A SCIENCE AND TECHNOLOGY AGENDA FOR THE NATION

RECOMMENDATIONS FOR THE PRESIDENT AND CONGRESS

DECEMBER 1992

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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FOREWORD

Historically the election or reelection of a President has meant new staff, new ideas, and new programs, as the four-year clock is reset. There is every reason to believe that the next four years will be a time of great change, domestically and internationally. Science and technology can play a major role in ensuring that this change is beneficial. This report summarizes the Carnegie Commission on Science, Technology, and Government's major recommendations to the Administration and Congress in four key policy areas: the economy, defense, the environment, and science education. It is our conviction that decisions on these and other critical issues will require governmental access to the best available scientific and technological information.

Since 1988, the Commission has been studying the way all branches of government handle decisions on issues affected by science and technology. The Commission has focused both on institutions (among them the Executive Office of the President, Congress, the Judiciary, the regulatory agencies, and the states), and on key problem areas (including economic growth,

national security, the environment, science education, and international relations). As of November 1992, it had published eleven reports, and seven more were expected before publication of its final report in 1993. The Commission has not examined a number of other areas of major concern where advances in science and technology, including the behavioral sciences, can make major contributions, such as health care, world population, and urban problems; other organizations with special expertise are addressing these issues.

As this report makes clear, economic, defense, environmental, and education issues involving science and technology are strongly interrelated. The reorientation and overhaul of defense procurement, for example, has major implications for the civilian economy. This interrelationship requires policy attention at the highest level—the White House and Congress—and broad technical competence throughout the government, particularly in the Executive Office. Thus, two chapters of the report focus on the organization of the Executive Office of the President and the need for the President's Science Advisor to be involved early in helping the President fill key scientific and technical positions.

The next Administration and Congress will be the first in over 50 years that will not have the problems of war or the Cold War as its first priority. There is a window of opportunity to direct the nation's science and technology resources to broader national goals—an opening that requires immediate attention, in terms of organization as well as policy.

Science and technology gave this nation a military edge for yesterday's agenda, and the result was a victory for the free world. The appropriate use of science and technology can help with tomorrow's agenda as well. We hope that this report will contribute to that process.

William T. Golden, Co-Chair
Joshua Lederberg, Co-Chair

PREFACE

The Carnegie Commission on Science, Technology, and Government was established by Carnegie Corporation of New York in April 1988 to assess the process by which the government at all levels brings scientific and technical knowledge to bear in setting policy and making decisions. The Commission is an independent bipartisan body of eminent individuals with technical and government experience. The Commission has established a distinguished Advisory Council of thirty-one members,* and a special group of forty-four Senators and Members of Congress advises the Commission's Committee on Science and Technology and Congress. The Commission's work on specific issues or organizational topics has been carried out primarily through task forces of highly qualified experts. Over two hundred individuals have served on these task forces.

The Commission has produced eleven reports, and it anticipates producing seven more before its final report in 1993. The reports published

* Members of the Commission and its Advisory Council are listed on pages 35–37.

so far contain more than 200 recommendations. At its June 1992 meeting, the Commission decided to issue a report, to appear after the election, that would update its major recommendations in a few priority areas for the benefit of the next Administration and Congress.

The report was prepared by David Z. Beckler, Mark Schaefer, and David Z. Robinson of the Commission staff, in consultation with the chairs of some of the task forces—Lewis M. Branscomb, B. R. Inman, William J. Perry, and H. Guyford Stever. Helpful comments were contributed by Commissioners Norman R. Augustine, Jimmy Carter, Sidney D. Drell, and Andrew J. Goodpaster, and by Advisory Council members Harvey Brooks, Harold Brown, Theodore Cooper, Maxine F. Singer, and Charles A. Zraket.

1
INTRODUCTION

This report by the Carnegie Commission on Science, Technology, and Government is intended for the next Administration and the new 103rd Congress.

Advances in science and technology offer compelling possibilities for addressing national priorities, but exploiting these possibilities will require organizational changes and a new level of understanding on the part of government. The report, based on the findings and recommendations of the Commission and its task forces, outlines some immediate steps that the government can take to use science and technology more effectively in four priority areas of national concern:

- *Making U.S. industry more competitive against world standards.* With the advent of a single European market and the new economic strength of Asian nations, the government must support

national technology policies that will enhance American economic performance.

- *Ensuring national security.* An effective defense rests in substantial measure on the application of technology. Steps must be taken to ensure that, as defense spending declines, the defense technology base will not grow weaker and more isolated from developments in the commercial sector on which it depends. Preventing the proliferation of weapons of mass destruction also remains a high priority.

- *Safeguarding the environment.* Choices and trade-offs must be made that will affect economic growth, energy use, and the quality of the human habitat. There will also be opportunities to develop new processes and products that safeguard the environment efficiently. Scientific and technological information will be critical.

- *Restructuring education.* Ensuring the technical capability to address national goals for the economy, environment, health, and security will require substantial reforms in K–12 math and science education. This undertaking has a long lead time, and early action is important.

These areas of concern are interdependent, and all require attention at the highest policy levels in the Executive Branch and in Congress. Strengthening economic performance and the national technology base, for example, will require simultaneous consideration of national security, economic, energy, environmental, regulatory, trade, and technology policies. Future progress in all these areas depends on a national commitment to maintain and replenish the nation's storehouse of basic knowledge in science.

The recommendations offered in this report fall into three categories. Chapters 2–5 bear on early budget and policy decisions by the next President and Congress, particularly as they affect the four priority areas noted above. Chapter 6 summarizes recommendations for strengthening the organization and procedures of the Executive Office to ensure that consistent and timely policy-oriented scientific and technical advice is available to the President and to the governmental decision-making process, and Chapter 7 deals with the role of science and technology in achieving U.S. foreign policy objectives. More detailed recommendations are contained in the Commission's reports.*

* Reports of the Commission, other organizations' reports sponsored by the Commission, and reports to the Commission by consultants are listed in the Appendix.

2

THE ECONOMY

Strengthen the capacity of the Executive Office to deal with technology policy issues related to economic performance and the national technology base.*

Improved national performance requires sustained growth in productivity. The development and diffusion of new technology and its underlying science have been a major source of such growth. Historically, the federal government has contributed to technological growth in many ways—indirectly through economic policies, and directly as part of traditional government interests in defense, space, health, science, and agriculture. Although primary responsibility for the advancement of commercial technology continues to lie with industry, an important role remains for government. An area of particular importance is the need for integration of the defense and commercial technology bases.

* See *Technology and Economic Performance: Organizing the Executive Branch for a Stronger National Technology Base.*

■ **The National Security Council should serve as a mechanism for coordinating and integrating the various policy perspectives of councils and offices in the Executive Office of the President on issues that link national security, economic performance, and technological strength.**

The fading of superpower confrontation means that the definition of national security will give greater weight to economic considerations. The mission and staff of the traditionally powerful and respected National Security Council should be broadened to enable it to decide on policies to strengthen the national technology base. If this broader definition of national security is not accepted, a separate council with responsibility for these issues should be established.

■ **Give the Office of Science and Technology Policy lead responsibility for identifying and evaluating policy issues related to the technological aspects of economic performance.**

The Assistant for Science and Technology, working closely with the Director of the Office of Management and Budget and the Chairman of the Council of Economic Advisers, should exercise leadership in analyzing and developing policy recommendations bearing on technology and economic performance.

■ **Build a Department of Commerce that is technologically sophisticated and capable of forging a strong partnership with business, labor, and universities, a partnership that will strengthen the U.S. commercial technology base without preempting business judgments.**

The Commerce Department should be greatly strengthened to serve as the lead agency for a coordinated governmentwide effort to help increase the productivity and innovative capacity of the U.S. industrial base, relying primarily on the National Institute for Standards and Technology (NIST). NIST should be recognized as having a central responsibility for supporting generic and precompetitive R&D that has potential commercial application over a range of industries and does not fall within the missions or R&D programs of other departments and agencies. Key to the capacity of Commerce to take the lead is the appointment of a Secretary recognized as a leader in the pursuit of expanded national competitiveness.

■ **Initiate federal–state collaboration in accelerating technology utilization.***

The states have a special role in industrial extension and technology diffusion. They need more effective access to federal R&D planning and

* See *Science, Technology, and the States in America's Third Century.*

resources, and help in financing diffusion activities over a long enough time to test their efficacy. The Administration should invite governors to join in convening a national conference on technology and economic development that can define and institute the federal–state–industry linkages that are essential for long-term economic development.

3
NATIONAL SECURITY

Bring together the nation's defense and commercial technology bases by initiating a sweeping reform of the defense acquisition system, and maintain the defense technological edge.*

In light of the new security era we are entering and the significantly reduced defense budgets likely in this new era, the next Administration must undertake immediate measures to preserve the advantage the United States now has in defense technology. The only way to do this efficiently is to integrate the defense industry into commercial industry: with the expected size of the defense industry in the 1990s, and with the increased importance of commercial technologies to defense, the United States can no longer afford

* See *New Thinking and American Defense Technology* and *Technology and Economic Performance.*

the luxury of maintaining two distinct industrial bases. This complex task will require a fundamental overhaul of the defense acquisition system, the restructuring and selective closing of military laboratories, and continuing defense support of dual-use technologies (those with both defense and commercial applications).

■ **Undertake a sweeping reform of the defense acquisition system.** The timing of this action is critical. With a dramatic decline in defense spending under way, there is a window of opportunity to make major changes in the acquisition system at a time when system procurement will be at its lowest level in more than forty years. Additionally, there will be public support for getting more value from the declining procurement budget. If the process is begun immediately—and this could be an important bellwether of a fresh commitment to change—the next Administration will have four years to get the new system in place. Any less time is probably not sufficient to make fundamental changes in such a large bureaucratic operation.

All studies of the defense acquisition system agree that it suffers from excessive cost and inefficiency, but previous attempts to reform the system have failed, mainly because they have tried to build on a flawed foundation. What is required is a decisive break with the present system and the creation of a new system based on the best of acquisition processes, along the lines of those used by large corporations when they undertake to develop new systems (for example, the process under way at Boeing to develop and build the 777, a new transport aircraft).

Producing and procuring defense equipment on a commercial basis would involve converting from a *cost-based* to a *price-based* procurement system and a shift wherever possible from military to commercial specifications. The problems with the present defense acquisition system are deeply rooted in the cost-based system of procurement, with its insidious system of allowable overhead. This system invites abuse, requiring thousands of government overseers, matched person-for-person by their counterparts in industry. Eliminating this fundamental source of abuse, and the corresponding personnel superstructure, would directly reduce defense expenditures by billions of dollars.

The present defense acquisition system is so deeply ingrained in practice and in law that any fundamental change will require a major commitment by the President, the Secretary of Defense, and Congress. But these recommendations promise substantial gains in efficiency and effectiveness by eliminating wasteful jobs and unnecessary specifications, and can enable major reductions in defense spending while maintaining significant defense capability.

■ **Maintain strong defense technology support, and adapt it to changing conditions.**

A number of steps are needed to maintain the advantage the United States now holds in defense technology:

- **Organize a commission, patterned after the "base-closing" commission, to recommend which military laboratory and technology centers should be shut down or converted to government-owned/contractor-operated (GOCO) organizations.**
  These laboratories were created at a time when defense technology led commercial technology, and many of them are no longer appropriate to an era when private industry—both domestic and overseas—is ahead in many technologies most significant to defense superiority.

- **Transform the Defense Advanced Research Projects Agency (DARPA) into a national Advanced Research Projects Agency by expanding collaboration between the Department of Defense (DoD) and U.S. commercial firms in the development of dual-use technology.**
  The agency should remain in the Department of Defense, and its focus should be on military and dual-use technologies. Building on present DARPA responsibilities to the DoD, it should *also* support
  - Long-range, high-risk, and generic technologies with potentially high payoff
  - Advanced technology to meet the mission objectives of non-defense agencies (only when requested and funded by them)

- **Continue Department of Defense investments in basic research, applied research, and exploratory development.**
  The Department of Defense will continue to be a major consumer both of science and technology and of scientific and engineering personnel. Defense research investments in universities, defense laboratories, and industry are vital to the nation's scientific and technical capacity, and they will need protection during the build-down of the defense budget. Much of the work should be performed by the private sector, so as to maximize the contribution of these investments to commercial technological performance. Defense exploratory development, with its emphasis on prototyping, is a relatively inexpensive way of creating a defense technology reserve for the strategic uncertainties of the future.

4
THE ENVIRONMENT

Strengthen the environmental and regulatory policymaking capacity of the White House and Congress.*

Federal regulatory policies for protecting the environment and human health and safety are perceived both within and outside the government as inconsistent and fragmented. Improvements are clearly needed in the ways in which the federal government examines risks, sets priorities, and communicates its policies to the public. Furthermore, federal environmental regulatory programs have focused mainly on health-related risks, paying relatively little attention to ecological risks and the sustainable use of resources.

Policies for environmental protection are interwoven with those for energy sufficiency and economic growth, but their effective integration and

* See *E³: Organizing for Environment, Energy, and the Economy in the Executive Branch of the U.S. Government* and *Environmental Research and Development: Strengthening the Federal Infrastructure* (available December 1992).

implementation requires a much stronger linking capability at the highest levels of government, with due regard for economic aspects and cost–benefit considerations.

■ **Expand the mission of the existing Office of Environmental Quality in the Executive Office of the President, giving it broad responsibility for developing environmental and risk-related policies.**

The Office of Environmental Quality was established by the National Environmental Quality Improvement Act of 1970. The Council on Environmental Quality (CEQ), which was established in 1969, however, has always been the dominant entity. We believe that the CEQ, which has not operated as a council over the past four years, should be abolished. Instead, we recommend an expanded mission for the Office of Environmental Quality. The Office should be headed by a director with the rank of Assistant to the President and the corresponding authority to call meetings of Cabinet officers. The Director should lead efforts in the White House and the Executive Office to develop environmental and risk-related policy options, presenting proposals to the President and Cabinet-level councils. In developing policy proposals, the Office of Environmental Quality should work to integrate environmental, energy, and economic considerations.

■ **Devise mechanisms to facilitate informal communications among the three branches of government with respect to environmental and other risk-related policies.**

Congress and the President share responsibility for developing environmental policy. Both branches of government should work to develop more effective environmental policies, for example, by incorporating economics-based schemes into regulatory strategies. Doing so will require closer interaction between these two branches in building a consensus on long-range objectives—both national and international—and in devising strategies to achieve them. Reaching agreement on the extent to which various public health and environmental risks should be reduced will be a continuing challenge in the years ahead.*

Improved communication between Congress, the Executive Branch, and the Judiciary is essential to developing better environmental and risk-related policies and to their effective implementation. Over the past decade of "divided government," distrust and strained relationships have made environmental policymaking particularly challenging. Informal bridging mech-

* These issues will be addressed in detail in two future Commission reports, *Science, Technology and Congress: Organizational and Procedural Reforms* and *Science and Technology in Regulatory Decision Making.*

anisms between the branches are badly needed.* We recommend the establishment of a Forum in which members of Congress, Executive Branch officials, and judges could meet informally to exchange views on broad issues raised by the interaction of science and policy in environmental regulation and risk management. A three-way conversation could lead to more coherent and consistent environmental and risk management policies by the Executive Branch and Congress. More broadly, there is a need to supplement these communications by a dedicated effort to educate the public about the meaning and implications of risks.

■ **Establish an Institute for Environmental Assessment, reporting to the Executive Office or an executive agency, to evaluate national and global environmental problems and to develop alternative approaches to them.**

The Executive Office needs a multidisciplinary corps of individuals who can assess the information resulting from research efforts and relate it to economic, social, and political considerations. Meeting the environmental challenges of the future will require innovative environmental protection policies and programs in a number of departments and agencies. Careful assessment of these policies and programs requires independent capability, outside the groups charged with formulating and carrying them out. The Institute for Environmental Assessment could report to the White House through the Director of the Office of Environmental Quality (or through CEQ), or it could be located in EPA or within a new Department of the Environment.

■ **Create a new Environmental Monitoring Agency by combining the National Oceanographic and Atmospheric Administration (now within the Department of Commerce) with the U.S. Geological Survey (now within the Department of the Interior).** This reorganization would focus environmental monitoring and increase the effectiveness of federal efforts to document the characteristics of air, land, and water resources and to evaluate the related impacts of human activity on them and on the earth's environment as a whole.

■ **Reorganize the laboratories of the Environmental Protection Agency, and establish a set of Environmental Research Institutes, associated with universities and nongovernmental organizations, throughout the country.**

The quantity and quality of research on the environment needs substantial upgrading, both inside and outside government. To accommo-

* The National Academy of Public Administration has offered some useful ideas for dealing with this problem. See *Beyond Distrust: Building Bridges between Congress and the Executive*, National Academy for Public Administration, Washington, DC (1992).

date the need for integrated environmental research and monitoring, EPA's laboratory structure should be revamped: the twelve EPA laboratories should be reorganized to produce four national laboratories: ecological systems; environmental monitoring; environmental engineering; and health effects research. To complement these government laboratories, several multidisciplinary environmental research institutes, affiliated with universities and nongovernmental organizations throughout the country, should be established.

5
EDUCATION

Upgrade K–12 math and science education.*

While ultimate responsibility rests with state and local government, there are at least two reasons why the federal government should pay special attention to math and science education: the increasing demand for numeracy and problem-solving ability in tomorrow's world, and the federal government's special responsibility for assuring the nation's technical capability to address national goals for the economy, environment, health, and security. President Bush and Governor Clinton were key leaders when the President and the governors set national educational goals at the Williamsburg summit in 1989. Reaching the ambitious goal for science and math education† will

* See *In the National Interest: The Federal Government in the Reform of K–12 Math and Science Education.*

† Goal #4 of the President and governors: "By the year 2000, U.S. students will be first in the world in science and mathematics achievement."

require forceful and imaginative action by the federal government and the states in the next decade.

■ **Commit federal R&D agencies to invest no less than 1 percent of their R&D budgets in support of a national strategy for math and science education reform.**

Every agency that uses science and technology should have an explicit education charter defining its responsibility to address precollege needs—new elements of curricula, teacher skills and knowledge upgrading, outreach of scientists and engineers to the schools, encouragement of university/school linkages—that lie within the agency's special expertise and its human resource requirements.

■ **Expand the integration of National Science Foundation and Department of Education activities.**

No single investment will reverse the decline of American public education; it requires systemic change (led by the Department of Education) and improvements in classroom instruction (supported by the National Science Foundation). These agencies should work together on three new initiatives:

- Creating a national system for helping schools get access to and successfully adopt proven educational innovations, utilizing the emerging national information infrastructure

- Adding new federal support to colleges and universities to upgrade the capabilities of teachers and to attract into teaching a much larger fraction of academically superior Arts and Sciences graduates

- Providing private sector initiatives and federal research support to generate and disseminate proven educational technology and curriculum materials for use with it, including techniques used by industry and by the military

6
SCIENCE AND TECHNOLOGY AND THE PRESIDENT

Ensure that the scientific and technical advice available to the President is coordinated, timely, and informed by the best possible information.*

In the nearly 50 years since World War II, the major impetus for presidential involvement with issues of science and technology has been national security—the Cold War, in particular, with its implications for everything from public education to the space race to the "hot line" to Moscow. Dealing with the new priorities of the 1990s will require decisions that are just as important as those of the Cold War period. But their wider range and greater complexity and subtlety require significant strengthening of the mechanisms by which the President receives technical advice and support.

* See *Science & Technology and the President.*

■ **Appoint before the inauguration a highly qualified technical leader to serve as Assistant to the President for Science and Technology, and ensure that the Office of Science and Technology Policy is adequately staffed.**

The Assistant for Science and Technology should be a member of the President's core team at the outset, to advise on technology-related issues, including national security, and to assist the President in filling vacancies in the 60 top government positions that require a high level of technical and managerial ability. Since the Assistant serves both as a senior staff advisor to the President and as director of the statutory Office of Science and Technology Policy (OSTP), senior staffing in OSTP must be sufficient to enable the Assistant to give primary attention to advising the President and working with presidential staff and policy councils.

■ **Maintain a direct relationship between the President and the President's Council of Advisors on Science and Technology (PCAST) to provide the President with the independent consultative advice from outstanding members of the technical and scientific communities.**

The basic criteria for appointment to PCAST should be outstanding professional accomplishment and policy judgment. The President should meet regularly with PCAST to hear the views of its members and to communicate his concerns and policy perspectives. PCAST reports should be made available to the public when they would contribute to the understanding of important national issues.

■ **Improve recruitment and appointing procedures for Presidential appointments and other senior positions requiring scientific or technological expertise.***

Ensuring high-quality S&T leadership in government should be a presidential priority. S&T posts require a separate recruitment process specially designed to identify and attract highly qualified appointees. Broader than necessary conflict-of-interest restrictions and the tendency to politicize the presidential appointment process are limiting the government's ability to attract individuals with substantial experience in rapidly changing fields of science and technology. The Administration should work with Congress to remove the hurdles that delay appointments and to reduce the disincentives to government service.

* See *Science and Technology Leadership in American Government: Ensuring the Best Presidential Appointments*, National Academy Press, Washington, DC (1992). This report was cosponsored by the National Academies complex and the Carnegie Commission on Science, Technology, and Government.

■ **Convene the interagency Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) regularly at Cabinet level, with the participation of the director of OMB. FCCSET should serve increasingly as a high-level forum for the assessment of policies for science and technology.**

In judging the strengths, weaknesses, and gaps in individual agency research programs, FCCSET should solicit the views of the National Academies complex (the National Academies of Sciences and Engineering and the Institute of Medicine) and other qualified professional S&T organizations. S&T advice from members of the business community is also needed. FCCSET should also draw on the advice and experience of the states, which are major supporters of research and technology related to economic development, and have a major role in environmental policy and education.

■ **Establish an interagency group on Policies for Science, chaired by the Assistant to the President for Science and Technology; the group would include the heads of the National Science Foundation and the National Institutes of Health, the NASA Administrator, the Director of Defense Research and Engineering, the Director of Energy Research, and the Deputy Director of OMB.**

The White House has not regularly addressed governmentwide issues concerning federal policies for science. An interagency group should identify and propose policies related to basic research, graduate education, and research facilities for consideration by policy mechanisms at the presidential level. The President's Council of Advisors on Science and Technology and the National Science Board should exercise their advisory roles in proposing policies for science.

■ **Provide mechanisms for integrating science and technology considerations in White House policy formulation.**

The following steps should be taken:

- Have the Assistant for S&T regularly attend meetings of the White House policy councils and chair subgroups on science and technology that bridge the interests of the several councils.

- Strengthen the policy orientation of the OSTP staff to enable OSTP to take the lead in identifying S&T-related issues for consideration by the White House policy councils.

- Develop a dedicated policy research and analysis capability for the Executive Office of the President in science and technology,

drawing on the capabilities of the recently established Critical Technologies Institute.

■ **Set federal long-term S&T goals and measure progress toward achieving them.***

The Office of Science and Technology Policy, OMB, and federal departments and agencies should work to integrate considerations of long-term S&T goals into annual budgeting and planning efforts. Parallel efforts should be made by Congress. Establishing a nongovernmental National Forum on Science and Technology Goals would help to define, focus, and articulate science and technology goals in the context of national and international societal goals.

* See *Enabling the Future: Linking Science and Technology to Societal Goals.*

7
INTERNATIONAL AFFAIRS

Make science and technology more effective instruments for achieving U.S. foreign policy objectives.*

The United States has a unique opportunity to use its strengths in science and technology to take international initiatives that can benefit both the United States and the world community. The international responsibilities and priorities for science and technology among government agencies should be reviewed and clarified to provide for Executive Office leadership, with foreign policy coordination through the Department of State. The State Department and the Assistant to the President for Science and Technology should play stronger roles in White House deliberations on science and technology in international affairs, especially in the National Security Council and White House groups concerned with international economic and environmental policies. A Science and Technology Counselor to the Secretary of State would enhance that process.

* See *Science and Technology in U.S. International Affairs.*

The United States can also help bring to bear the immense power of science and technology to aid in development throughout the world.* It needs to create a national roundtable for international development; it also needs new legislation to establish much stronger aid institutions, policies, and practices—legislation that will lead to greater use of the private and nonprofit sectors of society. There is also a great opportunity to strengthen multilateral organizations so that they can be more effective in using science and technology for development.†

* See *Partnerships for Global Development: The Clearing Horizon*, available December 1992.
† See *International Environmental Research and Assessment: Proposals for Better Organization and Decision Making.*

8
CONCLUSION

For the first time in nearly half a century, a new Administration and a new Congress are not faced with the reality of Cold War and the ever-present threat of nuclear conflict. The changed priorities of this post–Cold War world require new kinds of interactions between government, research institutions, and industry; between the federal government and the states; between the United States and other countries in the industrial and developing world; between defense and commercial industry; between our goals for the environment and for energy use and our requirements for economic growth. This report, focusing on science and technology, recommends new institutional arrangements, new policies, and new programs to promote such interactions.

Some of the changes proposed in this report should produce early payoffs—for example, changes in defense procurement. Others, even if implemented immediately, will take time to bear fruit—improved education in science and technology being only the most obvious. But a vigorous

beginning can make a major difference. Organizational changes, in particular, benefit from the leverage and fresh energy of a new Presidential term.

Science and technology can help this nation not only to take full advantage of the new opportunities, but also to address the challenges that remain. Wise use of science and technology will enable the United States to enhance its economic competitiveness, protect the environment, ensure national security, conserve energy, and improve its educational system. By offering the recommendations in this report to the new Administration and the new Congress, the Carnegie Commission on Science, Technology, and Government hopes to contribute to this process.

APPENDIX
COMMISSION REPORTS

FORMAL REPORTS OF THE COMMISSION

Science & Technology and the President (October 1988)

E^3: Organizing for Environment, Energy, and the Economy in the Executive Branch of the U.S. Government (April 1990)

New Thinking and American Defense Technology (August 1990)

Science, Technology, and Congress: Expert Advice and the Decision-Making Process (February 1991)

Technology and Economic Performance: Organizing the Executive Branch for a Stronger National Technology Base (September 1991)

In the National Interest: The Federal Government in the Reform of K–12 Math and Science Education (September 1991)

Science, Technology, and Congress: Analysis and Advice from the Congressional Support Agencies (October 1991)

Science and Technology in U.S. International Affairs (January 1992)

International Environmental Research and Assessment: Proposals for Better Organization and Decision Making (July 1992)

Science, Technology, and the States in America's Third Century (September 1992)

Enabling the Future: Linking Science and Technology to Societal Goals (September 1992)

Partnerships for Global Development: The Clearing Horizon (December 1992)

Environmental Research and Development: Strengthening the Federal Infrastructure (December 1992)

In addition to those already published, reports will appear on the following topics:

- Nongovernmental Organizations
- National Security
- Judicial Decision Making
- Regulatory Decision Making
- Congress

REPORTS SPONSORED BY THE COMMISSION

Recruitment, Retention, and Utilization of Federal Scientists and Engineers: A Report to the Carnegie Commission on Science, Technology, and Government, National Research Council, Committee on Scientists and Engineers in the Federal Government, Alan K. Campbell and Linda S. Dix, editors, National Academy Press, Washington, DC, 1990.

Science and Technology Leadership in American Government: Ensuring the Best Presidential Appointments, National Academy of Sciences, National Academy of Engineering, National Institute of Medicine, Committee on Science, Engineering, and Public Policy, National Academy Press, Washington, DC, 1992.

The Prune Book: The 60 Toughest Science and Technology Jobs in Washington, John H. Trattner, Madison Books, Lanham, MD, 1992.

Working with Congress: A Practical Guide for Scientists and Engineers, William G. Wells, Jr., sponsored by the Carnegie Commission on Science,

Technology, and Government and the American Association for the Advancement of Science, AAAS, Washington, DC (December 1992).

Copies of these reports are available from the publishers.

BACKGROUND PAPERS, WORKING PAPERS, AND CONSULTANT REPORTS

The Work of the Federal Courts in Resolving Science-Based Disputes: Suggested Agenda for Improvement, Report of a Working Group, Carnegie Commission on Science, Technology, and Government (1989); Reprinted in: *Federal Courts Study Committee Working Papers and Subcommittee Reports*, Vol. 1 (July 1, 1990).

The United States as a Partner in Scientific and Technological Cooperation: Some Perspectives from Across the Atlantic, Consultant Report, Alexander Keynan, Carnegie Commission on Science, Technology, and Government (June 1991).

Procedural and Evidentiary Mechanisms for Dealing with Toxic Tort Litigation: A Critique and Proposal, Consultant Report, Margaret A. Berger, Carnegie Commission on Science, Technology, and Government (October 1991).

The Budget Process and R&D, Consultant Report, Willis H. Shapley, Carnegie Commission on Science, Technology, and Government (April 1992).

The United States and Development Assistance, Background Papers for the Task Force on Development Organizations, Carnegie Commission on Science, Technology, and Government (June 1992).

MEMBERS OF THE CARNEGIE COMMISSION ON SCIENCE, TECHNOLOGY, AND GOVERNMENT

William T. Golden (Co-Chair)
Chairman of the Board
American Museum of Natural History

Joshua Lederberg (Co-Chair)
University Professor
Rockefeller University

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10 Waverly Place, New York, NY 10003
Phone: 212-998-2150 Fax: 212-995-3181

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