SCIENCE & TECHNOLOGY

AND THE PRESIDENT

OCTOBER 1988
Reprinted FEBRUARY 1993

A Report of the

CARNEGIE COMMISSION
ON SCIENCE, TECHNOLOGY, AND GOVERNMENT

The Carnegie Commission on Science, Technology, and Government was created in April 1988 by Carnegie Corporation of New York. It is committed to helping government institutions respond to the unprecedented advances in science and technology that are transforming the world. The Commission analyzes and assesses the factors that shape the relationship between science, technology, and government and is seeking ways to make this relationship more effective.

The Commission sponsors studies, conducts seminars, and establishes task forces to focus on specific issues. Through its reports, the Commission works to see that ideas for better use of science and technology in government are presented in a timely and intelligible manner.

Additional copies of this report may be obtained from the Commission's headquarters.

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EXECUTIVE SUMMARY

The Carnegie Commission on Science, Technology, and Government was established in April 1988 to assess the process by which the government incorporates scientific and technical knowledge into policy and decision making. The Commission is made up of individuals with broad experience in government and in science and technology.

- Science and technology, effectively mobilized, can help the President achieve his Administration's goals. That mobilization can best be accomplished by bringing science and technology (S&T) into the highest levels of government. The Commission has therefore focused its attention first on how S&T knowledge and advice can help the President deal with related matters in the transition period and beyond.
- Some of the issues involving S&T that will come up include: national security (new weapons, arms control, SDI), health (health costs, AIDS, drugs), large S&T projects (the superconducting supercollider, the High Speed Civil Transport), the environment (acid rain, ozone depletion and green-

house effect), economic competitiveness, energy and nuclear materials, and the S&T enterprise (science education, academic research and the defense technology base). Other issues are certain to emerge.

- The President will need the help of a senior staff assistant to respond to his needs by providing independent counsel in matters involving S&T—for advice, for assistance in policy formulation, budget preparations, policy and program implementation, responding to emergencies, and for early warning of major S&T developments.

- The Commission recommends that the President upgrade the existing position of Science Adviser to an Assistant to the President for Science and Technology. The appointment should be made early in the post-election period so that the Assistant can participate on the transition team and handle S&T questions relating to policy directions, budgetary choices, the organization of the Executive Office staff, and the identification and review of candidates for major Presidential appointments to S&T posts in the Executive Branch. The Assistant should propose S&T qualified individuals to serve on Presidential task forces dealing with policies and programs and should organize *ad hoc* expert groups on selected S&T issues when requested.

- The Assistant should have a strong and formal relationship with the National Security Council (NSC), the Domestic Policy Council, the Economic Policy Council, and the Office of Management and Budget.

- The Assistant would also be Director of the statutory Office of Science and Technology Policy (OSTP) within the Executive Office of the President. The OSTP should be strengthened. The four Presidential appointments to the positions of Associate Director of the OSTP should be made, and the OSTP staff should be increased. The Associate Directors should have policy functions as well as diversified expertise. They should be closely coupled with other parts of the Executive Office, including the NSC, through joint arrangements. The OSTP should have the resources to commission outside analytical studies.

- The President and his Assistant must have the ability to call on the national S&T community for help and to have the collective judgment of broad-gauged experts drawn from different facets of S&T. The Commission recommends that the President appoint an outside group of highly qualified and respected science and technology advisers to report to him through its chairman, the Assistant for Science and Technology. The members should be willing to devote a substantial portion of their time to its work.

- The Commission stands ready to help the President and his Assistant for Science and Technology during and following the transition period.

I
INTRODUCTION

This paper by the Carnegie Commission on Science, Technology, and Government was prepared to assist the incoming President and his staff as they deal with matters involving science and technology (S&T) during the transition period and thereafter.* The paper:

- Discusses the President's needs during the post-election period
- Highlights key S&T related issues that will require Presidential attention early in the new Administration
- Describes the major functions for the President's S&T staff
- Outlines organizational requirements for obtaining S&T advice

The Commission was established by Carnegie Corporation of New York in April 1988 to assess, over a three- to five-year period, the process

* The members of the Commission and Advisory Council are listed on pages 43–44.

by which the government brings S&T knowledge into policy and decision making. Rapid and pervasive transformations resulting from developments in S&T have imposed critical burdens on this process.*

While the Commission's mandate covers all parts and levels of government, it has given priority attention to how the President gets S&T advice and assistance. The organization of this function can influence the entire Federal decision-making system and the ability of the nation to use S&T to further military security and domestic well-being.

* See statement establishing the Commission by Dr. David A. Hamburg, President, Carnegie Corporation of New York, in Appendix A, page 31.

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THE PRESIDENT'S NEEDS DURING THE TRANSITION

Even before his inauguration, the new President will have to:

- Set initial policy priorities for the new Administration
- Resolve critical budgetary questions concerning S&T investments in defense, space, health, and other major programs that will affect his first Budget Message to the Congress
- Make several dozen key technical appointments to the Federal departments and agencies
- Organize the White House and the Executive Office staffs

Scientific and technical expertise and advice are relevant—even necessary—to all of these undertakings. A senior staff assistant who is compatible with the President and his other key staff advisers can be an important contributor to Presidential decisions during the transition period. The incoming President will want to be as knowledgeable as possible about

the issues, and have a staff capable of providing a confidential, independent, dependable, and continuing source of S&T expertise.

The Commission believes that the President should upgrade the existing position of Science Adviser and appoint a senior staff member, with the title of Assistant to the President for Science and Technology, early in the transition period. The person appointed must be capable of obtaining and providing advice on these immediate tasks, have the full confidence of the President, have the respect of the S&T community, and have the breadth to assist the President as he addresses a substantial agenda of issues. The Assistant would also serve as the Director of the statutory Office of Science and Technology Policy (OSTP).

Many significant budget decisions will have to be made by the President during the transition and in the early days of his Administration. A number of them will require judgments on the S&T aspects of programs. Research and development expenditures are approximately 25 percent of the discretionary budget. The Assistant should work with the new director of the Office of Management and Budget on major budget issues involving S&T.

The Assistant should be a member of the group that recruits for key Presidential appointments calling for technical competence. Appendix B lists some sixty important positions filled by Presidential appointment that also require S&T qualifications. The people involved in personnel searches are typically not knowledgeable or experienced in identifying persons with S&T experience. An Assistant for Science and Technology who is highly regarded by the President and the technical community can play a critical role in proposing and reviewing prospective candidates, and persuading distinguished individuals to accept high-level positions. In carrying out this task, the Assistant could enlist the help of organizations such as the National Academies of Sciences and Engineering, the Institute of Medicine, and the American Association for the Advancement of Science.

The President may wish to convene special task forces during the transition period to address immediate and longer-range policy issues. Where appropriate, the Assistant should be asked to recommend persons competent in S&T to serve as members of these task forces. When requested by the President or the transition team, the Assistant should also organize *ad hoc* expert working groups to probe S&T matters in depth.

■ **The Commission recommends that the President appoint an Assistant for Science and Technology very early in the transition and that the Assistant be a member of internal staff groups addressing policy and budgetary issues and advising on Presidential appointments to positions that require a scientific or technical background.**

■ The Commission further recommends that the Assistant be asked to propose technically qualified persons to serve on Presidential task forces dealing with particular areas of concern and to convene *ad hoc* groups of experts to examine selected S&T issues.

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PRESIDENTIAL-LEVEL ISSUES INVOLVING SCIENCE AND TECHNOLOGY

In recent years, there has been a substantial increase in the number and scope of issues coming before the President whose resolution require S&T knowledge and informed professional judgment. They stem from the acceleration of scientific knowledge and technological development, from the opportunities these developments offer, and from an increased understanding and awareness of their economic and societal consequences.

Beginning immediately and throughout his administration, the President will have four main areas in which he will need S&T advice. The first embraces the S&T aspects of space and national security, including arms control issues. The second concerns civilian technology and economic competitiveness. The third involves biomedical questions, including health and drug abuse, and the environment. The fourth is the S&T technical base—the entire research and development apparatus, basic science and generic technology, and science and engineering education. Many individual decisions affect more than one of these areas.

Among the critical S&T-related issues facing the next President are the following:

NATIONAL SECURITY

Many national security–related policies have interwoven technical, political, and military dimensions.

- *New weapons systems requirements.* There is general agreement that the recent build-up in the Defense department has been designed for an annual operation level that is substantially higher than the level of $300 billion agreed to for future expenditures by the Congress and the present Administration. As new weapons systems come on-line, the President will face major decisions on the balance between strategic and conventional forces and between weapons procurement, operations and maintenance, force structure, and sustainment capabilities.
- *Strategic forces.* It will be necessary to restructure and modernize the strategic forces to incorporate new weapons technologies. How can the changes be made to ensure that these forces are adequately survivable? Do they enhance our security and do so in the most economical way? How can capabilities and objectives be better matched?
- *Strategic interaction with conventional forces.* If strategic forces were to be reduced by 50 percent under a START agreement, what changes would be needed in the level and mix of our remaining strategic as well as conventional forces? For example, to what extent and in what way should technological opportunities, such as high-precision weapons, be exploited?
- *Arms control.* There are technical possibilities for unilateral verification of arms control agreements in addition to cooperative and more intrusive means of verification. How should these possibilities affect U.S. positions and goals in negotiating arms control treaties? The Strategic Defense Initiative program is a critical part of the arms control debate. Its goal requires changing the balance between defensive and offensive strategic forces. Is this goal technically and strategically viable?
- *Intelligence.* In the past, White House leadership has been important to the development and continued improvement of new technologies for surveillance. Are there new possibilities for collecting and analyzing information? What is the value of additional technical intelligence capabilities in relation to their cost? How could new intelligence technologies open up opportunities for viable phasedowns of strategic and conventional weapons systems?

SPACE POLICY

U.S. dominance in space peaked with the Apollo manned lunar landings and the Viking unmanned exploration of Mars. It has since declined. The President will have to make critical decisions about the space program.

- *Space goals and initiatives.* Priorities have to be set among the various expensive programs. Which major new initiatives—planetary exploration, earth science, or manned missions to the Moon or Mars—should the President support? Should any of these be cooperative programs with other countries? Will the space shuttle be able to justify its costs over time?
- *The Space Station.* Funding the Space Station—the logical next step to prepare for manned exploration—may crowd out NASA's smaller scientific and operational programs. The President will need to decide whether to fully fund, stretch out, or modify the program.
- *Launch capability.* Launch capability for unmanned missions has deteriorated. How do the military and civilian programs obtain a balanced, mixed fleet of launchers?
- *Civilian space programs.* While the U.S. did the pioneering work in civilian space applications, we are losing that lead. U.S. leadership in satellite communications is threatened by the Europeans and the Japanese. The French earth observation satellite is outperforming the American unclassified version, and French and Chinese launchers are gaining in the commercial satellite launching market. Should the government take a more active role in the development and promotion of civilian space applications?

CIVILIAN TECHNOLOGY AND ECONOMIC COMPETITIVENESS

The international competitiveness of American industry has suffered serious erosion. One of the underlying causes—though only one of several—is a loss of American leadership in important product and process technologies. The critical deficiency is not in research but in failure to achieve fast and effective commercialization of scientific and engineering advances. The hard task facing the government is to find ways to induce industry to abandon short-sighted management practices, without interfering in the details of business decision making. Policy will have to go beyond the support of R&D to such complex goals as achieving a lower cost of capital for investment, stimulating long-range improvements in manufacturing technology, and creating a labor force with skills and motivations adequate for the modern competitive world. S&T machinery must interact with economic and fiscal policy.

HEALTH

Health care accounts for over 11 percent of the U.S. GNP, but there is ever-increasing dissatisfaction with the balance of costs and benefits. These conflicts will surely be aggravated for a variety of reasons, including the aging of the U.S. population, the rapid evolution of new but more costly technologies (like the new artificial kidney and the magnetic resonance scanner), a host of new ethical dilemmas, and increasing expectations that technology can offer and society will pay for alleviation of all disease.

Meanwhile, substance abuse is a festering wound that threatens the fundamental tenets of civility, compounded by its further consequences in crime and in the spread of AIDS and other infections.

Scientific research related to health care is a legitimate source of pride in the U.S., but it constitutes barely 3 percent of the investment in care alone. Are expenditures in health care, disease prevention, and research in proper balance and coherence?

ENVIRONMENT

- *Air quality.* Acid rain pollution has been a contentious issue between different geographic areas of the country. Ozone depletion in the upper atmosphere has focused attention on the impact of apparently benign gases, such as chlorofluorocarbons, on the atmosphere. The increase in infrared-absorbing gases such as carbon dioxide and methane seems to be reinforcing concerns about a "greenhouse effect" that is causing global warming. These problems go beyond our borders, and require international agreements and Presidential attention.
- *Waste disposal.* Toxic chemicals and medical waste attract public attention, but the waste disposal problem is much broader. What more should be done to anticipate and reduce environmental threats?

LARGE-SCALE S&T PROGRAMS

Large science and technology programs have become costly discretionary items in the budget. Many of them start out as relatively small items in a given agency's budget and do not appear to raise significant questions. Because these projects are generally sponsored by different agencies, their relative priorities are often not weighed systematically. The opportunities for international cooperation tend to be neglected. Some examples include:

■ *New aerospace transports.* The Air Force is developing technology for a National Aerospace Plane (NASP). This program—currently budgeted to receive approximately $100 million per year—is aimed at developing a Mach 25 aircraft that can go into space. At the same time NASA is pursuing the Mach 2.5–5.0 High Speed Civil Transport (HSCT), also scheduled to cost $100 million per year. The project competes with Japanese and European efforts.

■ *The superconducting supercollider.* Site selection is proceeding on this high-energy accelerator that is expected to advance the field of fundamental particle physics. The project is sponsored by the Department of Energy. Congress has funded the program at a relatively low level, thereby deferring the decision to build to the next President. The program will eventually cost $5–6 billion.

■ *The human genome program.* The Department of Energy and the National Institutes of Health are co-sponsoring an ambitious, long-range effort to map the structure of the human genome. The long-term cost could reach $2–3 billion.

SCIENTIFIC AND TECHNICAL EDUCATION AND RESEARCH

■ *Scientific and technical education.* The current quality and extent of science education are seriously inadequate in meeting the nation's need for an informed citizenry and for technological growth in the decades to come. While the states are mainly responsible for elementary and secondary education, Federal leadership is needed for upgrading curricula, development of tests, improvement of teaching, and meeting the special needs of women and minorities. At the college and graduate level, more American students are needed, particularly in engineering. In addition, the Federal Government should find ways to encourage technical upgrading of those already in the work force.

■ *Scientific and technical research.* There needs to be stronger support from Federal research grants and contracts for basic research at universities. University research facilities are well behind the industry norm, reducing the opportunity for cutting-edge research. In considering the cost and value of "big science and technology" projects, the President will need to take into account the appropriate balance between them and investigator initiated "small science"—the backbone of basic science and S&T graduate education. To what extent should some of these large-scale projects be carried out cooperatively with other countries?

GOVERNMENT TECHNICAL PERSONNEL

The success of the next Administration will depend heavily on the quality of people it can recruit for technical positions. It is generally agreed that the quality has eroded. Low government salaries, conflict of interest laws, and lessened respect for civil servants may all contribute to the problem. Can recruitment policies and hiring procedures be modified to attract excellent technical people to managerial positions?

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SCIENCE AND TECHNOLOGY FUNCTIONS SUPPORTING THE PRESIDENT

The Assistant for Science and Technology wears two hats: that of a senior member of the White House staff, and that of Director of the statutory Office of Science and Technology Policy. In both capacities, the Assistant should perform the following principal functions drawing on the resources of the OSTP staff and outside consultants:

- **Advice:** Advising and assisting the President and his staff
- **Policy:** Participating in the formulation of policy involving S&T
- **Funding:** Advising on the priorities and funding of S&T
- **Implementation:** Tracking of S&T-related policy implementation
- **Early Warning:** Alerting the President to developments in S&T and their policy significance
- **Emergencies:** Responding to emergencies such as electricity blackouts, technoterrorism, computer breakdown, and natural disasters

Matters coming to Presidential attention that involve S&T usually have one or more of the following characteristics:

- They reach across or beyond the interests and responsibilities of several departments and agencies.
- They have major budgetary or policy implications.
- They have significant national security or foreign policy dimensions.
- They have particularly high public visibility.

ADVISING THE PRESIDENT

It is not possible to differentiate sharply between the roles of the Assistant and the Director of OSTP. The Assistant acts in an individual capacity as a member of the President's inner staff to respond to his day-to-day requests for advice and assistance and to integrate all S&T inputs and relevant considerations in making suggestions and recommendations to the President.

Science and technology advice and assistance to the President can take the form of weighing conflicting technical arguments, presenting policy alternatives and options, recommending choices and priorities, and evaluating scientific or technical solutions to problems.

An important function of the Assistant is to foresee opportunities and problems. As President Ford has noted in this context, Presidents don't like surprises. At the same time, the Assistant must balance his attention to longer-range issues with current and ongoing problems and opportunities.

The Assistant can help the President in his meetings with the heads of foreign governments. Presidential meetings with the leaders of the Soviet Union, India, Japan, Korea, and Taiwan have featured S&T initiatives and agreements. Such agreements often symbolize U.S. technical leadership, while serving broader foreign policy objectives.

Although the Assistant is selected from the S&T community, it should be stressed that he is not a lobbyist for that community. Thus, the President can rely on the Assistant to monitor the health of science and engineering and to identify measures needed to strengthen the national S&T base, working closely with the National Science Board. In the past, some members of the S&T community have erroneously expected the Assistant to be their spokesperson. There have also been occasions when the Science Adviser has been viewed within government as a special pleader for science. The performance and effectiveness of the Assistant must challenge and transcend that misperception.

The departments and agencies will provide much of the help the President needs on S&T matters. While some may view the Assistant and the OSTP as substitutes for S&T competence in the agencies, they function most effectively when the agencies have good technical leadership and staff. In both roles, the Assistant works with departments and agencies to negotiate compromises or agreements among conflicting interests and to point them in new directions, linking them to Presidential concerns.

WORKING WITH CABINET-LEVEL COUNCILS

The Assistant should work closely with other senior members of the President's staff and with Cabinet members as they come together in the National Security Council, the Domestic Policy Council, the Economic Policy Council, the Council of Economic Advisers, the Council on Environmental Quality, and other Executive Office mechanisms that may be established.

THE NATIONAL SECURITY COUNCIL (NSC)

In carrying out its integrative role, the NSC must involve specialized and sensitive understanding of modern military technologies and their future evolutionary prospects.

The NSC has added a number of staff members with technical training, many directly from the military services. However, for further depth, the NSC needs outside experts at the forefront of S&T. These experts must, of course, be versed in the strategic and tactical, as well as the technological aspects of weapons systems.

Since 1951, the Presidential Science Advisers have been engaged in the national security area, and have attended NSC meetings when technical considerations were involved.

THE DOMESTIC POLICY COUNCIL (DPC)

In monitoring the Administration's domestic goals, the DPC reviews programs in areas such as health, natural resources, transportation, energy, or education—all of which are heavily influenced by S&T. Scientific and technological considerations may set limits on what can be accomplished, or may offer opportunities to reduce costs or increase benefits. In the DPC, these considerations interact with economic, social, legal, and political factors.

THE ECONOMIC POLICY COUNCIL (EPC)

The EPC coordinates activities concerning domestic and international economic policy. The Assistant would help in defining the economic policy environment needed to strengthen the contribution of S&T to economic growth, and in framing economic and fiscal policies aimed at restoring American industrial leadership.

OTHER EXECUTIVE OFFICE ORGANIZATIONS

The President may wish to establish new Executive Office organizations or change existing ones. For example, new organizational and institutional arrangements may be needed to deal with U.S. industrial competitiveness, a major domestic policy issue facing the new Administration. The Assistant must play a key role in this area.

■ **The Commission recommends that the Assistant for Science and Technology have a strong and formal relationship with the National Security Council, the Domestic Council, the Economic Policy Council, and the Office of Management and Budget.**

SUPPORTING EXECUTIVE OFFICE OVERSIGHT

Many of the activities of the Assistant, in his capacity as Director of the OSTP, involve review and oversight of S&T-related programs. The Assistant, through the OSTP, will need to cooperate with many parts of the Executive Office and with the departments and agencies to oversee programs and policies from an Executive Office perspective.

OFFICE OF MANAGEMENT AND BUDGET (OMB)

The Assistant's involvement in the budgetary process is particularly sensitive. As Director of OSTP, the Assistant is directed by the Congress to advise the President on S&T budgets and assist the OMB with an annual review and analysis of R&D funding proposals. OMB strongly influences the content, scope, and direction of Federal R&D programs, and the organization of the government's S&T activities. The relationship between the Assistant and the OMB leadership must be robust if the Assistant is to be effective.

PROGRAM OVERSIGHT AND REVIEW

Because of the pervasiveness of S&T in departmental and agency programs, Executive oversight is critical. For example, R&D in atmospheric sciences is of interest to the Department of Commerce, the Department of Interior, the Department of Agriculture, the Department of Defense, the Department of Energy, the Environmental Protection Agency, and the National Science Foundation. At a minimum, information should flow readily among the departments and agencies and the Assistant. Ideally, fully informed oversight can identify undesirable duplication as well as locate gaps and assure that, overall, the R&D policies and programs are being effectively carried out.

One existing mechanism for these purposes is the statutory Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), chaired by the Director of OSTP. The members of FCCSET are the top-ranking scientists and engineers in the department and agencies. FCCSET operates through specialized panels. Informed observers believe that neither FCCSET nor its predecessor, the Federal Council for Science and Technology, performed the oversight functions adequately. The Assistant will need to explore other approaches to coordination.

THE SCIENCE AND TECHNOLOGY REPORT

The OSTP Director is required to submit a "Science and Technology Report and Outlook" to the Congress no later than January 15 of each odd-numbered year. This report, which was intended to provide the Congress with a current statement of the President's policy for maintaining the nation's leadership in S&T, has not been provided regularly by the OSTP.

The biennial Science and Technology Report could serve a useful purpose and be a valuable mechanism for Presidential outreach not only to the Congress, but to the general public. Its preparation, however, is a substantial task requiring significant staff resources.

TESTIFYING BEFORE THE CONGRESS

The Director of OSTP is called on to testify before the Congress, primarily on the OSTP appropriation, but also on substantive matters. There has been a lingering concern that requiring the OSTP Director to testify may conflict with the confidentiality of his advice to the President as a Presidential Assistant. Experience has shown that the Congressional Committees have been sensitive to this issue, and it has not been a significant problem.

5
S&T ORGANIZATION WITHIN THE EXECUTIVE OFFICE

The President must decide how to organize the S&T expertise and advice he needs within the White House staff and Executive Office of the President.* There are four organizational considerations:

- The status of the S&T staff Assistant
- The S&T capabilities within the Executive Office
- The capacity for in-depth S&T policy analysis
- Drawing on outside S&T advice

Although these considerations are treated separately in this report, they are interactive parts of an S&T management system that must involve the non-governmental as well as the governmental sector.

* The current apparatus has evolved gradually over the past three decades; some highlights of its organizational history are summarized in Appendix C, page 40.

STATUS OF THE S&T STAFF ASSISTANT

We have recommended the appointment of an Assistant to the President for Science and Technology. The significance and pervasiveness of S&T in Presidential decision making and the increased complexity of technological issues justify this status and the need for direct access to the President. The status of the Assistant to the President is also a basic ingredient in the recruitment and effectiveness of an outstanding person to perform this function.

Clearly, the personal attributes of the Assistant are even more important than status and title: the ability to relate S&T to short-term needs as well as broad policy concerns, and personality and adaptability to the style of the President and his senior staff. Most important is the ability to establish and maintain the trust, confidence, and interest of the President.

It is essential that officials inside the government perceive that the Assistant has direct access to the President, is effective, and has a close relationship with the White House senior staff. The perception may be as important as the reality. If government officials believe that the President understands the importance of S&T to his policy and decision making and that he relies on his Assistant, their cooperation will be forthcoming. The Assistant's relationship with the President will also be the key factor in recruiting a strong technical staff and a cadre of high-caliber consultants.

The Assistant could be accorded Cabinet rank (without portfolio). As a Cabinet member, he would participate in Cabinet meetings on his own initiative and could more appropriately chair meetings involving Cabinet members.

Some have suggested that the Adviser be appointed the Secretary of a new Department of Science and Technology that would incorporate a number of S&T-related agencies.* Even if there were ultimately to be a new Department of Science and Technology, there will remain a need for a separate S&T Assistant on the President's staff. The Assistant must be viewed as impartial and solely concerned with the interests of the President. If the Secretary of an operational Department of Science and Technology were also the Assistant to the President for Science and Technology, this could be rightly regarded as a conflict of interest when advising on the programs and priorities of other departments and agencies.

■ **The Commission recommends that the S&T advisory function not be fragmented and that there be a single senior staff assistant reporting to the**

* Suggestions for a Department of Science and Technology have arisen from time to time over many decades. A Departmental reorganization of this magnitude would likely entail very extensive analysis, discussion, and legislative attention. This question has not been studied by the Commission.

President on S&T matters with the title of Assistant to the President for Science and Technology. The merits of Cabinet rank should also be considered.

STRENGTHENING EXECUTIVE OFFICE S&T CAPACITY

The National Science and Technology Policy, Organization, and Priorities Act of 1976 (P.L. 94-282), which created the OSTP, charged that office with helping to define and implement national S&T policy to

- Advise the President of S&T considerations involved in areas of national concern
- Evaluate the scale, quality, and effectiveness of the Federal effort in S&T
- Advise the President on S&T considerations with regard to the Federal budgets
- Assist the President in providing general leadership and coordination of R&D programs of the Federal Government

Even after 12 years, the Office is a long way from fulfilling that mandate.

Of considerable importance in strengthening OSTP are the four presidentially appointed Associate Director positions provided for in the OSTP legislation. These posts, mostly vacant through the years, should be filled by highly qualified individuals drawn from different scientific and technical fields. The posts should be used to reinforce the policy functions of the Office and to improve the coupling between OSTP and the various offices and councils in the Executive Office of the President. Serious consideration should be given to joint arrangements whereby one Associate Director would work part-time with the NSC staff. A similar arrangement in the early years of OSTP and its predecessor, the Office of Science and Technology, proved highly constructive in promoting cooperation between the two offices and introduced outside S&T expertise in the work of the NSC staff. Similar joint arrangements with the Office of Management and Budget and other Executive Office agencies should be considered for other Associate Directors.

The coupling problem extends outside government as well. There are many perplexities about how to relate Federal S&T policies and programs to the private sector. It will be a task of the Assistant to find ways to strengthen and effectuate this coupling.

The performance of the OSTP depends on the size and quality of its full-time professional staff. Over the years, successive Administrations

have tended to limit the number of staff and outside consultants to levels that are unrealistic in relation to OSTP's policy and program responsibilities. The presently authorized staff is fifteen positions. Eleven of these are filled and there are about fifteen others on detail from other agencies. The budget for Fiscal Year 1989 was about $1.7 million.

■ **The Commission recommends that the President strengthen the Office of Science and Technology Policy by appointing outstanding professionals to the four posts of Associate Director. Part-time assignments of Associate Directors to other bodies in the Executive Office, such as the NSC staff, should be explored, as well as arrangements to achieve close coupling with the budgetary and legislative staffs.**

■ **The Commission further recommends a substantial strengthening of the professional staff support of the OSTP as an essential step in the invigoration of the S&T advisory function.**

S&T POLICY ANALYSIS

For the President to have the best assessments of major policy options involving S&T, the Assistant and OSTP need clear-cut authority and suitable resources for eliciting independent policy-oriented analytical work outside of the Executive Branch. The National Research Council (the operating arm of the National Academies of Science and Engineering and the Institute of Medicine) can provide in-depth analysis of high quality. Additional analytical capabilities are found in scientific societies, universities, other not-for-profit organizations, and established technical consulting firms. In addition, the congressional support agencies (the Office of Technology Assessment, the Congressional Research Service, the Congressional Budget Office, and the Government Accounting Office) are respected for the quality of their bipartisan reports dealing with matters of S&T.

■ **The Commission recommends that the OSTP be funded to commission in-depth outside analytical studies.**

DRAWING ON THE OUTSIDE S&T COMMUNITY

The range and quality of S&T advice needed by the President cannot be obtained by depending solely on in-house competence. The President can

often rely on the departmental and agency staffs, but their expertise is usually narrowly focused and their advice is often colored by mission commitments and bureaucratic self-interest. Furthermore, developments at the frontiers of science and technology are diverse and their pace is accelerating. Not only does the President need the advice of individual experts from the scientific and technical community outside the Federal Government, but he also needs a responsive mechanism for securing their collective judgments.

The Commission considered the organizational arrangement of the White House Science Council (WHSC), which was established in 1982 by President Reagan's first Science Adviser. Members of WHSC are appointed by and report to the Adviser, and it is chaired by a council member.

The Commission also considered reliance on *ad hoc* panels. This approach, which was employed during the Ford and Carter Administrations, can deal usefully with specific questions. Without an overview committee, however, the early warning and agenda-setting function is lost and the findings of the panels cannot readily be judged or their broader applicability determined.

Having considered the organizational alternatives, the Commission fully supports the establishment of a presidentially appointed S&T advisory group that reports to the President through the Assistant for Science and Technology, who serves as its chairman. Many informed participants in the contemporary S&T scene strongly support this approach.

The advisory group would both respond to the President's requests and initiate studies in areas of national significance, consistent with the wishes of the President. It would critically review S&T proposals, act as a sounding board for the Assistant, and add authority to the Assistant's judgments on S&T issues. The advisory group's deliberations could also help resolve differences of views among the executive departments and agencies. Presidential appointment will be important to recruit outstanding members of the group and, particularly, to elicit the time commitment necessary if the group is to be effective and useful.

■ **The Commission recommends that the President establish an outside group of dedicated senior S&T advisers appointed by the President, headed by and reporting to the President through the Assistant for Science and Technology. Members of the group should agree to devote a substantial portion of their time to its work. *Ad hoc* panels should be convened for in-depth examinations of particular subjects.**

APPENDIXES

APPENDIX A
STATEMENT ESTABLISHING COMMISSION

by Dr. David A. Hamburg, President
Carnegie Corporation of New York

ISSUES UNDERLYING FORMATION OF THE COMMISSION

Since 1940 the pace of advance in basic scientific knowledge—of the structure of matter and life, of the nature of the universe, of the human environment, and even self-knowledge—has accelerated dramatically. These scientific advances have provided an unprecedented basis for technological innovation, especially in the context of political and economic freedom. Such technological innovations have pervasive, worldwide effects beyond prior experience.

Science and technology bear upon war and peace, health and disease, the economy and society, resources and the environment—indeed the entire human future. The international economy, for example, is increasingly driven by developments in science and technology: witness telecommunications, biotechnology, computers, and the technical upgrading of established industries. No reminder is needed of the immense impact on societies

of weapons development and distribution. The issues involve not only the existence of the new hardware but the uses of hardware.

These trends are intrinsically worldwide in scope. Many problems historically considered as internal might better be viewed as domestic aspects of international problems. Moreover, the opportunities and problems arising out of modern science and technology cut across traditional disciplines and sectors of society. Thus, institutional innovations are needed that can transcend traditional barriers—disciplinary, sectoral, and geopolitical.

Clearly, wise policy and administrative decision making in each sphere of life depend on access to the best available knowledge and advice in the various fields of science and technology. Sound advice requires analysis, and analysis requires a broad base of research and development on which informed decisions can be made. Decision makers, moreover, need an understanding of major facets of the scientific enterprise itself.

The rapid and pervasive transformations resulting from science and technology call for strengthening the institutional capability for objective analysis of critical issues based on a broad foundation of knowledge and experience. The government of the United States is in an extraordinary position to stimulate and support such inquiries at a level far beyond what it has done up to now. In addition, the states, the "laboratories of democracy," need better means for dealing with the ongoing and potential applications of research and development.

The Federal Government and the states have an obligation to see that the country exploits the opportunities and avoids the dangers inherent in modern science and technology. This involves, among other desiderata, an understanding of the impact of science and technology on both governmental and nongovernmental tasks. It requires the establishment of a continuing, dependable capability for analyzing policy questions in ways that take adequate account of their scientific and technological aspects.

Science and technology policy itself should strive to meet the following goals:

- Maintaining excellence, technical competence, and efficiency in the conduct of research and development
- Broadening participation in scientific activity as well as in the benefits of applied science
- Shaping the uses of science toward widely shared ends, for example, the relief of human suffering, economic well-being, equitable distribution of resources, and the peaceful resolution of disputes
- Encouraging scientists to participate analytically in the uses of science—at the interfaces of fact and value—neither avoiding nor dominating the processes by which the social uses of science are decided

The nation needs several mechanisms, both governmental and nongovernmental, for analyzing thoroughly and objectively the various options relating to two broad questions: What can science do for society, and how can society keep the scientific enterprise healthy? The capacity for providing the best possible analysis and advice on long-term issues of great national importance must not only be built into government operations themselves; the nation must institute ways of capitalizing on the capability of its diverse nongovernmental institutions to gain and provide such analysis and advice. This orientation emphasizes ways in which science and technology can help to identify the early warning signals of emerging problems and spot neglected or new opportunities for improving national and international well-being.

THE CHALLENGE

Thoughtful policymakers have increasingly felt the need for intelligible and credible syntheses of research related to important public policy questions. What is the factual basis drawn from many sources that can provide the underpinning for constructive options in the future? Pertinent information is widely scattered among government agencies and quasi-governmental or nongovernmental institutions. Moreover, it is very difficult for the nonexpert and sometimes even for the expert to assess the credibility of assertions on emotionally charged issues. In the current process of world transformation, studies are needed to tackle vital and complex issues analytically rather than polemically. This means having access to a wide range of high-quality information, analyses, and options. Jumping to conclusions, or using a heavy ideological filter, can easily lead to major mistakes, missed opportunities, or even disasters.

The central question for thoughtful consideration is how the various branches of government can take careful account of science and technology in policy formulation and implementation affecting all aspects of modern society. What are the mechanisms government now has that are useful for analysis in each major area of responsibility? Which mechanisms should be strengthened or created? How can the various branches of government be organized to improve their operations through the use of modern scientific advances?

Further, how can the government stimulate and utilize the full range of science and technology in the scholarly community both in and out of government, taking into account ethical considerations pertinent to each problem area? Questions about government's role in specific facets of the scientific enterprise include:

- Science policy: What are the conditions under which science flourishes in the United States?
- Technology policy: What are the conditions under which the science base can fruitfully be drawn upon for useful technological innovation?
- Technology assessment policy: What institutional mechanisms and analytical methods are needed for ongoing assessment of major technologies with respect to the humane, constructive uses of technology?
- Science education policy: How can the nation achieve a technically literate citizenry and a skilled work force at all levels of human endeavor as well as prepare first-rate scientists and science-based professionals?

CARNEGIE COMMISSION ON SCIENCE, TECHNOLOGY, AND GOVERNMENT

In November 1987, the Corporation convened a consultative group of experienced scientists and administrators to examine the issues concerning the central role of government in using and stimulating scientific and technological advances for humane purposes. There was general consensus that problems in this regard exist in the executive, legislative, judicial, and regulatory branches and that in-depth analysis of these problems is needed if enduring improvements are to be made. There was additional agreement that an effective approach to the problem would be a commission that would work for about three years with a small high-quality staff. The commission would be intersectoral in nature and include distinguished former government officials, eminent scientists, and private sector leaders.

It was further recommended that the commission should consider the entire range of the sciences—physical, biological, behavioral, and social—as well as the technologies based on them. The main emphasis should be on mechanisms by which the government can systematically assess the ways in which science can contribute to the general well-being of the nation, with special emphasis on the most serious social problems. Mechanisms for sustaining the health of the scientific enterprise should also be considered.

The recommendations of the consultative group were adopted at the Corporation's February 17 meeting of the board of trustees, and the new Carnegie Commission on Science, Technology, and Government was duly created with an initial $500,000 grant.

In addition to eminent scientists, the Commission includes former government officials who have served at high levels in all branches of the government. Leaders from nongovernmental sectors of American society are also included.

Co-chairs of the Commission are Joshua Lederberg, president of The Rockefeller University, and William T. Golden, president of the New York Academy of Sciences and editor of *Science and Technology Advice to the President, Congress, and Judiciary* (Pergamon Press, 1988).

Executive director and member of the Carnegie Commission is David Z. Robinson, most recently executive vice-president and treasurer of the Corporation. Dr. Robinson, who received a PhD in physics from Harvard University, is a former research physicist and was a staff member of the President's Science Advisory Committee. He will continue to serve Carnegie Corporation as senior counselor to the president.

The Commission will organize studies, issue interim reports, and make its final recommendations in about three years, with a two-year follow-up period. It will be assisted by an advisory council.

APPENDIX B
LIST OF PRESIDENTIAL S&T APPOINTMENTS

EXECUTIVE OFFICE OF THE PRESIDENT

- President's Foreign Intelligence Advisory Board

- Office of Management and Budget
  - Associate Director for Human Resources
  - Associate Director for National Security and International Affairs
  - Deputy Associate Director, National Security Division
  - Associate Director for Natural Resources, Energy, and Science

- National Security Council
  - Special Assistant for Arms Control
  - Special Assistant for Defense Policy
  - Special Assistant for Intelligence Programs
  - Special Assistant for International Programs/Technology Affairs

- Central Intelligence Agency
  - Deputy Director for Intelligence
  - Deputy Director for Science and Technology

- Council on Environmental Quality
  - 3 Members

- Office of Science and Technology Policy
  - 4 Associate Directors

CABINET DEPARTMENTS

- Department of Agriculture
  - Assistant Secretary for Science and Education

- Department of Commerce
  - Undersecretary for Oceans and Atmosphere (NOAA)
  - Assistant Secretary for Telecommunications (NTIA)
  - Assistant Secretary and Commissioner of Patents and Trademarks
  - Director, National Institute of Standards and Technology (NIST)
  - Assistant Secretary for Productivity, Technology, and Innovation

- Department of Defense
  - Assistant Secretary, Production and Logistics
  - Assistant Secretary, Command and Control (C_3I)
  - Director, Defense Research and Engineering
  - Assistant Secretary, Health Affairs

- Department of Education
  - Assistant Secretary, Educational Research and Improvement

- Department of Energy
  - Deputy Secretary
  - Undersecretary
  - Assistant Secretary, Conservation and Renewable Energy
  - Assistant Secretary, Defense Programs
  - Assistant Secretary, Environment, Safety and Health
  - Assistant Secretary, Fossil Energy
  - Assistant Secretary, International Affairs and Energy Emergencies
  - Assistant Secretary, Nuclear Energy

- Department of Health and Human Services
  - Assistant Secretary for Health
  - Surgeon General, Public Health Service
  - Director, National Institutes of Health

- Department of Housing and Urban Development
  - Assistant Secretary for Policy Development and Research

- Department of the Interior
  - Science Advisor
  - Assistant Secretary, Land and Minerals Management
  - Assistant Secretary, Water and Science

- Department of Labor
  - Assistant Secretary, Mine Safety and Health

- Department of State
  - Undersecretary for Security Assistance, Science and Technology
  - Special Advisor, Arms Control Matters
  - Ambassador-at-Large, Non-Proliferation and Nuclear Energy Affairs
  - Office of Negotiations on Nuclear and Space Arms with USSR
  - Assistant Secretary, Bureau of Oceans and Environmental/Scientific Affairs

- Department of Transportation
  - Assistant Secretary, Policy and International Affairs
  - Administrator, Federal Aviation Administration

- Arms Control and Disarmament Agency
  - Director

- Consumer Product Safety Commission
  - 5 Commissioners

- Environmental Protection Agency
  - Administrator
  - Deputy Administrator
  - Assistant Administrator for Research and Development

- National Aeronautics and Space Administration
  - Administrator
  - Deputy Administrator

- National Science Foundation
  - Director
  - Deputy Director
  - National Science Board

- Nuclear Regulatory Commission
  - 5 Commissioners

APPENDIX C
HISTORY OF THE PRESIDENT'S S&T ORGANIZATION

All Presidents since Truman have recognized the value of tapping a broad range of S&T knowledge from outside the government. President Truman appointed a Science Adviser who served in the Office of Defense Mobilization and also had direct access to him, though this access was seldom used. The systematic use by the President of S&T advice began in 1957 with Sputnik. President Eisenhower brought James Killian into the White House as his Adviser, with the title of Special Assistant to the President, and elevated the Science Advisory Committee from the Office of Defense Mobilization so that it reported directly to him.

President Eisenhower sought advice in responding to Sputnik and to the competing proposals of the military services. The Adviser also was involved in the organization of NASA and the establishment of the Office of the Director of Defense Research and Engineering and the Advanced Research Projects Agency in the Department of Defense. There were important questions regarding technical intelligence, and the possibilities for a

nuclear test ban. Members of the President's Science Advisory Committee were mobilized for these tasks, and many of them spent substantial time in Washington. The Adviser also helped establish high-level S&T posts in the departments and agencies. Toward the end of the Eisenhower Administration, the Adviser and PSAC added to their work the concern for the advancement of science.

President Kennedy kept the same bipartisan PSAC mechanism with some systematic rotation of its members. In order to institutionalize the advisory function, he established the Office of Science and Technology (OST) in the Executive Office of the President. The title of Director of OST (confirmed by the Senate) was added to that of Special Assistant to the President and Chairman of the President's Science Advisory Committee. The Adviser's staff was transferred from the White House to OST. The Adviser's portfolio broadened to include health, civilian science, and the environment.

The Adviser's role continued under President Johnson and through President Nixon's first term. During this period, the Adviser and PSAC were deeply involved in national security issues particularly as related to the Vietnam war, arms control, and the treaty to eliminate biological weapons.

After the election in 1972, President Nixon abolished both OST and PSAC. These actions appeared to derive from two principal concerns. One was that former PSAC members had opposed the President's position in testifying before the Congress on antiballistic missile defense. The other was the disclosure of the existence of a PSAC panel report questioning the development of a supersonic transport, a project that had been strongly supported by the President. Perhaps the most important underlying factor was the cumulative effect of years of strain between the White House and the academic community over the Vietnam war, and the perception by the White House staff that PSAC was part of that community.

President Nixon added the duties of Science Adviser to those of the Director of the National Science Foundation. His Advisory work concentrated on energy R&D, problems in industrial R&D, agricultural research, and academic–industrial cooperation.

President Ford asked Vice-President Rockefeller to recommend appropriate organization for S&T advice to the President. The OST function was resurrected in the Executive Office by an Act of Congress in 1976 in the form of the Office of Science and Technology Policy. President Ford reestablished the Adviser's position in the White House and created the President's Committee on Science and Technology, authorized by the legislation, which worked particularly on energy and individual research issues.

Presidents Carter and Reagan named their Science Advisers after their inauguration. Although the President's Committee was not continued, President Carter's Adviser appointed *ad hoc* panels of nongovernment scien-

tists and engineers to advise him on certain issues. He dealt with questions such as the MX missile, the test ban, space policy, and air quality standards.

In 1982, President Reagan's Adviser established a White House Science Council of outside consultants that reported to the Adviser, rather than to the President. During this Administration, the Adviser has dealt with matters such as strengthening basic research, the National Aerospace Plane, Stealth technology, the Strategic Defense Initiative, and international S&T agreements.

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