

Subsequent high-level discussions led to the conclusion, on 31 January 1979, of a U.S.-China Agreement on Cooperation in Science and Technology. The agreement was signed by President Carter and Vice Premier Deng Xiaoping. Since that time, our two countries have negotiated and signed 13 protocols for cooperation in a broad range of scientific and technological areas. More than 2000 Chinese students are now studying in this country and a large number of U.S. scholars are in China. We view this cooperation as being of great importance to the building of an economically strong and stable China, a development clearly in the long-term interest of the United States. The developing scientific and technological relations with China proved to play a significant positive role in the broader effort to normalize relations between our two countries.

Japan. A different kind of challenge was presented by Japan. With the second largest gross national product in the world and a modern, well-developed, aggressive science and technology establishment, that nation had already contributed a great deal to scientific and technological advancement, and had the potential to contribute much more. In May 1978, then Prime Minister Fukuda made a major proposal that the United States and Japan cooperate in energy research and development. The President asked OSTP to lead a task force to respond with specific projects. After detailed negotiations, U.S. and Japanese representatives signed a bilateral agreement for cooperation in large-scale energy research and development projects such as coal liquefaction, nuclear fusion, and geothermal and solar energy. The next year, President Carter proposed to Prime Minister Ohira a complementary program of joint research and development in various nonenergy areas of global importance, such as space, environmental protection, health, agriculture, and resource conservation. Again, OSTP led the development of U.S. government policies and programs.

The scale of these programs represents a new concept in international science and technology cooperation in which expensive, risky, globally important projects are undertaken across the entire range of technological possibilities and in both the energy and nonenergy fields. These projects are designed not only to benefit the two countries, but also to advance the state of the art in various fields, thus benefiting all nations. Manpower, physical resources, and financing of these large-scale projects are shared. An increased Japanese investment in basic research could also result from these activities. In recognition of the importance of this new approach, President Carter and Prime Minister Ohira signed the Science and Technology Agreement in a White House ceremony on 1 May 1980.

Latin America. In another part of the world, we have made impressive progress in our science and technology relations with Mexico. During President Carter's meeting with President Lopez Portillo in February 1979, an associate director of OSTP signed a memorandum of understanding inaugurating or expanding bilateral cooperation in a number of areas including arid lands agriculture, railroad safety, and energy research and development. In October 1979, at the President's request, I led a high-level government delegation to a number of countries in South America and the Caribbean to strengthen cooperation in this hemisphere. Intensive consultations with leading science officials in Venezuela, Brazil, Peru, the Andean Pact nations, and the Caribbean region led to joint science and technology activities in many fields.

Africa. At the President's direction, I took a similar high-level delegation to Nigeria, Zimbabwe, Kenya, and Senegal in September 1980. With each of these important countries, months of planning led to the identification of projects and funds to start or strengthen programs for scientific or technical assistance. With each, I signed a science and technology agreement that provides a useful framework for cooperation. We also signed specific agreements for carrying out major projects with the host countries in areas which they identified as having high priority—typically agriculture and fisheries, energy, health, remote sensing, management, and manpower training. These visits took on added significance in that I met with the head of state of each country to deliver a personal message from the President in support of the mission. The President used the results of the visits in follow-on interchanges with these leaders.

Our cooperation with all these countries reflects the importance that each of them has placed on the relationship between economic growth and scientific and technological capability. It also reflects their view that the great strength of the United States in science and technology makes close relations with the

Frank Press greeting President Shagari of Nigeria, during his visit to the White House, 7 October 1980.

U.S. technical community a particularly productive means of enhancing this capability. I am convinced that scientific and technical assistance is a key linkage between the United States and the developing countries, one that has been underutilized in the past.

Institute for Scientific and Technological Cooperation. In a March 1978 speech in Venezuela, President Carter announced his intention to create what came to be called the Institute for Scientific and Technological Cooperation (ISTC). The new institute was conceived as an agency that would have as its primary mission the strengthening of the capacity of developing nations to undertake sustained research efforts on critical development problems. It was also intended to play an important role within the U.S. government in stimulating more extensive scientific and technical cooperation with developing countries as well as "middle-income" countries no longer eligible for foreign aid.

Ambassador Henry Owen, a presidential adviser on international economic issues, and I worked intensively for more than 3 years to establish the ISTC. A broadly based Advisory Committee on Science and Technology for International Development, with members drawn from industry, labor, universities, and the foundations, was assembled to guide its design. With the President's announcement and his continued interest and commitment, the concept of such an institute has gained wide support here and abroad. Yet the ISTC has not become a reality. Although it was authorized by Congress, opposition during the appropriations process has prevented the institute from becoming operational. However, in response to this initiative, Congress did appropriate funds for a new science office in the Agency for International Development (AID) with the charge of undertaking innovative scientific research pertinent to development. The effort has led also to increased interest within AID in the role of scientific and technical assistance in our foreign aid programs. Indeed, there are those who believe that, in time, U.S. bilateral aid programs will increasingly emphasize scientific and technical assistance, leaving financial resource transfers to the international development banks to which industrialized countries contribute.

National Security

Our national security depends in large measure on our ability to meet present and future technological challenges. As other nations are becoming more proficient in science and technology, we must make certain that our research capabilities remain at the frontier of knowledge and our technological capabilities remain productive and innovative. OSTP has worked with the President, the Office of Management and Budget (OMB), and the Department of Defense to restore the declining support for research and technology in defense budgets during the first half of the 1970's. We also have worked to revitalize relations between the Defense Department and the university and industrial research communities—relations that had deteriorated in the aftermath of the Vietnam war (*4*).

As mentioned in part 1 of this article,

an OSTP review of Department of Defense research programs led the Secretary of Defense to propose significant increases in basic research and to strengthen basic research management in the department. Since then, with the strong support of the President, funding for basic research in defense has been increased sharply, showing a cumulative growth of more than 50 percent over fiscal years 1978 to 1981, including an increase in basic research of nearly 65 percent. Defense support of university research will have increased more than 40 percent during this period.

As director of OSTP, I am involved in the development of policy related to a broad array of national security issues. My staff and I participate in policy deliberations on these issues through a variety of processes and mechanisms. We chair or sit on various Cabinet-level and sub-Cabinet-level committees and working groups of the National Security Council (NSC) and participate in the review processes established by the OMB for analyzing the defense, intelligence, and foreign assistance budgets. For example, I have chaired Cabinet-level NSC policy review committees formulating our scientific and technological cooperation with China, developing space policy and programs, and considering our telecommunications protection policy. Efforts of these groups have formed the basis for a number of presidential decisions. In addition, the OSTP associate director responsible for national security issues serves jointly as a senior member of the NSC staff, providing the NSC with a channel for obtaining valuable analytical support and contributing to early and full consideration of scientific and technological components of major defense and foreign policy issues.

Frequently, the President asks me to assemble committees of prestigious scientists and engineers from outside the government to provide independent advice on key national security issues. The President has used their advice in making final decisions on a variety of issues and, when appropriate, committee reports have been given to government agencies to use in shaping policies and programs. For example, OSTP convened a high-level panel to compare and assess U.S. and U.S.S.R. technologies in such areas as computers, nuclear warheads, space, battlefield weapons, and high-energy lasers. The President's initial review of the U.S. defense posture incorporated this panel's findings. At a later stage, the President asked for a review of the vulnerability of U.S. strategic weapons systems to an expanding Soviet missile threat. That panel's findings were considered by the President in decisions on U.S. strategic modernization efforts such as the Trident, cruise missile, and M-X intercontinental ballistic missile programs. Regarding the complex M-X issue, the panel advised the President on several alternatives to our current Minuteman system and on the underlying environmental, military, and arms control implications.

OSTP participates in a wide range of NSC arms control reviews, many of which involve difficult technical questions. For example, a senior member of the OSTP staff chairs the NSC interagency working group on the Comprehensive Nuclear Test Ban (CTB) and has also chaired NSC working groups on the U.S. nuclear test program and other arms control issues. OSTP frequently convenes outside panels to support these activities. For example, a panel was convened to review the relative impact of a halt in testing on both U.S. and Soviet capabilities and to consider special verification procedures and other provisions to support the CTB negotiations.

At the request of the President, OSTP has conducted reviews of special problems such as the sonic booms heard on the East Coast last year and the 22 September 1979 light flash recorded by a Vela satellite over the South Atlantic. In exploring the origin of the mysterious booms, OSTP organized an intensive review involving both government agencies and outside consultants. This review concluded that the booms were caused by supersonic aircraft rather than unusual geophysical sources. The OSTP evaluation of the 22 September event concluded that the light flash probably was not caused by a nuclear explosion, although it could not be certain. This conclusion was based on the absence of persuasive corroborative data, the existence of signals from natural phenomena similar to signals from known nuclear explosions, and characteristics of the 22 September signal unlike those observed in light signals from previous nuclear explosions.

Space Policy

Since its inception almost a quarter-century ago, the space program has been a highly visible and dramatic testimony to this nation's technological achievements. Space-age benefits are an integral part of our lives—for communication, weather forecasting, navigation, resource evaluation, environmental monitoring, as well as national security and arms control efforts. Now our national space program is entering a new stage of maturity, one in which we will receive increased dividends through scientific exploration and technological applications.

Early in his Administration, President Carter called for a review of national space policy, which culminated in a presidential directive outlining a comprehensive policy based on reaffirmation of the principles that have guided our space efforts since their beginning and on support for new programs of technology sharing between the military and civilian sectors. This policy is consistent with the view that space is an extension of our environment, and that our space program is a major vehicle for achieving our goals for scientific advancement, social and economic benefits, national security, and international well-being.

The President also created, and asked me to chair, a policy review committee to make recommendations on space policy issues. The committee's review of the nation's civil space policy led to a presidential decision that civil programs should be balanced among space science and exploration, space technology applications, and new technology development. Completion of the Space Shuttle will receive our highest priority. This flexible system will make possible routine manned operations in space, including launching spacecraft of larger size and capacity than ever before. It will allow spacecraft retrieval and repair, assembly of large structures in orbit, and experimentation with materials processing in space. It is likely that no other nation will have this capacity for the remainder of this century. The shuttle will be central to our national efforts in space science, commercial space utilization, defense, and technological leadership. In addition, its completion could release significant funds for new space science and applications projects, thus eliminating a concern, which I share with members of the space science community, that cost overruns will lead to a decline in planetary exploration and space research.

Despite budgetary constraints, our space science and planetary exploration programs continue to be challenging. We have exciting missions now under way. A Voyager craft, having explored Jupiter, is continuing on to Saturn and Uranus. Under development are the Galileo mission to explore Jupiter, the Solar Polar mission, several Explorer missions, the Space Telescope, and Spacelab. The Gamma Ray Observatory has been approved as a new start in 1981 and the Venus Orbiting Imaging Radar will be a new start in the fiscal 1982 budget.

A key element of our civil space policy

is its emphasis on space technology applications that provide information to all nations about the earth's resources, climate, weather, agriculture, and pollution. Under a new initiative, NASA will reenter research and development efforts on the next generation of satellite communications systems. In addition, our Landsat remote sensing satellites, which have proved so useful since they were first launched in 1972, will move from experimental to operational use under the management of the National Oceanic and Atmospheric Administration. Finally, two new multiagency projects are beginning. The first is AGRISTARS, a remote sensing experiment that will improve agricultural and resource assessment capabilities from space. The other is the National Ocean Satellite System, which will analyze sea and ice conditions, marine weather, and marine pollution and provide scientific oceanographic observations (*5*).

Energy briefing at Georgia Tech, 30 August 1979. Shown are Energy Secretary Charles Duncan, President Carter, Frank Press, Georgia Tech President Joseph Pettit, and presidential assistant Stuart Eizenstat.

Energy and the Environment

The development and implementation of a rational energy policy based on creditable assessments of worldwide supply and demand and on recognition of economic, political, and social realities is an important goal. Ultimately, energy research and development will produce the scientific knowledge and technological capabilities necessary to address the complex questions we face: What alternative energy resources and technologies do we choose to pursue? How do we develop them over time? What are their safety, reliability, and environmental impacts? What bearing might they have on economic policy, national security, and international relations?

The Administration's energy policy emphasizes reliance on a range of energy strategies. These include conservation; deregulation of domestic natural gas and oil prices; replacement of oil with coal where possible; efforts to reduce vulnerability to short-term oil supply disruptions through a strategic petroleum reserve and standby gasoline rationing; synthetic fuel development from coal, oil shale, and biomass; nuclear energy with measures to improve safety, control nuclear weapons proliferation, and manage radioactive waste; expanded use of geothermal and solar energy; and long-range energy resource development in areas such as breeder reactors and fusion.

Within the broad array of policy issues corresponding to this range of energy resources, OSTP has focused on specific energy technology issues, the overall budget for energy research and development, and government organization to meet energy research and development needs (*6*).

Early in the Administration, the President decided that, in order to make possible a coordinated, balanced energy program, it would be necessary to establish a single Department of Energy (DOE) comprising the existing federal energy organizations. Because it was essential that this highly technical mission agency have a strong research and development focus with a long-term research agenda, an Office of Energy Research was created. Now the annual budget for this office alone is the largest of any physical science research agency in the world. Of particular importance in the DOE budget process is our role in providing the President with independent evaluations of costly energy demonstration projects and with recommendations on priorities for support of energy supply technologies.

The safety of existing and proposed energy technologies is a major consideration in the formulation of energy policy. For example, nuclear energy safety has received a great deal of presidential attention. The accident at Three Mile Island revealed substantial shortcomings on the part of the government and the utilities in ensuring the safety of nuclear power. The Kemeny Commission, established by the President to investigate the accident, made 44 recommendations for change. These included modification of the structure and procedures of the Nuclear Regulatory Commission (NRC), improved training of operating personnel, and greatly strengthened emergency planning and response. The President adopted virtually all these recommendations, although in some cases he has taken a somewhat different approach than the commission recommended. The reorganization plan submitted to Congress should serve to assist in the development of a unified and more reliable nuclear safety regulatory program. The President's nominee to become the next chairman of the NRC awaits Senate confirmation.

OSTP worked on the Three Mile Island accident from the outset. I flew to the site with the President and helped establish the Kemeny Commission and select its members. Finally, John Deutch, then undersecretary of DOE, and I chaired the Executive Branch group that developed a response on behalf of the Administration.

The issue of nuclear waste management has been neglected to the point where it is a major impediment to the development of nuclear energy. Accordingly, the President directed that an Interagency Review Group (IRG) on Nuclear Waste Management be created to recommend a comprehensive governmentwide approach. OSTP chaired the technical working group that examined alternative technical strategies for disposal of high-level radioactive wastes and spent fuel, and coordinated much of the preparation of the IRG report, the recommendations to the President, and the subsequent announcements. In the course of this work, OSTP augmented its staff with several consultants and with experts in geology and engineering from other agencies, and convened an advisory panel of representatives from industrial, state government, and public environmental groups.

On 12 February 1980, the President sent to Congress the first comprehensive plan for a national radioactive waste management program. The plan outlines the technical strategy that will be followed in working toward the construction of one or more mined geologic waste repositories, procedures for state and local government and public participation, provisions for interim storage of spent fuel from nuclear reactors, plans for low-level waste disposal and for remedial cleanup action at waste disposal and uranium mill tailing sites, and regulatory actions necessary to implement the program. Although several elements of this comprehensive plan are included in legislation enacted or reported by the Senate and the House of Representatives, or their committees, Congress has not yet acted on the recommendations.

Potentially one of the most serious energy-environmental problems to confront our nation is the buildup of carbon dioxide in the atmosphere from burning of fossil fuels and from deforestation. This was the subject of one of the first memoranda I sent to the President and has already entered into discussions between the President and other heads of state. Plausible projections of future carbon dioxide concentrations suggest a doubling by the middle of the next century. Since carbon dioxide is a powerful absorber of thermal radiation in a region of the spectrum where the atmosphere is otherwise transparent, small changes in the concentration of this trace constituent could have major effects on the heat balance of the earth. The consequence might be substantial changes in climate and large impacts on society.

Informed policy decisions about this potentially significant environmental problem will require greater knowledge and sophistication than now exist. In response to this need, OSTP commissioned two studies by the National Academy of Sciences. The first study examined the status of climate modeling in order to determine the expected climatic consequences of a doubling of carbon dioxide and the level of uncertainty in our knowledge. The study indicated that there was reasonable agreement among different approaches that a doubling of carbon dioxide would result in major climatic shifts. The second study addressed the way in which we might examine and deal with the potential social and economic impacts of increased carbon dioxide concentrations and the degree to which such impacts should influence current energy strategies and international political discussions. OSTP will continue to provide leadership in this important area. We are currently planning a further comprehensive review of the carbon dioxide issue, as required by the recently enacted synfuels legislation.

Health Policy

Health policy initiatives of this Administration have emphasized wider availability of health care services; prevention of injury, disease, and disability; control of health care costs; and expansion of health insurance coverage. Such health service initiatives generally are not considered to be within the purview of science and technology policy. Yet their successful development and implementation require decisions informed by the best available scientific knowledge, programs supported by sound basic and applied research, and evaluation and impact assessments based on complete data. OSTP has concentrated on the scientific and technological issues in health care and identified specific key issues for consideration (*7*).

One example is the controversy over the role of new health care technologies in escalating health care costs. Many observers equate the two, singling out specific technologies—for example, computed tomography and coronary artery bypass surgery—as causes of cost inflation. Cutting wasteful and excessive health care costs without inhibiting technological innovation requires objective analysis of incentives in the system, identification of incentives that may reward inappropriate or excessive use of technologies, and wise assessment of the safety and efficacy of new technologies. Rational assessment and utilization of existing technologies could open marketplace opportunities and spur acceptance of innovative and cost-effective newer technologies in health.

OSTP is working with the appropriate federal agencies to address these needs. The National Institutes of Health (NIH) is holding consensus development conferences on the safety, effectiveness, and appropriateness of medical practices and procedures. The new National Center for Health Care Technology (NCHCT) and its advisory council are assessing selected health care technologies and providing advice on government reimbursement for use of these technologies. In addition, OSTP, NCHCT, and the Health Care Financing Administration are collaborating on a model system for benefit-cost assessments of new technologies and for better reimbursement policies.

In response to considerable agency and congressional interest as well as public concern, OSTP organized and led an interagency effort to define research opportunities in human nutrition, set priorities for such research, and delineate agency roles (*8*). The definition of clear areas for emphasis—human nutrition research, food sciences, nutrition education, and nutrition surveillance and methodologies—enhanced individual agency nutrition programs and enabled managers and scientists from the different agencies to coordinate their efforts. The priority topics for research in these four areas have been emphasized and expanded in the agencies in the 3 years since the study. Continuing interagency coordination is facilitated by a highly effective interagency committee in human nutrition research under the aegis of OSTP.

There has also been widespread concern about the proliferation of potentially dangerous toxic chemical dumps and considerable pressure on the government immediately to impose rigorous restraints on the chemical industry. However, such decisions, which have broad public health and welfare as well as economic implications, must be based on sound scientific information. Accordingly, OSTP convened a working group of government and nongovernment experts to identify the major problems of hazardous waste management and the scientific and technological advances needed to address them. Questions reviewed included sampling and analytical procedures, health effects data, fate and transport of wastes, site cleanup technologies, and means of improved management of waste streams, as well as long-range research needs, public information, and personnel training. On the basis of this group's recommendations, we are working with agencies to put together a long-range, hazardous waste research plan, develop standard procedures for responding to specific waste hazards, and improve coordination among various government hazardous waste research programs.

Another area which evokes strong public concern is that of environmental and occupational exposures to ionizing and nonionizing radiation. Yet objective and reliable data on the biological and health effects of such exposures have not been available. For example, we do not know with certainty the health effects of exposure to low levels of ionizing radiation, such as those associated with atmospheric nuclear tests, nuclear shipbuilding, nuclear power plants, and medical diagnostic procedures, including x-rays. The President called for an interagency task force to lay out appropriate government radiation policies and research strategies. OSTP helped formulate the task force's agenda, monitored outside review of its work, and assumed responsibility for ensuring that its recommendations were carried out. A similar review on the biological effects of nonionizing radiation, conducted by

OSTP, has influenced a number of decisions on federal research policies and budgets (*9*).

Public policy decisions related to the regulation of environmental and occupational exposures to toxic chemicals, hazardous wastes, and radiation, and decisions related to other personal medical and public health concerns, must be informed by the best possible science. Indeed, basic knowledge of the human organism in health and disease is fundamental in addressing successfully the major health challenges we face. Rational growth of this country's biomedical research enterprise and of its federal guardian—the NIH—has been an important Administration goal. Consistent with his overall budget strategy, the President has proposed each year a substantial increase in the NIH budget over his request of the previous year. Congress has consistently increased the NIH budget above the President's request, resulting in rapid unplanned growth, with money frequently allocated according to criteria other than needs and opportunities in the field. This approach is not in the long-term best interest of the NIH institutes or of the research universities, where instability is particularly damaging to basic research. Accordingly, OSTP has joined with Congress, NIH, the biomedical research community, and the OMB to develop a consistent approach to NIH budget growth. The fiscal 1981 NIH budget proposes to stabilize the number of new and competing research grants at around 5000 awards. This approach will provide continuity and predictability, especially for research initiated by individual investigators.

OSTP has taken parallel actions to strengthen the biomedical research establishment. Over the last 3 years we have emphasized basic research across the board. We have stressed the importance of upgrading scientific resources fundamental to high-quality scientific work. Lastly, we are working with NIH to reduce the administrative burden on researchers through shorter grant applications, simplified reporting, streamlined review procedures, and innovative approaches to grant funding and management.

Agricultural Research

Advanced agricultural research is vital to our future and that of other nations. Our agricultural productivity must grow to meet ever increasing domestic and worldwide needs. Yet our cultivated land is producing near its biological limits and we are approaching the boundaries of our present knowledge and technology. We face other challenges as well. Prime agricultural land is being diverted to other uses or to nonfood crops such as energy, fiber, and chemical feedstocks. Our farmers are turning to other occupations. Many agricultural chemicals and practices are being restricted for valid health, safety, and environmental reasons. Critical agricultural resources such as energy, soil, water, chemicals, and capital are increasing in cost.

OSTP has worked closely with the Secretary of Agriculture to stabilize and increase agricultural research budgets and strengthen the management of Department of Agriculture (DOA) research programs. The department's director of science and education has been elevated to the level of assistant secretary and is a member of the Secretary's budget and policy review group. Program review and evaluation procedures are being improved to ensure that scarce resources fund the highest quality, most relevant research.

OSTP and DOA have given special attention to the role of the federal government in agricultural research and to the relationships between the government and the other partners in the agricultural research enterprise—the states, private and state universities, producers, consumers, and business. We are exploring new joint government-industry research programs in such areas as food processing, occupational health and safety, and animal fats. The new competitive research grants program, a new DOA approach to funding research, is now in its third year and has been especially successful. This small program supports high-priority, basic research in plant science and human nutrition. It has attracted a number of investigators to the field, including young scientists as well as more senior scientists from other research areas.

The demand in our country as well as abroad for freshwater and marine plants and animals for food, fiber, and biomass has focused attention on the need to strengthen government aquaculture research and development activities. Although aquaculture—in both fresh and salt water—is a substantial business in the United States, providing revenues for many farmers and small business enterprises, it supplies only 3 percent of our current demand for seafood. There has not been, at the federal level, a coordinated approach to aquaculture research and development. Responsibility for these activities has been divided among several departments and agencies and a number of congressional committees. At the direction of the President, OSTP worked with the relevant agencies and Congress to develop a National Aquaculture Plan, study factors that may constrain the American aquaculture industry, institutionalize interagency coordination and joint programming, and develop appropriate and effective aquaculture legislation. On 26 September 1980, the President signed the National Aquaculture Act of 1980, culminating 2 years of intensive cooperation with congressional committees. This legislation recognizes the progress made by the Administration in strengthening federal aquaculture programs and lays the groundwork for government assistance in the future development of commercial aquaculture in this country (*10*).

Advisory Mechanisms and Long-Range Planning

In developing and analyzing national science and technology policy alternatives across the whole spectrum of issues addressed by this office, we have drawn on expertise from the federal government, state and local governments, industry, and universities.

Two formal OSTP mechanisms facilitate communications between our office and representatives from various levels of government. The Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), the highest-level coordinating mechanism for science and technology issues, operates as a sub-Cabinet group under my chairmanship with membership composed of chief officials for research and development in the various agencies. FCCSET and its various committees have proved effective in anticipating and defining science and technology issues confronting the government, mobilizing federal agency reactions to these issues, and achieving long-term interagency coordination. The Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP), which I co-chair with Governor James Hunt of North Carolina, provides a mechanism for identifying and ranking state and local government research needs that might be fulfilled by better direction of appropriate research and development at the federal level, and for disseminating to those governments the results of federally sponsored and conducted research projects. Established by Congress in the law that reestablished this office, ISETAP was a new feature of the White House science policy process. It has brought a needed new perspective on many research and development issues to the Executive Office and to the policy leadership of the departments and agencies (*11*).

The policy analysis process OSTP applies to major issues depends to a considerable degree on external advisers drawn from the university and business communities and representing many scientific and technical disciplines and fields. Acting as individuals or as ad hoc panels focused on specific, high-priority issues, these advisers have proved to be an effective and flexible means of obtaining objective, expert advice. In addition, we have utilized the expertise of many professional scientific and engineering societies and, in some instances, arranged to have specific analyses undertaken by them (*12*).

Some hold the view that these mechanisms are inadequate for securing outside advice on complex scientific and technical matters and advocate the reestablishment of the President's Science Advisory Committee (PSAC). PSAC consisted of nationally known, presidentially appointed scientists and engineers, who met 2 or 3 days a month under the chairmanship of the science adviser. During its existence, PSAC was used to varying degrees by past presidents. In its most effective period it was fully briefed on presidential matters and provided advice to the President on major issues, particularly national security problems. It made use of subcommittees on special topics such as space technology, defense systems, and supersonic aircraft.

The concept has much to recommend it, and future presidents may choose to use it. It was not adopted by this Administration, however, for several reasons. The range of issues for a modern PSAC would be much more diverse than the predominantly national security questions considered in the past. The President preferred, therefore, specially constituted panels on individual issues (more akin to the PSAC subcommittees), seeing these as more effective instruments and closer to his operating style than a longer term, standing advisory committee of generalists. Furthermore, the Federal Advisory Committee Act and the Freedom of Information Act would prevent PSAC from operating in its earlier closed style, since, as a general rule, they require that meetings and documents be open to the public unless they concern classified topics. Under these circumstances, it would be difficult to involve PSAC in current presidential deliberations and the decision-making process to the same degree as in the past.

Some observers of the science policy scene have also questioned the degree to which OSTP participates in long-range planning for science and technology. Long-range planning for science is both necessary and difficult. Certainly, in order to formulate goals, a president and Congress need informed advice about what the future may hold in the way of opportunities and risks. Accordingly, I have made it a point to keep the President aware of major issues worthy of his concern, no matter how distant their impact, and have raised long-range issues with Congress through personal conversations, frequent testimony, and special messages sent by the President. However, the degree to which a White House office can engage in long-term planning unrelated to near-term policy decisions is limited. Moreover, just as is the case for much of our advice on near-term issues, the scientific and technical advice that OSTP provides on longer term concerns must be brought together with the advice of other senior advisers to the President. Our planning efforts have, by necessity, emphasized those intermediate and long-range issues for which early action is needed. These have included such topics as destabilizing and weakening trends in the national scientific and technological endeavor, future science and engineering manpower needs, defense weapons choices, priorities among long-range energy technologies, climatic change, incentives for technological innovation and productivity improvements, and relations with developing countries. In identifying and analyzing such issues, we have used our own staff and have relied on the larger planning staffs in the mission agencies and on advice from the national academies, professional groups, industry, and our individual consultants.

The complexity of science and technology planning in our pluralistic system and the dangers of overplanning in a rapidly changing environment make it imperative that a balance be sought between a focus only on short-term problems and a preoccupation with long-range alternative futures. Carried too far, either would preclude this office from having a significant impact on policy within the Executive Office of the President. OSTP simply would not survive in the White House structure were it not to emphasize issues on the President's agenda, nor would it serve either the President or Congress well if it neglected entirely long-term issues, goals, and plans.

In this regard, we look to the potential of multiyear authorizations for research and development budgets, an improved Five-Year Outlook prepared by The National Science Foundation with OSTP guidance, and the new OMB system of 5-year budget projections to provide a longer range view of science and technology policy.

Conclusion

Scientific advancement and technological achievements pervade all areas of government responsibility. Their scope and complexity throughout the national agenda complicate the task of structuring the government efficiently for science and technology. The President needs scientific and technological advice and support thoroughly integrated with political, economic, and other perspectives in the White House. In the last 4 years we have worked to reestablish the OSTP and the role of the President's science adviser in the Executive Office. We also have outlined a national science and technology policy to guide government programs. Our efforts have been strengthened by the President's personal interest and his call for a scientific and technological perspective in policy formulation. It is my hope that our work has provided a strong impetus to the national scientific and technological endeavor and that, together with the earlier successful White House science offices, we have justified the need for scientific and technological input in the formulation of presidential policy.

References and Notes

1. The President's Message to Congress on Science and Technology, The White House, Washington, D.C., 27 March 1979.
2. Contributing OSTP staff: B. Huberman, A. G. Keatley, N. Fields, and M. G. Finarelli.
3. A. G. Keatley conceptualized this initiative and, with B. Huberman, undertook the planning and implementation.
4. Contributing OSTP staff: B. Huberman, J. M. Marcum, and W. G. Kay.
5. Contributing OSTP staff: B. Huberman, A. C. Morrissey, P. M. Smith, and R. A. Meserve.
6. Contributing OSTP staff: P. M. Smith, R. A. Meserve, L. H. Linden, J. C. Houghton, and T. Greenwood.
7. Contributing OSTP staff: D. J. Prager, G. S. Omenn, J. R. Ball, and C. R. Gerber.
8. Nutrition Research Interagency Working Group, *New Directions in Federally-Supported Human Nutrition Research* (Office of Science and Technology Policy, Washington, D.C., December 1977).
9. *A Technical Review of the Biological Effects of Non-Ionizing Radiation: Report of an Ad Hoc Working Group* (Office of Science and Technology Policy, Washington, D.C., May 1978).
10. Contributing OSTP staff: D. J. Prager and P. M. Smith.
11. FCCSET executive secretary, D. J. Prager; ISETAP executive secretary, J. E. Clark.
12. An example is the American Physical Society Study on Photovoltaic Energy Conversion, January 1979.
13. Many others have contributed substantively to the activities and accomplishments described in this article. They include R. H. Adamson, L. H. Blair, D. R. Calkins, R. C. Curl, R. L. Dixon, E. E. Finney, R. E. Goldman, R. H. Hartke, R. S. Nicholson, R. A. Rhoden, C. Thiel, and R. Wesson (short-term or part-time staff); and C. L. Berg, J. P. Ruina, and E. B. Skolnikoff (senior consultants).