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SCIENCE, TECHNOLOGY, AND CONGRESS
ORGANIZATIONAL AND PROCEDURAL REFORMS

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CONTENTS

FOREWORD

Since World War II, Congress has played a vital role in the advance of science and technology (S&T). The creation of the Atomic Energy Commission, the National Institutes of Health, the Office of Naval Research, the National Science Foundation, the National Aeronautics and Space Administration, and the Environmental Protection Agency all required Congressional leadership, and Congress has consistently appropriated funds to support the science and technology that is vital for meeting government missions. Congressional committees actively oversaw the S&T activities of executive agencies and developed legislation that contributed significantly to the nation's technological growth. Activities involving S&T make up a large and increasing fraction of the federal government's discretionary spending.

The enormous growth of activity in science and technology and the change in national priorities since the end of the Cold War now require changes in the structure and mechanisms that Congress uses for dealing with S&T. Congress has recognized the need for change in general with the establishment of the Joint Committee on the Organization of Congress. Some of the leaders who called for the creation of the committee cited the difficulties of dealing effectively with issues involving science and technology as one of the principal reasons for its establishment.

Because the Carnegie Commission recognized from the outset the importance of the role played by Congress, it established the Committee on Science, Technology, and Congress. The Committee remained active throughout the life of the Commission. The distinguished members of the committee, under the leadership of Dr. John Brademas, have already produced two reports that examine in depth the way Congress obtains scientific and technological advice. In this third and final report, they address the difficult problems of organizational and procedural reforms, looking particularly at long-range planning and goal setting, at committee structure, and at the budget process.

In developing this report, the Committee consulted extensively with current and former Members of Congress, particularly the members of its Congressional Advisory Council, a bipartisan group of more than 40 Senators and Representatives; with current and former members of congressional staff; with public policy scholars; and with representatives of the scientific and engineering communities. The substance of this report was approved by the Carnegie Commission at its final meeting in April 1993.

The Commission is grateful to Dr. Brademas for his dedicated leadership of the Committee on Science, Technology, and Congress, to the members of the Committee, to the staff, and to all the others who contributed to the report.

A single report cannot explain all the complexities of congressional S&T policy or all of the aspects of reform. The Commission believes, however, that this report can be helpful to Congress as it tries to adapt its structure to the new realities. And members of the Commission and its staff remain available, as individuals, for discussion if called upon.

William T. Golden, Co-Chair

Joshua Lederberg, Co-Chair

PREFACE

The Carnegie Commission on Science, Technology, and Government was established in April 1988 to analyze the factors that shape the relationships between science and technology (S&T) and government and to seek ways to make those relationships more effective. The Commission established its Committee on Science, Technology, and Congress to consider ways to improve the structures, procedures, and resources Congress needs to develop effective science and technology policy.

Science, Technology, and Congress: Organizational and Procedural Reforms is

the last in a series of three reports prepared by the Committee on how Congress addresses science and technology issues.

The Committee's first report, Science, Technology, and Congress: Expert Advice and the Decision-Making Process, published in February 1991, examines the mechanisms by which Congress receives and uses information, expert analyses, and advice from sources outside Congress, including academia, industry, and nongovernmental organizations.

The second report, Science, Technology, and Congress: Analysis and Advice from the Congressional Support Agencies, published in October 1991, focuses on the contributions to S&T policymaking in Congress made by each of the four main congressional support agencies: the Congressional Budget Office, the Congressional Research Service of the Library of Congress, the General Accounting Office, and the Office of Technology Assessment.

In this third and final report, the Committee examines how Congress is organized to consider S&T issues and what procedures it uses in this process. In Science, Technology, and Congress: Organizational and Procedural Reforms, the Committee on Science, Technology, and Congress presents a series of recommendations designed to enable Congress to develop more coordinated and effective public policy for science and technology and to employ S&T more effectively in developing policies in a range of fields.

Chapter 2.0 documents the scope and significance of S&T policy and describes why we believe the time is right for such recommendations. Chapter 3.0 discusses the need for establishing long-term goals and priorities and recommends ways to incorporate more long-term thinking into congressional decision making for S&T issues. Chapter 4.0 examines the role of the congressional Leadership, congressional oversight of S&T activities, and the distribution of responsibility for S&T issues within the current committee structure. Chapter 5.0 describes the budget process for S&T and suggests areas for improvement. Chapter 6.0, a case study of how Congress makes decisions affecting science and technology, explores the reasons for

academic earmarking and presents possible reforms to curtail the practice.

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This report of the Carnegie Commission on Science, Technology, and Government was prepared by the Committee on Science, Technology, and Congress:

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In the course of its studies, the Committee discussed issues and policy directions with current and former Members of Congress and their staff, staff members of the congressional support agencies, public policy scholars, and representatives of the scientific and engineering communities. The Committee greatly appreciates the thoughtful advice and suggestions that it has received. However, the conclusions and recommendations that follow are those of the Committee on Science, Technology, and Congress and the Carnegie Commission on Science, Technology, and Government and are not necessarily endorsed by the members of the Congressional Advisory Council and others here acknowledged.

The Committee is indebted to the many congressional staff members who have been particularly generous with their time and effort. Their insights and suggestions were indispensable.

In addition, we wish to thank our principal consultants for their excellent and substantial contributions to this report. This report could not have been completed without their dedicated efforts.

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We are particularly grateful to the staff of the Committee on Science, Technology, and Congress:

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1.0 EXECUTIVE SUMMARY

From the everyday to the extraordinary, scientific and technological breakthroughs have changed our lives dramatically in a short period of time. From the environment to foreign affairs, employment to education, transportation to health care, the issues that shape our lives are influenced by science and technology policy. Congress has been and will continue to be involved in formulating that policy; in doing so, Congress faces enormous challenges.

In a time of scarce fiscal resources, Congress must decide among conflicting priorities and sort through contradictory advice. How much money should go to AIDS research versus cancer research? In a post-Cold War world how should Department of Energy National Laboratories be converted to civilian use? Should Congress continue to fund the space station? How can technology help in hazardous waste cleanup, pollution prevention, and energy efficiency?

These important issues arise at a time when the American public is well aware of the many successes of science and technology, from laser surgery to space probes. It is also aware of failures, from Three-Mile Island to the lost Mars Observer. Past optimism has been tempered with skepticism. A blind faith in scientific progress has been replaced by a watchful eye.

With the information age upon us, the first lanes of an "information superhighway" have already opened. The President and many Members of Congress receive hundreds of electronic mail messages every day. The nation's largest cable company and one of the largest telephone companies have proposed a merger to create a high-tech communications system of integrated voice, video, and computer services, raising concerns in Congress over antitrust issues. Disturbing images from around the globe are instantly accessible on television, affecting the debate about our foreign policy toward, for example, Bosnia, Somalia, and Haiti. Disturbing images are also common on children's television programs, affecting the way young people think and act. In the information age, Congress faces difficult decisions about regulations, censorship, cost, quality, equity, and access. The only constant is rapid change.

With both the scope and pace of change increasing exponentially, it is now more important than ever for Congress to equip itself to make wise choices. In some cases, the questions could not be more difficult: scientific advances have raised life-and-death issues, from genetic engineering to euthanasia. When it comes to science and technology policy, Congress is not well organized to address the broad spectrum of challenging issues it must face.

In this report, the Commission offers suggestions for improving the way Congress formulates science and technology (S&T) policy. The report focuses on organizational and procedural reforms that will enable Congress to contribute more effectively to S&T policy. We are aware, however, that scientific and technological issues influence many policy debates beyond the obvious ones. In focusing on S&T policy, we also hope to illuminate other issues in need of improvement.

To help Congress prepare for and manage change, the Commission makes recommendations in three areas: long-range planning and goal-setting; congressional committees, the Leadership, and oversight; and the budget process. We also examine academic earmarking as a case study illuminating

the process of congressional decision making on science and technology.

The controversial issue of academic earmarking offers insights into S&T policymaking in particular and congressional procedures in general. The practice illustrates tensions that have arisen between the scientific community and the federal government, between the executive branch and Congress, and in Congress between authorizing committees and appropriations committees over how to fund S&T facilities and research programs. Academic earmarking raises the most basic questions regarding national science policy: Who should decide about the distribution of federal funds for science and technology? What should be the criteria for award of those funds? And how should funds be distributed? We feel that these questions apply to other issues as well, and in that spirit offer the case study.

We believe the time is right for debating and acting on S&T policy reforms for two reasons: The American people are increasingly aware of the successes -- and failures -- of science and technology; and, as the creation in 1992 of a Joint Committee on the Organization of Congress indicates, Congress seems ready for reform.

1.1 Vision, Goals, And Priorities

Goals, Investment, and the S&T Base

- Congress should help articulate long-term goals for S&T programs, foster a robust and resilient science and technology base as a resource for future generations, determine appropriate public investment in S&T, and promote private investment in S&T (see pages 31-32).

In an era of severe resource constraints and increased international economic competition, enhancing the contributions of science and technology to our national security, economic strength, and quality of life will require careful consideration of S&T priorities in relation to societal goals. Congress plays a critical role in articulating national goals and in directing resources toward achieving them. The federal government currently

spends tens of billions of dollars annually on research and development activities, many of which are closely related to national policy objectives. A clear long-term vision for science and technology policy would assist Congress in making decisions not only about S&T but also about a range of other policy areas.

A National Forum on S&T Goals

- Congress should enact legislation to establish an ongoing National Forum on Science and Technology Goals in order to facilitate the identification, articulation, and adoption of science and technology goals in the context of national and international objectives. Such a forum should also monitor the development and implementation of policies to achieve the agreed-upon goals. Congressional involvement in the Forum is vital to its success (see pages 32-33).

An institution is needed that can communicate effectively with the federal government while retaining the independence required for objective analysis of the actions, as they relate to S&T goals, of the legislative and executive branches. A National Forum on Science and Technology Goals would bring together individuals from academia, nongovernmental organizations, industry, and the public to examine how science and technology could be used to promote national goals in such policy areas as agriculture, economic performance, education, energy, environmental protection, health, telecommunications, and transportation. The Forum should be established as a private, government-chartered entity in order to ensure its legitimacy as well as its independence from partisan influence. An act of Congress can confer such legitimacy.

The S&T Community

- Congress should encourage the S&T community to develop better mechanisms to consider long-range national goals, to suggest means for better use of S&T in helping to achieve national goals, and to help set

priorities within and among disciplines (see page 33).

Efforts by scientists to set long-range priorities for research have been sporadic, inconsistent, and limited to single disciplines. There is no established participatory or representative method for aggregating the needs and priorities of each research field or for communicating these needs and priorities to Congress.

Expert Studies of Cross-Cutting Policy Issues

- The congressional Leadership and their staff designees should facilitate the commissioning, by several relevant congressional committees acting jointly, of studies by the congressional support agencies of cross-cutting S&T issues, S&T funding priorities, and long-term S&T policy considerations. The findings of these studies should be reported and discussed at combined hearings of the participating committees (see pages 33-34).

If, in developing and overseeing S&T policy, Members of Congress are to consider long-term issues and look beyond the borders of individual executive branch departments and agencies, they require appropriate data and policy options. The four main congressional support agencies (the Congressional Budget Office, the Congressional Research Service, the General Accounting Office, and the Office of Technology Assessment) should be commissioned to work together to provide such analyses. At present, the support agencies charged with providing data and analysis to Congress tend to respond to the requests of their particular client committees, which understandably place a high priority on the needs within their immediate jurisdictions. Commissioning studies by multiple committees jointly could ameliorate this problem and result in reports that address a broader range of issues.

Congress and the Executive Branch

- Congress and the executive branch should cooperate to create new

mechanisms that would increase communication and cooperation between the branches in identifying S&T goals and monitoring progress in achieving them. Congress should work closely with established offices in the executive branch, particularly the Office of Science and Technology Policy and the Office of Management and Budget in the Executive Office of the President, in defining S&T objectives in light of overall national goals (see pages 34-36).

Congress and the executive branch should work together to develop a broad policy framework linking science and technology to national goals, thereby delineating the boundaries within which more specific proposals can be debated. Congress and the executive branch should institute a periodic Congressional-Executive Science and Technology Policy Conference to identify common areas of interest, develop strategies to address high-priority issues, and devise long-term legislative goals.

Civilian and Military S&T

- Congress should forge stronger links between civilian and military science and technology policies and programs (see pages 36-38).

Roughly half of all federal spending for research and development is currently allocated to defense activities. Congressional organization reflects a divide between committees that address military and international issues and those that deal with domestic policies and civilian departments and agencies. As civilian technology replaces military technology as the vanguard of innovation in the United States, the practice of considering defense S&T policies and programs separately from civilian S&T priorities is not productive.

1.2 Committee Reform, Leadership Initiatives, And Oversight

Improved Committee Structures and Relationships

- Congress should adopt a committee structure that promotes more consistent formulation, funding, implementation, and oversight of science and technology policies and programs (see pages 41-45).

The structure of Congress militates against consideration and development of coherent science and technology policies. The existing authorizing and appropriations jurisdictions for science and technology are not only cumbersome but, for authorizing committees, also vary substantially between the House and the Senate. For example, the House Committee on Science, Space, and Technology has no Senate counterpart and must deal chiefly with four Senate committees. Moreover, responsibility for funding science and technology activities is divided among nine appropriations subcommittees (eight of which fund civilian S&T activities, and one of which focuses on defense).

Encroachments of committee jurisdiction originally justified as responses to extraordinary circumstances have become routine. Consequently, authorizing committees, which focus on programmatic legislation and oversight, have lost power to appropriations committees, which center on fiscal issues. Incomplete information and inadequate awareness of broader concerns sometimes result in the multiple committees and subcommittees of Congress working at cross-purposes.

S&T Subcommittee Consolidation

- Congress should modify appropriations committee jurisdictions to reduce the multiplicity of appropriations subcommittees responsible for funding science and technology activities (see page 45).

To facilitate coherent policymaking for science and technology issues, Congress should consolidate responsibility for related S&T programs into fewer appropriations subcommittees. Currently, eight of the thirteen appropriations subcommittees consider civilian S&T activities. (One subcommittee focuses on defense.) Reducing the number of subcommittees considering civilian S&T would give a few appropriations subcommittees

sufficient jurisdiction to address cross-cutting issues, facilitating priority setting and allowing Members to consider such S&T funding in a broader policy context.

The Role of the Leadership of Congress

- Congress should enforce existing rules regarding the division of responsibility among all committees, and the Leadership should exert authority to that end (see pages 45-47).

With respect to the delineation of authority between authorizing and appropriations committees, the gap between principle and practice has become considerable. Both House and Senate rules require that an authorization bill be passed first, then funds appropriated according to the guidance given in the authorizing legislation. House rules prohibit consideration of an appropriations bill that has not been authorized; Senate rules are not so strict.

To work, rules must be enforced; however, these rules are frequently waived or ignored. Tensions between authorizing committees and appropriations committees often result. (These tensions can be seen at work in the debate over earmarking, discussed in Chapter 5.) The Leadership has a key role to play in enforcing existing rules.

- The Leadership of Congress should schedule periodic floor debate on S&T policy (see page 47).

Several commissions and experts on Congress have recommended that the congressional Leadership schedule periodic floor debates on major national issues, such as health policy, education policy, environmental policy -- or S&T policy. If a debate on science and technology policy is to receive the serious attention of Members, it must be linked to specific major issues on the legislative agenda.

- The legislative agenda is devised in an informal, private manner by the Leadership of Congress. The Leadership should create intercommittee task forces to address cross-cutting science and technology issues. The Leadership should also make better use of existing authority to coordinate activities by arranging time-limited, joint or sequential referrals of bills involving cross-cutting S&T issues, and by creating ad hoc task forces of committee chairs or their designees to facilitate integrated consideration of such issues (see pages 47-48).

The members of the Leadership meet with committee chairs and Members in private to discuss priorities. These discussions involve a mixture of substantive and political concerns, reflecting ties to constituencies and the views of the executive branch, committee chairs, and Members. The Leadership has considerable authority to promote coordination, for example by creating ad hoc task forces to deal with such complex cross-cutting issues as energy policy, environmental policy, health policy, and defense-civilian industrial conversion. The Leadership has also arranged time-limited, joint or sequential referral of bills affecting the jurisdiction of multiple committees.

Oversight

- Congressional Leadership and committees should enhance their efforts to develop comprehensive, long-term oversight plans to complement the short-term oversight agendas of individual committees. Congressional support agencies should also be involved in the development of such long-range oversight plans (see pages 49-50).

Long-term concerns and issues that cut across departments, agencies, programs, and congressional committees have in general received little attention from Congress. Partly because most S&T oversight takes place in reauthorization hearings and is thus linked to specific pieces of legislation, Congress typically focuses its S&T oversight activities on narrowly defined, often short-term, issues rather than engaging in broad, long-term review of S&T programs. Congress must frequently respond to

unanticipated issues and oversee the resolution of emerging problems; however, near-term demands should not distract attention from long-term concerns.

Measuring Programs and Progress

- Congress should require federal departments and agencies to develop consistent operational definitions, accounting procedures, data, and progress indicators for S&T programs so that both Congress and the executive branch can measure progress and perform oversight more effectively (see page 50).

Congress and the executive branch should convene working groups of key staff of S&T-relevant congressional committees and executive branch departments and agencies to develop consistent operational definitions and accounting procedures and to oversee the application of policies and processes. These groups should develop criteria for, among other things, "basic" and "applied" research, development, facilities and instrumentation, evaluation, and multiyear grants and contracts.

1.3 The Budget Process, Multiyear Funding, And Funding Categories

Multiyear Funding

- Congress should extend program and project funding cycles for S&T programs by adopting a variety of multiyear funding mechanisms, such as multiyear appropriations, advanced or forward funding, and up-front funding for major construction projects. All such programs should adopt standardized granting and accounting procedures (see pages 54-56).

Although Congress does not have a consistent system for making funds available to the executive branch on a multiyear basis, some congressional committees, departments, and agencies have developed mechanisms to make funds available on a multiyear basis for programs, grants, and contracts.

Multiyear funding is intended to provide increased program stability while maintaining annual oversight. Multiyear funding can also improve the cost-effectiveness of programs.

A Pilot Program for Biennial Budgeting

- Congress should create a pilot program to determine the effectiveness of a two-year congressional budget cycle. Such a pilot program could be conducted for a few federal departments and agencies, for a subset of authorizing committees and appropriations subcommittees, or for a selection of programs from each department or agency. In order for its efficacy to be assessed accurately, the pilot program should run for at least two two-year budget cycles (see page 56).

Time pressures associated with the current annual budget cycle have generated support among Members for shifting to biennial congressional budgets. Vice President Gore's National Performance Review report recommended that Congress establish biennial budget resolutions, biennial appropriations, and multiyear authorizations. We agree with the goal of biennial budgets but feel that a pilot program would serve as the appropriate first step to reach that goal.

There are several ways to organize a biennial budget cycle. In a "split-session" model, budget activities -- that is, budget resolution, reconciliation, and appropriations -- would be compressed into one year, leaving an entire year free for authorizations and oversight. In a "stretched-session" model, the present annual budget process would be spread over two years, allowing more time for authorizations and oversight. Another possible approach involves devoting half of each two-year Congress to passing two-year budget resolutions, authorizations, and appropriations and the other half to conducting policy oversight.

Funding Categories

- Congress and the executive branch should develop an accurate and

consistent set of funding categories that would carry through all stages of the budget process and would reflect the decisions Congress must make about science and technology and other critical policy areas. These consistent categories must begin with the "supercategories" used to set the parameters for budget planning and continue through the budget resolution to the committee and subcommittee allocations that are critical for detailed decision making (see pages 57-62).

Several structural problems in congressional decision making can be addressed by establishing an appropriate and consistent set of budget categories. The "supercategories" used to set the broad parameters for budgetary decisions submerge S&T within a catchall category of "domestic discretionary" spending. This category does not reflect the importance of national goals, nor does it allow knowledgeable people responsible for S&T policy to have a seat at the bargaining table. The categories designed to facilitate the debate on budget priorities and those used to enforce actual spending limits are so inconsistent as to render the debate meaningless.

The inability to carry through broad policy decisions on overall S&T investments is frustrating to Members of Congress as well as to the scientific and engineering communities. The inconsistency of the budget categories is compounded by the fact that until the process has been completed, S&T spending is not tracked to see whether the broad decisions about national priorities made in the early stages of the budget process are reflected in specific agency appropriations at the end of the process.

1.4 A Case Study: Academic Earmarking

The controversial issue of congressional earmarking for research facilities and programs offers an informative case study of S&T policymaking in particular and of congressional procedures in general. The practice illustrates tensions that have arisen between the scientific community and the federal government, between the executive branch and Congress, and within Congress between the authorization and appropriation committees over

how to fund S&T facilities and research programs. Academic earmarking raises basic questions regarding national science policy: Who should decide about the distribution of federal funds for science and technology? What should be the criteria for awarding these funds? How should funds be distributed? We feel that these questions have a wider relevance, and that the lessons of this case study may thus be applicable to other areas of federal expenditure. Chapter 5 offers a detailed examination of this issue and offers some specific recommendations.

2.0 SCIENCE, TECHNOLOGY, AND CONGRESS: WHAT IS AT STAKE?

> There must be science in government, because science dominates society.
>
> -- Justice Felix Frankfurter

Many of the great issues that Congress now faces -- enhancing international economic competitiveness, protecting the environment, safeguarding human health, improving education, and ensuring national security -- share a common dimension: Their solution will depend in large part on advances in and effective use of science and technology. In these and other policy areas, science and technology support the missions of government departments and agencies rather than compete with these missions for limited resources. Indeed, this report is an investigation of how that support can be organized and used more effectively rather than a plea for more science and technology funding from Congress.

Congress is a key player in many matters affecting science and technology in the United States. Members of Congress must select among major S&T investments; they must determine how to undertake large-scale, expensive projects without sacrificing the creative base of small, investigator-initiated research projects or frontier-area science; and they must sort out the competing and complementary roles of different agencies in such areas as biotechnology and dual-use (civilian and military) technologies.

Members must also determine the balance of funding among investment in basic science (fundamental, theoretical research); infrastructure (laboratories and equipment as well as teaching and training); and applied science (which includes not only the development of commercial products and processes but also educational, medical, environmental, and military missions). Congress also influences science and technology in deciding between national and international approaches and between competition and cooperation on expensive cutting-edge projects. [2]

When Congress considers funding for scientific activities, Members hear from a wide variety of interests: scientists at large research universities in small states as well as researchers at small colleges in large states, molecular biologists and ecologists, Nobel prize winners and postdoctoral researchers, advocates of "Big Science" (such as the space station or the Superconducting Super Collider) and proponents of "little science" (small research grants), and many others. Congress also receives appeals for funds for the science and technology programs that support missions of federal departments and agencies, such as education, health care, or space exploration. Moreover, Members must consider not only calls for investment in science and technology but requests for increased funding for pressing social concerns as well.

Unfortunately, the ways in which the Senate and House of Representatives are organized and do business sometimes prevent Congress from forming effective partnerships with the executive branch and with the scientific and engineering communities to develop and implement coherent policies for science and technology.

In our conversations with Members of Congress and their staffs, we found that the division of authority within each chamber, including authority with respect to the S&T policy process, is a major source of frustration. Responsibility for authorizing, funding, and overseeing science and technology activities is divided among at least eighteen House and Senate committees (see Box 1) and dozens of subcommittees. Most other major policy

areas, like education or health, are ordinarily dealt with by fewer committees. Thus, Members cannot easily compare S&T as a whole with these other areas. For example, the House Science, Space, and Technology Committee has only limited legislative jurisdiction over research and development (R&D) activities but has broad jurisdiction over R&D oversight. This committee does not handle biomedical R&D (which is the province of the House Energy and Commerce Committee), agricultural R&D (House Agriculture Committee), fisheries and oceanic R&D (House Merchant Marine and Fisheries Committee), or basic research of either the Defense Department or the Department of Energy's weapons laboratories (both in the House Armed Services Committee).

BOX 1: House and Senate Authorizing Committees with Significant Jurisdiction over S&T-Related Issues

HOUSE	SENATE
Agriculture Committee	Agriculture, Nutrition, and Forestry Committee
Armed Services Committee	Armed Services Committee
Education and Labor Committee	Commerce, Science, and Transportation Committee
Energy and Commerce Committee	
Judiciary Committee	Judiciary Committee
Merchant Marine and Fisheries Committee	Energy and Natural Resources Committee
Natural Resources Committee	Environment and Public Works Committee
Public Works and Transportation Committee	Labor and Human Resources Committee

Science, Space, and Technology Committee

Small Business Committee

Small Business Committee

* * * * *

2.1 Is It Time For Change?

Recent events both within and outside Congress suggest that reform is needed:

- In July 1992, Members of Congress clearly demonstrated their interest in increasing the effectiveness of Congress by establishing the Joint Committee on the Organization of Congress to recommend comprehensive reforms for both the House of Representatives and the Senate. Over the next year, the Joint Committee, co-chaired by Sen. David L. Boren (D-Okla.) and Rep. Lee H. Hamilton (D-Ind.), with Sen. Pete V. Domenici (R-N.M.) and Rep. David Dreier (R-Calif.) serving as vice-chairs, held hearings and developed a series of comprehensive recommendations for reform.

- In the summer of 1993 the Joint Committee on the Organization of Congress released its survey of House and Senate Members on various aspects of reform. Eighty-eight percent of all respondents strongly agreed that the budget process was a priority for reorganization, and 85 percent strongly agreed that committee structure and membership assignments were priorities for reorganization. [3]

- In its first report, the Strengthening of America Commission, chaired by Sen. Sam Nunn (D-Ga.) and Sen. Domenici, called for more integrated allocation of federal resources for research and

development. [4]

- A recent survey of the members of the American Association for the Advancement of Science (AAAS) found that "the vast majority of those surveyed (87 percent) believe there is a need for change within the federally funded research system; only fewer than one in ten (8 percent) think the system is fine as it is, without change." [5]

We, too, think the time is right for change.

2.2 Context For Change: Separation Of Powers, Divided Government, Political Parties, And Power Of The Purse

Basic to an appreciation of the American form of government and its potential for change are certain fundamental factors. First, we have a Constitution founded on the principle of separation of powers. Second, our political parties are decentralized. Third, over the past two decades, there have been significant changes in the operation of Congress that, in an already fragmented system, have further dispersed power. Any suggestions for change in congressional structures and processes for formulating S&T policy must take these factors into account, as well as the impact of enormous annual budget deficits and a national debt of some $4.5 trillion.

The Constitution requires that political power in the United States be divided among three branches of government. Any changes in congressional procedures must ensure that Congress maintains its independence from the other branches, particularly the executive branch. Congress does not exist to do whatever a President wants. Presidents, Senators, and Representatives are elected by different constituencies, for differing terms, and with different constitutional responsibilities.

The American way of governing was not designed for peaceful coexistence between the executive and legislative branches, even when both are controlled by the same party. Eliminating all friction and disagreement is

not only an impossible goal but an imprudent one. What is necessary is an attitude of respect and trust between the President and Congress. In such an atmosphere, constructive change is possible.

2.3 The Budget Process

This year marks the twentieth anniversary of the passage of the Congressional Budget and Impoundment Control Act of 1974, which created budget committees in both the House and Senate and established a Congressional Budget Office. The congressional budget process was designed, among other purposes, to provide a mechanism by which Congress could assess the nation's needs and consider the various parts of the budget, such as science and technology, in the context of the entire budget of the government of the United States.

Because the budget process figures so prominently in any discussion of congressional reform, a brief overview of the process and the committees involved is offered here; more detail is provided in Chapter 4. (The Budget Enforcement Act of 1990 amended both the Congressional Budget Act of 1974 and the Balanced Budget and Emergency Deficit Control Act of 1985, better known as Gramm-Rudman-Hollings, but a comprehensive discussion of this legislation is beyond the scope of this report.)

The framers of the Constitution gave Congress control of the purse strings. Article I, Section 9, of the Constitution states, "No money shall be drawn from the Treasury, but in consequence of appropriations made by law; and a regular statement and account of the receipts and expenditures of all public money shall be published from time to time." In an attempt to arrive at a "regular statement and account" of public money, and in response to the President's budget submitted at the beginning of the year, Congress employs a multitiered process involving the following kinds of committee.

- Budget committees are charged with setting broad guidelines for revenue and spending each year, while considering both national

economic conditions and spending priorities.

- Authorizing committees are responsible, by authorizing spending, for setting broad policy parameters as well as for conducting oversight of executive branch departments, agencies, and programs. Authorizing legislation determines the scope and purpose of federal spending and recommends funding levels. Authorizations are then subject to action by the appropriations committees.

- Appropriations committees make detailed determinations of the amount of funding available for each federal department, agency, and program. These committees, however, do not set the levels of "entitlement" spending (mandatory spending, such as Social Security and Medicare), which are determined by authorizing and revenue committees. Although appropriations bills are technically prohibited from including authorizing provisions, legislative "riders" on appropriations bills or language in appropriations committee reports instructing the agencies on how funds are to be spent have considerable impact on actual policies. In other cases, some authorizing legislation "entitles" classes of beneficiaries (such as individuals, firms, state or local governments, or universities) to funding in accordance with a legislative formula, and appropriations action becomes solely administrative.

- Revenue committees (the House Ways and Means Committee and the Senate Finance Committee) are responsible for any legislation that raises taxes or other broad-based forms of revenue. Major entitlement programs such as Social Security, Medicare and Medicaid, and child and family welfare are also under the jurisdiction of the revenue committees, as they are funded chiefly through permanent trust funds financed by broad-based taxes. Therefore, for certain major programs the revenue committees act as authorizing committees.

- Process committees determine how legislation will be considered in each chamber, thereby influencing the substantive content of legislation. The House Rules Committee has a direct effect on policy by specifying what provisions may be included in a bill, whether or not a bill reaches the House floor, and what amendments will be allowed. In the Senate, on the other hand, the Rules and Administration Committee deals with general procedures and committee responsibilities and not with the consideration of specific bills. The Senate Governmental Affairs Committee and the House Government Operations Committee have broad mandates for oversight of executive branch activities and share jurisdiction on budget and accounting measures with the Senate and House budget committees.

2.4 Challenges And Opportunities In Science And Technology Policy

Authorization of S&T programs, appropriation of funds, and oversight of executive branch activities can be complicated in a bicameral legislature with undisciplined political parties, a decentralized committee system, and Members who represent diverse constituencies. Many difficulties confront Congress as it helps shape the nation's science and technology policies. Several of these challenges underlie the problems and recommendations discussed in later chapters and should be highlighted.

First, the difficulties associated with congressional S&T policymaking are not simply those of process. The lack of necessary data and analytical techniques also imposes obstacles to setting priorities. [6] Furthermore, no mechanism exists to convert complete, consistent, and accurate data about S&T expenditures, needs, and effects into a strategic plan for consideration by congressional policymakers. Also, decision makers lack methods for comparing and coordinating the requirements of the nation's scientific enterprise with other critical national needs.

Second, although Congress establishes priorities every day through formal decisions and informal communications, carrying out this task usually requires two activities that are particularly difficult to harmonize for S&T policy: First, legislators must respond to demands to redress current problems, such as threats to the health of citizens or to national security; and second, legislators must prepare the nation for possible challenges by investing in future opportunities, the benefits of which may not be easy to reconcile with immediate needs. Customarily, incentives drive Members of Congress to focus more on the present than the future. In the words of James Madison, however, the purpose of government is to "refine and enlarge the public views, by passing them through the medium of a chosen body of citizens, whose wisdom may best discern the true interest of their country, and whose patriotism and love of justice will be least likely to sacrifice it to temporary or partial considerations."

Third, it is inevitable that some policy areas will overlap. The Carnegie Commission's report E^3: Organizing for Environment, Energy, and the Economy in the Executive Branch of the U.S. Government underscores this point. [7] Policies for science and technology are a fundamental component of many other policies. Advances in fields of science and technology often affect multiple policy areas; for example, developments in biotechnology may have implications for health, agricultural, and environmental policies.

Problems with the congressional S&T policy process should not, however, be so overstated as to eclipse the accomplishments of Congress. The United States Senate and House of Representatives have been crucial to the many successes the United States has enjoyed in science and technology since World War II. For example, Congress played a central role in supporting the continuation of the National Energy Laboratories and the use of defense funding for basic research after the war. Congress later took the initiative in establishing the National Aeronautics and Space Administration and the Office of Science and Technology Policy in the Executive Office of the President. The advances that have derived from a technically educated workforce, a diverse system of public and private research institutions, and a science and technology enterprise that

combines public support with substantial autonomy for creative researchers have greatly enhanced the well-being of the nation. In offering our recommendations, we seek to ensure that such advances continue.

3.0 A VISION FOR SCIENCE, TECHNOLOGY, AND CONGRESS: SETTING GOALS AND PRIORITIES

In order to direct and use its research capabilities most effectively, the United States needs a long-range vision that clearly articulates goals for science and technology. [8] In an era of severe resource constraints and increased international economic competition, enhancing the contributions of science and technology to our national security, economic strength, and quality of life will require careful consideration of S&T priorities in relation to overall goals for the nation.

Members of Congress, like other policymakers and policy analysts, often underestimate the degree to which the S&T enterprise serves the nation. The lack of methods for assessing past accomplishments, charting progress, and determining future directions of the enterprise contributes to this lack of understanding.

3.1 Goals, Investment, And The S&T Base

- Congress should help articulate long-term goals for S&T programs, foster a robust and resilient science and technology base [9] as a resource for future generations, determine appropriate public investment in S&T, and promote private investment in S&T. [10]

Congress plays a critical role in articulating national goals and in directing resources toward achieving them. The federal government spends tens of billions of dollars annually on research and development activities, many of which are driven by or will directly affect national policy objectives.

Improving the congressional capacity to establish a long-term vision for science and technology could help provide direction for many of the specific decisions Congress must make. Yet the task of choosing among individual programs would remain, and fulfilling this responsibility is not simple. The essential uncertainties in science and technology about long-term possibilities, the lack of consensus on short-term goals on the part of the scientific community, and the absence of clearly articulated national long-term goals for the many missions that science and technology support make the task of selecting among programs even more difficult.

There are three levels of congressional priority setting for science and technology:

- S&T competes with other policy areas. (For example, because funds for both the National Science Foundation and the Department of Housing and Urban Development are appropriated by the same subcommittee, scientific research competes with, for example, housing for the homeless.)

- Priorities must be set among competing S&T initiatives. (For example, the debates over the Supersonic Transport, the breeder reactor, the Superconducting Super Collider, and synthetic fuels were based, in part, on whether such programs were the wisest use of S&T funds.)

- Public policies can influence priorities within S&T disciplines. (For example, the space program dramatically boosted space-related research, and President Nixon's War on Cancer channeled large sums of money to specific research programs at the National Institutes of Health.)

The first two categories of priority setting clearly involve political decisions; the third often sparks conflicts between and among scientists and political leaders. Each of these decision areas involves different sets

of actors, processes, and goals. Scientists and engineers generally prefer to set priorities according to the promise of scientific progress. But increasingly scientists have been asking the broad questions, such as which fields of science have important societal benefits. In contrast, policymakers, at least in recent years, typically prefer budget-conscious priority setting -- that is, allocating funding levels for missions and requiring programs to fit within those funding levels.

Congress and the scientific community have different ways of establishing goals and priorities, projecting outcomes, and assessing results. There is no agreement in Congress or within the scientific community on how to combine these characteristics in the priority-setting process. It is difficult to separate the process of setting S&T priorities from the outcomes that might benefit one research institution, discipline, or constituency over another. Even when S&T policy decisions are based on objective goals, they have political consequences.

3.2 Needed: A National Forum On Science And Technology Goals

- Congress should enact legislation to establish an ongoing National Forum on Science and Technology Goals in order to facilitate the identification, articulation, and adoption of science and technology goals in the context of national and international objectives. Such a forum should also monitor the development and implementation of policies to achieve the agreed-upon goals. Congressional involvement in the Forum is vital to its success.

In its report Enabling the Future: Linking Science and Technology to Societal Goals, the Carnegie Commission recommended a new mechanism to help policymakers relate the goals of science and technology to national goals. The Commission found that an institution is needed that can communicate effectively with the federal government while retaining the independence required for objective analysis of the actions, as they relate to S&T

goals, of the legislative and executive branches. [11]

The Commission recommended the establishment of a nongovernmental National Forum on Science and Technology Goals to develop consensus on S&T goals in relation to national objectives. The National Forum would bring together individuals from academia, nongovernmental organizations, industry, and the public to examine how science and technology could be used to promote societal goals in such policy areas as agriculture, economic performance, education, energy, environmental protection, health, telecommunications, and transportation.

The Forum should be established as a private, government-chartered entity in order to ensure its legitimacy as well as its independence from partisan influence. An act of Congress can confer such legitimacy. The legislative process, which includes public hearings, should ensure that all views are heard.

3.3 Congress And The S&T Community

- Congress should encourage the S&T community to develop better mechanisms to consider long-range national goals, to suggest means for better use of S&T in helping to achieve national goals, and to help set priorities within and among disciplines.

Scientists themselves need to take more responsibility for helping to set research priorities within and among disciplines. Although several scientific disciplines (for example, astronomy, ecology, and psychology) have addressed long-range priorities for research, these efforts, in both their criteria and time horizons, have been sporadic, inconsistent, and limited to single disciplines. Most scientific disciplines have developed internal peer-guided processes for considering priorities. There is, however, no established participatory or representative method for aggregating the needs and priorities of each research field or for communicating these needs and priorities to Congress. Consequently, certain phases of the S&T process and particular fields of research tend to attract

congressional attention. [12]

3.4 Within Congress

- The congressional Leadership and their staff designees should facilitate the commissioning, by several relevant congressional committees acting jointly, of studies by the congressional support agencies of cross-cutting S&T issues, S&T funding priorities, and long-term S&T policy considerations. The findings of these studies should be reported and discussed at combined hearings of the participating committees.

Congress needs appropriate data and policy options if it is to consider long-term issues and look beyond the borders of individual executive branch departments and agencies. The four main congressional support agencies (the Congressional Budget Office, the Congressional Research Service, the General Accounting Office, and the Office of Technology Assessment) should be commissioned to work together to provide such analyses.

The decentralized structure of congressional committees affects the flow of information and analysis as well as the pattern of decision making. Congressional support agencies tend to respond to particular committees as primary clients: the Congressional Budget Office to the Budget and Appropriations Committees; the General Accounting Office to the Senate Governmental Affairs and House Government Operations Committees; and the Office of Technology Assessment to certain authorizing committees. Therefore, in preparing analyses, the support agencies tend to follow closely the questions raised by their client committees rather than addressing long-term policies, funding priorities, and cross-cutting issues. (For more information on this issue, please refer to our Committee's second report, Science, Technology and Congress: Analysis and Advice from Congressional Support Agencies, October 1991.) If the advice given to Congress is narrowly focused, Members will lack the basis for broad policy initiatives.

It is of particular relevance to science and technology policy that the Office of Technology Assessment has a reputation for openness and objectivity. To preserve it as a source of neutral analyses of options rather than as a proponent of recommendations, OTA should not be charged with the task of determining S&T priorities; this role clearly belongs to the committees. [13]

Legislative service organizations (LSOs) are quasi-congressional entities designed to augment the information-gathering and analytic capabilities of committees and the personal offices of Members. LSOs also offer Members a mechanism for building consensus, across committee jurisdictions and party lines, for action on particular issues. In our first two reports, we recommended the establishment of a bipartisan Science and Technology Study Conference and an independent institute on science, technology, and Congress to serve as a focal point for analysis and dissemination of information on S&T-related legislative issues. [14]

3.5 Congress And The Executive Branch

Efforts have been made and mechanisms devised to improve linkages within the executive branch and between the legislative and executive branches for shaping science and technology policy and relating it to broader national goals. [15] But these efforts typically have been sporadic and slow to respond to emerging problems and opportunities. [16] Policymakers in the legislative and executive branches lack a unified list of S&T programs, an agreed-upon set of progress indicators, and common analytical techniques for oversight and evaluation.

- Congress and the executive branch should cooperate to create new mechanisms that would increase communication and cooperation between the branches in identifying S&T goals and monitoring progress in achieving them. Congress should work closely with established offices in the executive branch, particularly the Office of Science and Technology Policy and the Office of

Management and Budget in the Executive Office of the President, in the process of defining S&T objectives in light of overall national goals.

Congress and the executive branch should work together to develop a broad policy framework linking science and technology to national goals, thereby delineating the boundaries within which specific proposals can be debated. Scientific progress is often unpredictable. S&T policy planning should allow a role for merit review in research program assessment and, to respond to unforeseen scientific advances, should provide flexibility in program implementation.

Congress and the executive branch should institute a periodic Congressional-Executive Science and Technology Policy Conference to identify common areas of interest, develop strategies to address high-priority issues, and devise long-term legislative goals. Coordination in S&T priority-setting between Congress and the executive branch would also be enhanced if Members of Congress had a clear indication of how the President's national policy goals relate to presidential budget requests for science and technology activities.

Congressional leaders should urge the Assistant to the President for Science and Technology (better known as the President's science advisor), who serves simultaneously as Director of the Office of Science and Technology Policy (OSTP), to develop long-term goals for science and technology. A report accompanying the President's budget requests for S&T activities should indicate how the S&T goals relate to specific societal goals.

The process of establishing long-term goals could include discussions with the National Forum on Science and Technology Goals recommended earlier in this report, the Office of Management and Budget (OMB), and the heads of federal departments and agencies with significant S&T activities. This process should be separated from development of the annual budget. Because

S&T goals should shape the S&T budget, OSTP and OMB should work together to formulate long-term S&T goals and, before the budget cycle begins, should communicate them to departments and agencies. Then OSTP and OMB should monitor progress within the departments and agencies in achieving these goals. [17]

To promote debate on and evaluation of long-term societal goals, the President could submit a national goals statement to Congress every four years, including details of ways in which S&T could contribute to attaining these goals. Congress could also require executive branch departments and agencies to submit statements of long-range goals with their annual budget requests for S&T programs. The S&T-relevant committees in Congress then could hold regular hearings on long-range S&T goals and incorporate into legislation explicit statements on S&T goals and their relation to national goals. (See Box 2 for examples of major societal goals to which science and technology contribute.)

BOX 2: Some Major Societal Goals to Which Science and Technology Contribute

Quality of Life, Health, Human Development, and Knowledge

- Education and diffusion of knowledge
- Personal and public health and safety
- Personal development and self-realization
- Exploration and expansion of knowledge
- High standard of living
- Creation and maintenance of civic culture
- Cultural pluralism and community harmony

- Population stabilization

A Resilient, Sustainable, and Competitive Economy

- Economic growth
- Full employment and workforce training
- International competitiveness
- Modernized communications and transportation
- International cooperation and action

Environmental Quality and Sustainable Use of Natural Resources

- Worldwide sustainable development
- Resource exploration, extraction, conservation, and recycling
- Energy production and efficiency in use
- Environmental quality and protection
- Provisions for public recreation
- Maintenance and enhancement of productivity of the biosphere
- Maintenance of urban infrastructure
- Energy security and strategic materials

Personal, National, and International Security

- Personal security and social justice

- National and international security

- Individual freedom

- Worldwide human rights

Source: Carnegie Commission on Science, Technology, and Government, Enabling the Future: Linking Science and Technology to Societal Goals (1992), p. 24.

* * * * *

Cooperative efforts by Congress and the executive branch to consider long-range S&T policy goals could take several forms. Congressional leaders should invite executive branch S&T policymakers to a series of informal meetings. This mechanism for coordination has received widespread endorsement during the Commission's discussions with S&T policymakers in both branches of government.

In addition, an institution outside the legislative and executive branches (but endorsed by congressional and White House leadership) -- an "honest broker" such as a nongovernmental organization -- should invite leaders from both branches to a series of informal meetings to discuss long-range S&T policy goals. These meetings could be similar to the annual Administration of Justice seminars hosted by the Brookings Institution that are designed to improve, through informal, off-the-record discussions, communication among the legislative, executive, and judicial branches. Participants would learn more about the responsibilities and capabilities of their counterparts in the other branch. These meetings would not be intended to produce a common policy statement, but rather to allow sharing of perspectives and concerns about current and emerging S&T issues.

The Commission also encourages congressional leaders to arrange staff

exchanges between Congress and the executive branch for six-month and one-year periods. Such exchanges would help each branch understand the responsibilities and limitations of the other and would allow staff members to develop contacts in the other branch. These exchanges should enable congressional staff to spend time in departments and agencies as well as executive branch staff to spend time in congressional offices. Congress should specifically allocate funds to committees for such exchanges.

Similarly, staff-to-staff working groups should be established at both the senior and junior (working expert) levels in key S&T areas. In a recent report, the National Academy of Public Administration endorsed the creation of such groups to facilitate interbranch communications. [18] Key interest areas could be identified at the proposed annual Congressional-Executive Science and Technology Policy Conference. These topics would form the basis for discussions about new ways to apply science and technology to the policy missions of particular agencies and departments.

3.6 Civilian And Military S&T

- Congress should forge stronger links between civilian and military science and technology policies and programs.

Roughly half of all federal spending for research and development is currently allocated to defense activities. Congressional organization reflects a divide between committees that address military and international issues and those that deal with domestic policies and civilian departments and agencies. In recent years, the division of responsibilities among committees has been reinforced by separate spending caps for domestic, military, and international appropriations.

As civilian technology succeeds military technology in the vanguard of innovation in the United States, this practice of considering defense S&T policies and programs separately from civilian S&T priorities is not productive. Important issues must be explored: for example, it is not clear

how reducing defense program contributions to educational institutions will affect the nation's science and technology base and the quality of scientific and technical personnel in the long term.

Limited steps, such as the formation in the Senate of an ad hoc task force, have been taken to forge closer links between civilian and military S&T policy. The Leadership of Congress should encourage more extensive collaboration among civilian and defense S&T authorizing committees and appropriations subcommittees. Key issues ripe for joint consideration include dual-use technologies, the roles of the national laboratories and the Advanced Research Projects Agency, nuclear materials production and hazardous waste disposal, and conversion of the economic-technological infrastructure in light of the changed international environment (see, for example, the Carnegie Commission report New Thinking and American Defense Technology [19]). As part of the process of consolidating congressional consideration of civilian and military S&T priorities, Congress should work with the Department of Defense, the Office of Management and Budget, and other relevant agencies to develop consistent operational definitions, accounting procedures, data, and progress indicators for the Department of Defense and the civilian departments and agencies with related S&T jurisdictions.

4.0 COMMITTEE REFORM, LEADERSHIP INITIATIVES, AND OVERSIGHT

The Joint Committee on the Organization of Congress, co-chaired by Rep. Lee H. Hamilton (D-Ind.) and Sen. David L. Boren (D-Okla.), has been a forum for considering changes in the structure and operations of Congress. The activities of the Joint Committee have also included consideration of the way congressional committee organization, the congressional Leadership, and oversight can affect science and technology policy. We are aware that informal practices and relationships among Members may be as important in Congress as any formal organization or procedure. The recommendations we make, therefore, also require changes in behavior on the part of the Leadership and other Members of Congress.

4.1 Less Is More For Members

A cursory glance at the daily schedule of any Member of the House or Senate reveals a simple yet serious problem -- too many tasks, too little time. No one can be in six places at once. In testimony before the Joint Committee on the Organization of Congress, Thomas E. Mann and Norman J. Ornstein, co-directors of the Renewing Congress Project, outlined four major elements that should guide any attempt at committee reform. We focus on the first two. As Mann and Ornstein advised the Joint Committee in their testimony:

> First, you should reduce the sizes of committees, the number of slots for committees and subcommittees, and the assignments held by each member. Second, you should reduce the number of committees, and consolidate and partially realign committee jurisdictions, to highlight important emerging policy areas and create a better balance in the workload and attractiveness among standing committees. [20]

As Mann and Ornstein pointed out, in 1992 the average number of committee and subcommittee assignments for each Member in the House was 7.2; each Senator had an average of 11 such assignments. [21] With so many assignments, it is difficult, if not impossible, for Members to give each task the time and attention it deserves.

4.2 Committee Coherence

The Congressional Budget Act of 1974 and many evaluations of Congress are based on a model that assumes a fixed sequence of action, namely from budget resolution to authorizing legislation to appropriations bill. But this model is overly simplistic. All congressional committees are continually engaged in both formal and informal reviews of policies and developments within their general jurisdictions. Each committee also exerts

influence on the legislation of other committees. Although this structure may not be especially neat and orderly, it reflects both the American constitutional system and political reality. Not surprisingly, the resulting overlap and interaction often lead to conflict and delays. Rather than trying to enforce an overly simplistic sequencing of events, congressional structures and procedures should encourage both a clear division of responsibility and better communication among committees sharing jurisdiction over various S&T issues.

The structure of Congress militates against consideration and development of coherent science and technology policies. Not only are the existing authorizing committee and appropriations subcommittee jurisdictions for science and technology cumbersome, but, for authorizing committees, they also vary substantially between the House and the Senate. For example, the House Committee on Science, Space, and Technology has no Senate counterpart and must deal primarily with four Senate committees. Moreover, on the House and Senate appropriations committees, responsibility for funding science and technology activities is divided among nine subcommittees.

- Congress should adopt a committee structure that promotes more consistent formulation, funding, implementation, and oversight of science and technology policies and programs.

Encroachments of committee jurisdiction originally justified as a response to extraordinary circumstances have become routine. The result has been to deprive Congress as a whole of the proper balance of power between the authorizing committees, which focus on programmatic legislation and oversight, and the appropriations committees, which concentrate on financial issues. Incomplete information and inadequate awareness of broader concerns sometimes result in the multiple committees and subcommittees of Congress working at cross-purposes.

The Example of the Executive Branch

There is no congressional organizational structure parallel to that of the

executive branch, where the Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB) seek to coordinate policy across the different departments and agencies. Although Congress mandated coordination for S&T in the executive branch, it has not coordinated its own consideration of S&T policy. The relationships between the Executive Office of the President (OSTP and OMB) and the departments and agencies were carefully designed to balance the need for coordination with the desire to avoid overcentralization. The various committees and subcommittees of Congress parallel the department and agency structure, but there is no "single ear" to receive the unified S&T policy messages enunciated by OSTP and OMB. Nor is there a method of processing such messages and converting them into coherent legislative policy. The budget committees play this role in examining broad ranges of spending policy for all federal activities and relating them to national economic concerns. The nearest counterpart for S&T policy is the House Science, Space, and Technology Committee, with its special responsibilities, granted under House rules, for oversight of all research and development activities.

Vice President Gore's National Performance Review report recommended reconstituting the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) as the National Science and Technology Council, and giving it a "broader role in setting science and technology policy." The report noted, "A new National Science and Technology Council would direct science and technology policy more forcefully, and would streamline the White House's advisory apparatus by combining the functions of FCCSET, the National Space Council, and the National Critical Materials Council." [22] That President Clinton has accepted this recommendation and will himself chair the new council indicates the great importance the present Administration assigns to science and technology policy. We believe that Congress should make similar improvements in its organizational structure.

Overlap and Delay

The current structure of budget committees, authorizing committees, and

appropriations committees has led to overlap of responsibility and authority, thereby delaying congressional action. Moreover, when several committees consider similar issues several times each session, the result is often conflicting policy signals to the executive branch. For S&T policy, the conflicts between authorizing committees and appropriations committees in setting policy are compounded by the multiplicity of executive branch departments and agencies and congressional committees involved in major S&T issues.

Among the recommendations considered by the Joint Committee on the Organization of Congress was that the House and Senate have parallel committee jurisdictions (in the Joint Committee poll of House and Senate Members, 77 percent of all respondents strongly favored such a proposal [23]). Establishing such a parallel structure for science and technology issues in the two chambers would greatly enhance the ability of Congress to consider S&T policy rationally; it would also remove some of the obstacles that overlapping jurisdictions currently place in the path of legislation and oversight.

Differences between House and Senate jurisdictions over S&T activities have often diluted responsibility for science and technology policy. For example, some initiatives within the jurisdiction of the House Science, Space, and Technology Committee have been referred to multiple committees in the Senate, impeding consideration of S&T policies in a coordinated manner. By the same token, a bill emerging from a single Senate committee may become difficult to manage when it is referred to four or five committees in the House. In the case of nuclear waste legislation in the 102nd Congress, for instance, a bill drawn up by the Senate Committee on Energy and Natural Resources was referred to four House Committees -- the Committee on Energy and Commerce, the Committee on Interior and Insular Affairs, the Armed Services Committee, and the Science, Space, and Technology Committee.

The House Science, Space, and Technology Committee

We recognize that this recommendation would require one or both houses to realign jurisdictions for the authorization of S&T programs. At present, the House Science, Space, and Technology Committee has limited legislative jurisdiction over R&D activities. The committee does not handle biomedical R&D (which is in the House Energy and Commerce Committee), agricultural R&D (House Agriculture Committee), fisheries and oceans R&D (House Merchant Marine and Fisheries Committee), or basic research of the Defense Department and of weapons laboratories of the Department of Energy (House Armed Services Committee). Despite these limitations on its legislative jurisdiction, the committee has, as mentioned above, responsibility for oversight of all R&D activities.

The House Science, Space and Technology Committee has long sought to improve the planning and coordination of science and technology in the United States. In 1976, under the chairmanship of Olin E. Teague (D-Tex.), the Committee developed legislation that created the Office of Science and Technology Policy in the Executive Office of the President. The Director of OSTP was authorized to advise the President on S&T issues, including related budget matters; to evaluate the scale, quality, and effectiveness of the federal S&T effort; to assist OMB with its annual review of S&T in the budget; and to provide leadership and coordination for federal research and development programs. The act also created the Federal Coordinating Council for Science, Engineering, and Technology to coordinate the activities of federal R&D agencies in meeting national objectives.

In 1993, through the special R&D oversight responsibilities of the House Science, Space, and Technology Committee, the Subcommittee on Science, under the chairmanship of Rep. Rick Boucher (D-Va.), initiated a comprehensive review of research in the United States. The series of hearings, entitled "Setting Priorities in Science," had three objectives: to assess the current process for setting priorities in the federal funding of research, including the roles and responsibilities of the research community, the executive branch, and Congress; to identify areas where the process needs improvement; and to make practical recommendations for

improving the priority-setting process.

Senate Committee Jurisdictions

Committee jurisdictions in the Senate reflect a 1981 reorganization that reduced the number of committees and combined space and technology with commerce, fisheries, and oceans (creating the Senate Commerce, Science, and Transportation Committee); energy R&D with energy and natural resources (the Senate Energy and Natural Resources Committee); environmental, water, and transportation R&D with public works (the Senate Environment and Public Works Committee); and biomedical R&D with education and labor (the Senate Labor and Human Resources Committee).

Parallel Jurisdiction and Other Reforms

Although overall jurisdictional realignment of committees is beyond the purview of this report, concrete examples of functional areas where congressional committees have parallel jurisdictions include the Committees on Agriculture, Appropriations, Armed Services, and Veterans Affairs. The existence of parallel committees in the House and Senate has permitted those committees to take a broad view of policy issues, knowing that their counterparts will base their decisions on access to the same set of facts or arguments. If the jurisdictions for authorizing science and technology programs were parallel, or at least more clearly defined, the legislative agenda would be less likely to be delayed or diverted by competing committee interests.

Modifying House rules to provide for cross-membership among different committees dealing with related aspects of S&T should be considered. In the Senate, such cross-membership between authorizing committees and appropriations committees serves two useful functions. First, it ensures that, when a committee considers a cross-cutting issue, at least one member will be familiar with the other committee's perspective; cross-membership can also provide specialized knowledge of the subject matter. Second, this arrangement provides an early-warning system to alert committees of

potential legislative conflicts. For example, cross-membership between the Ways and Means Committee and authorizing committees could facilitate the consideration of tax, regulatory, and expenditure methods of implementing policy.

We do not have a preference for either the present House arrangement, where a significant portion (but not all) of S&T jurisdiction resides in a single committee, or the Senate approach, which gives S&T jurisdiction to committees with responsibilities for programs in such diverse areas as human resources or public works. Compelling arguments can be made in favor of either jurisdictional alignment -- or of a new arrangement. No matter what approach is eventually chosen, we emphasize the importance of parallel jurisdictions in the House and Senate.

4.3 S&T Subcommittee Consolidation

- Congress should modify appropriations committee jurisdictions to reduce the multiplicity of appropriations subcommittees responsible for funding science and technology activities.

To facilitate coherent policymaking for science and technology issues, Congress should consolidate responsibility for related S&T programs into fewer appropriations subcommittees. Currently, nine of the thirteen appropriations subcommittees consider S&T-related spending, with one subcommittee responsible for funding defense-related activities and eight subcommittees covering civilian S&T efforts. Reducing the number of subcommittees considering civilian S&T would facilitate priority setting and allow Members to consider such S&T funding in a broader context. [24]

Box 3 shows the current distribution of S&T programs among appropriations subcommittees. Some examples of duplication are clear. The Rural Development, Agriculture, and Related Agencies Subcommittee considers nutrition research by the Department of Agriculture and the Food and Drug Administration in the Department of Health and Human Services. Similar and

related research at the National Institutes of Health falls under the jurisdiction of the Labor, Health and Human Services, Education, and Related Agencies (Labor/HHS) Subcommittee.

BOX 3: House and Senate Appropriations Subcommittees with Significant Jurisdiction over S&T-Related Issues

Appropriations subcommittees	S&T-related jurisdiction: departments and independent agencies (major S&T agencies, programs, or research areas)
Commerce, Justice, State, the Judiciary and Related Agencies (House); Commerce, Justice, State and Judiciary (Senate)	Department of Commerce (Economic Development Administration, National Institute of Standards and Technology, National Oceanic and Atmospheric Administration, National Technical Information Service, National Telecommunications and Information Administration)
Defense (both)	Department of Defense (defense R&D)
Energy and Water Development (both)	Department of Energy (energy R&D, except fossil energy R&D, clean coal technology, energy conservation, and alternative fuels production)
Interior (House); Interior and Related Agencies (Senate)	Department of Interior (U.S. Geological Survey, Bureau of Mines, Fish and Wildlife Service); Department of Energy (fossil energy R&D, clean coal technology, energy

	conservation, and alternative fuels production)
Labor, Health and Human Services and Education (both)	Department of Health and Human Services (Public Health Service, National Institutes of Health, Health Care Financing Administration); Department of Education (Office of Educational Research and Improvement); Department of Labor (Occupational Safety and Health Administration, Bureau of Labor Statistics)
Rural Development, Agriculture and Related Agencies (House); Agriculture, Rural Development and Related Agencies (Senate)	Department of Agriculture (Agricultural Research Service, Cooperative State Research Service, nutrition research); Food and Drug Administration (in Department of Health and Human Services)
Transportation (both)	Department of Transportation (Federal Highway Administration, Federal Aviation Administration, National Highway Traffic Safety Administration)
Treasury -- Postal Service and General Government (House); Treasury, Postal Service and General Government (Senate)	Executive Office of the President (Office of Management and Budget, Office of Federal Procurement Policy)
Veterans Affairs, Housing and Urban Development and Independent	Environmental Protection Agency, National Aeronautics and Space

Agencies (both)	Administration, National Science Foundation, Office of Science and Technology Policy

* * * * *

Jurisdiction over funding environmental research is divided among several appropriations subcommittees, depending on which executive branch department or agency conducts the research. The Veterans Affairs, Housing and Urban Development, and Independent Agencies Subcommittee considers activities of the Environmental Protection Agency; the Labor/HHS Subcommittee considers research conducted by the National Institute of Environmental Health Sciences; and the Commerce, Justice, State, the Judiciary, and Related Agencies Subcommittee considers the environmental research activities of the National Oceanic and Atmospheric Administration within the Department of Commerce.

4.4 The Role Of The Leadership

- Congress should strengthen existing rules to enforce the division of responsibility among committees, and the Leadership should exert authority to that end.

With respect to the delineation of authority between authorizing and appropriations committees, the gap between principle and practice has become considerable. In theory, Congress first approves an authorization and then appropriates funds. House rules (clause 2 of House Rule XXI) prohibit consideration of an appropriations bill that has not been authorized. Senate rules are not so strict. Both House and Senate rules restrict legislating on appropriations bills.

However, to work, rules must be enforced. All these rules can be, and frequently are, waived or ignored, and tensions between authorizing committees and appropriations committees are often the result. (We discuss this matter in more detail in the case study of earmarking in Chapter 5.)

The Leadership has a key role to play in enforcing existing rules, thereby lessening the gap between principle and practice with respect to the functions of authorizing committees and appropriations committees. (The Leadership of Congress is generally understood to comprise, in the Senate, the Majority Leader, the Assistant Majority Leader, the Democratic Conference Secretary, the Minority Leader, the Minority Whip, and the Republican Conference Chairman. In the House, the Speaker, the Majority Leader, the Majority Whip, the Democratic Caucus Chairman, the Minority Leader, the Minority Whip, and the Republican Conference Chairman constitute the Leadership.)

- The Leadership of Congress should schedule periodic floor debate on S&T policy.

Several commissions and experts on Congress have recommended that the congressional Leadership schedule periodic floor debates on major national issues, such as health policy, education policy, environmental policy -- and S&T policy. Such floor debates were recommended most recently by Thomas E. Mann and Norman J. Ornstein in the first of their Renewing Congress reports. [25]

A model for this proposal may be found in the Humphrey-Hawkins Act, which requires that a portion of the debate on the annual budget resolution be devoted to a discussion of the conditions of employment and related national policies. If a debate on science and technology policy is to receive the serious attention of Members, it too must be linked to specific major issues on the legislative agenda.

- The legislative agenda is devised in an informal, private manner by the Leadership of Congress. As part of those discussions, the Leadership should create intercommittee task forces to address cross-cutting science and technology issues. The Leadership should also make better use of existing authority to coordinate activities by arranging time-limited, joint or sequential

referrals of bills involving cross-cutting S&T issues, and by creating ad hoc task forces of committee chairs or their designees to facilitate integrated consideration of such issues.

The members of the Leadership meet with committee chairs and Members in private to discuss priorities. These discussions involve a mixture of substantive and political concerns, reflecting ties to constituencies and the views of the executive branch, committee chairs, and Members. The Leadership has considerable authority to facilitate coordinated action and has sometimes used that authority constructively. For example, it has created ad hoc task forces to deal with such complex, cross-cutting issues as energy policy, environmental policy, health policy, and defense-civilian industrial conversion. The Leadership has also arranged time-limited joint or sequential referral of bills affecting the jurisdiction of multiple committees. Joint referral means that a legislative proposal is assigned to more than one committee for consideration at the same time; in sequential referral, a bill is also referred to more than one committee, but sequentially rather than simultaneously. Ordinarily, each bill is considered by only one committee.

We believe that the Majority and Minority Leadership in the House and Senate should more frequently coordinate the activities of different committees to help develop coherent science and technology policy and to respond to cross-cutting, multiagency proposals from the executive branch. A particular effort should be made to link civilian and military aspects of science and technology policy. As a pilot effort, civilian and military authorizing committees and appropriations subcommittees could be assigned joint jurisdiction over a clearly defined set of activities, such as, for example, the Department of Energy's national laboratories. Such a process would permit science and technology issues to be considered within a unified framework, with comparable concepts, standards, and procedures.

During the past several years, the Subcommittee on Science of the House Science, Space, and Technology Committee and several subcommittees of the House Agriculture Committee have held joint hearings on the adequacy of

nutrition monitoring by the federal government. One result of these hearings is the Nutrition Monitoring Act of 1990 (P.L. 101-445), and after years of disagreement the Department of Agriculture and the Department of Health and Human Services are now cooperating in implementing this act.

In another area, the House Science, Space, and Technology Committee and the House Natural Resources Committee have been working together to reduce the human suffering and property damage from earthquakes. The two committees share jurisdiction over the agencies that fund earthquake research: the National Science Foundation and the U.S. Geological survey. The resulting research programs have helped improve techniques to predict and prepare for earthquakes.

4.5 Oversight Of S&T Policies And Programs

Congressional oversight -- the congressional review of the actions of federal departments and agencies and of the policies and programs they administer -- has increased significantly since the 1960s, [26] when oversight was described as "Congress's neglected function." [27] Public policy experts credit this increase in oversight to several factors. After a relative abundance of federal funds for programs during the 1960s, resources became more constrained, and, in the 1970s, public resentment of "big government" rose. As a result, there were more incentives to perform oversight as Members sought new ways, without expending significant resources, to shape policy, make existing programs more effective, and satisfy public concerns about fiscal responsibility, safety, and government efficiency. [28]

Like congressional oversight in other policy areas, oversight of federal S&T-related departments, agencies, programs, and policies has increased over the past two decades. Because of the relatively short authorization cycle typical of most S&T programs, committees make frequent use of reauthorization hearings to conduct oversight. One student of the process found that science and technology committees devoted almost twice as much

time to oversight activities in the early 1980s as in the 1960s. [29] Oversight has become more prevalent during the past decade. [30]

Although S&T oversight as a whole has expanded in recent years, congressional attention has not focused evenly across the range of science and technology agencies, programs, and issues. Certain high-profile departments and agencies, such as the Department of Defense and the National Aeronautics and Space Administration, tend to remain highly visible on the oversight agenda from year to year. Meanwhile, many important issues, such as research infrastructure needs and the quality of scientific training, have received less attention. [31]

Long-term concerns and issues that cut across departments, agencies, programs, and congressional committees have typically commanded little scrutiny from Congress. Partly because most S&T oversight takes place in reauthorization hearings and is thus linked to specific pieces of legislation, Congress typically focuses its S&T oversight activities on narrowly defined, often short-term, issues rather than engaging in broad, long-term review of S&T programs. Other S&T oversight is crisis-driven, such as the investigation of the space shuttle Challenger explosion; although such scrutiny is a central part of effective oversight, it should not replace consideration of broader or longer-term issues, such as progress in achieving goals in U.S. space research.

Congressional oversight of federal S&T programs tends to be inconsistent across departments, agencies, and programs. In addition, Congress typically focuses its oversight activities on specific, short-term issues linked to authorization concerns rather than devoting significant attention to broad policy issues and assessing long-term progress in achieving statutory goals.

- Congressional Leadership should encourage committees to develop comprehensive, long-term oversight plans that would complement their short-term oversight agendas. Congressional support agencies should also be involved in the development of such long-

range oversight plans.

A considerable proportion of the oversight agendas of congressional committees is determined by relatively short-term concerns. This approach is appropriate because Congress must frequently respond to unanticipated issues and oversee the resolution of emerging problems. However, more specific near-term oversight activities should not supplant broad, long-term concerns such as assessing progress in achieving major statutory objectives, correcting fundamental program weaknesses, and identifying emerging issues that may need congressional attention.

- Congress should require federal departments and agencies to develop consistent operational definitions, accounting procedures, data, and progress indicators for S&T programs so that both Congress and the executive branch can measure progress and perform oversight more effectively.

Congress and the executive branch should convene working groups of key staff of S&T-relevant congressional committees and executive branch departments and agencies to develop consistent operational definitions and accounting procedures and to oversee the application of policies and processes. These groups should develop criteria for, among other things, "basic" and "applied" research, development, facilities and instrumentation, evaluation, and multiyear grants and contracts. The groups should also work to improve methods for categorizing expenditures that overlap policy areas, departments, or agencies. [32]

5.0 THE BUDGET PROCESS: S&T PRIORITIES AND MULTIYEAR FUNDING

The current congressional budget process was created with the passage of the Congressional Budget and Impoundment Control Act in 1974. The process was designed to provide a vehicle for an annual debate in Congress on national spending priorities and to enable Congress to participate in

establishing national macroeconomic policy by voting on the aggregate levels of spending, revenues, deficit, and debt each year. The budget process has undergone several revisions since 1974, through codification of the budget reconciliation process and adoption of the Balanced Budget and Emergency Deficit Control Act of 1985 (better known as Gramm-Rudman-Hollings [33]) and the Budget Enforcement Act of 1990. (See Box 4 for definitions of terms used in this chapter.)

BOX 4: Federal Budget Terminology

Allocation: The process under Section 602 of the Budget Enforcement Act of 1990 (and under Section 302 of the Congressional Budget Act of 1974) by which the total spending authority approved in the budget resolution is divided among appropriations committees and subcommittees in the House and Senate: 602(a) allocations, formerly 302(a), grant spending authority to the appropriations committees; 602(b) allocations, formerly 302(b), divide funds among the 13 subcommittees of the appropriations committees in the House and Senate.

Budget authority: The authority granted by Congress in legislation that allows federal agencies to incur financial obligations.

Budget resolution: A concurrent resolution passed by the House and Senate (but not requiring the signature of the President) that establishes the levels of spending, revenues (taxes), and allowable deficit for a given fiscal year. The resolution may include a reconciliation section instructing authorizing committees to propose changes in existing laws to achieve prescribed spending and revenue levels.

Caps: Legal limits on the budget authority and outlays for discretionary appropriations categories for each fiscal year. A sequester is required if appropriations exceed the caps.

Discretionary appropriations: Expenditures controlled by the annual appropriations process rather than by direct, or mandatory, spending (also

known as "entitlements"). Through fiscal year 1993, discretionary appropriations were divided among the following categories: defense, international, or domestic. Separate spending limits (caps) were set for each category. For fiscal years 1994 and 1995, all discretionary appropriations constitute a single category, with a single cap.

Reconciliation: The process, initiated in the budget resolution, of instructing authorizing committees to recommend changes in existing revenue or spending laws to conform to spending, revenue, and deficit limits established in the budget resolution. The resulting legislation is typically packaged into a single reconciliation bill that must be passed by both houses of Congress and, unlike the budget resolution, be signed into law by the President.

Sequester: An across-the-board cut ordered by the President for discretionary spending, direct spending, or both, if the Office of Management and Budget determines that spending or revenue legislation would exceed spending caps, deficit targets, or pay-as-you-go requirements established under the Budget Enforcement Act of 1990.

Sources: Budget of the United States Government, Fiscal Year 1994 (U.S. Government Printing Office, April 1993); Budget Systems and Concepts of the United States Government (U.S. Government Printing Office, April 1993); and Stanley Bach, An Introduction to the Spending and Budget Process in Congress (Congressional Research Service, Library of Congress, August 29, 1984).

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In addition to creating the Congressional Budget Office, the Congressional Budget Act of 1974 linked, for the first time, revenue-generating measures with spending levels and explicit levels of deficit and debt. The successive modifications of the legislation enhanced the ability of Congress to control spending and enact comprehensive deficit reduction

packages. However, the frequent addition of new measures to control spending without the elimination of previous methods has made the budget process increasingly complex and time-consuming.

Under the current budget system, Congress begins action on the budget early in the year with consideration of the budget resolution, but budget work continues until the end of the year, as appropriations bills (or continuing resolutions) must be passed before Congress adjourns. The Gramm-Rudman-Hollings "sequestration" procedure requires across-the-board spending reductions at the end of the congressional session if the projected deficit or discretionary spending totals exceed specified levels. Although formal Gramm-Rudman-Hollings deadlines call for early legislative action to set spending levels, the sequester has become a perverse mechanism because final spending and deficit projections are not available until autumn, thus creating a strong incentive to delay making difficult funding decisions until late in the legislative session.

5.1 Effects Of Current System On S&T Programs

Gramm-Rudman-Hollings divides spending into direct, or mandatory, spending (also referred to as "entitlements") and discretionary appropriations. Almost all S&T spending falls within the discretionary category (decided annually in appropriations bills), which under Gramm-Rudman-Hollings is subject to annual spending caps and sequesters (sequesters can apply to mandatory spending as well, but they are less common than sequesters of discretionary spending). Although Gramm-Rudman-Hollings has adverse impacts in other policy areas, science and technology spending is disproportionately affected because the bulk of such spending, in contrast to expenditures in many other policy areas, is discretionary rather than mandatory. For example, most health services are funded through mandatory spending, but funding for most health research is discretionary.

The current annual budget process -- which compresses budget resolution, authorization, and appropriations into a single year -- is not an efficient or effective way to fund federal S&T programs, or, indeed, other programs.

The complexity of the process, the blurring of roles among various participating committees, and the need to focus on the annual deficit have reduced congressional attention to long-term S&T policy considerations.

Because of the annual budget limits placed on federal departments and agencies, commitments are extremely difficult to secure for long-term projects or programs. Budgetary uncertainty leads to planning inefficiency. Use of multiyear appropriations would help to overcome the arbitrary annual review cycle, which distorts planning timelines for any long-term effort like research. It is difficult for government to send clear messages to those receiving funding in universities or private research establishments when funding levels and policy directives are in a state of nearly continual revision.

We draw attention to the impact of the current budget process on science and technology as illustrative; obviously, the current budget process results in similar difficulties in other program areas as well. Many of the recommendations we propose for improving the budget process for science and technology activities also apply to congressional organization and funding practices in other policy areas.

5.2 Multiyear Funding

- Congress should extend program and project funding cycles for S&T programs by adopting a variety of multiyear funding mechanisms, such as multiyear appropriations, advanced or forward funding, and up-front funding for major construction projects. All such programs should adopt standardized granting and accounting procedures.

Although Congress does not have a consistent system for making funds available to the executive branch on a multiyear basis, some congressional committees, departments, and agencies have developed ad hoc mechanisms to make funds available on such a basis for programs, grants, and contracts.

Multiyear funding mechanisms are designed to provide increased program stability while maintaining annual oversight. Multiyear funding can also improve cost-effectiveness of programs by increasing managerial flexibility with regard to the timing of expenditures rather than fixing program expenses to an annual budget cycle.

For R&D programs currently receiving multiyear funding, a joint effort involving congressional staff from the responsible committees, department and agency project officers, and representatives of the Office of Management and Budget should be convened to develop standardized granting and accounting procedures. Conducting such an effort on a multiagency basis and including knowledgeable staff from both Congress and the executive branch would make the effort more likely to result in the adoption of a generally applicable set of procedures, since the various stakeholders would have participated in developing the accounting procedures.

Several mechanisms can be used to make funds available to programs on a multiyear basis. With a rolling multiyear appropriation, funds are appropriated annually but for several years ahead. For example, to maintain fiscal control and annual oversight while providing funding stability, Congress uses a rolling three-year appropriation to fund the Corporation for Public Broadcasting. Congress should consider adopting a consistent method of making multiyear appropriations to agencies and should require agencies to utilize similar multiyear methods when issuing grants and contracts. A congressional-executive working group should develop the appropriate standards.

Advanced, or forward, funding provides funds annually, but one year in advance of actual expenditures. For example, most federal elementary and secondary education funds are allocated in this manner, allowing states and school districts to plan their expenditures before the start of the school year.

With up-front funding, funds for an entire project are appropriated in a single year. Major construction projects, particularly those that use

technology that is well-developed (in contrast to experimental technologies), are an area where this type of multiyear funding can be effectively utilized. This mechanism was used to pay for the replacement Space Shuttle orbiter and is often employed in procurement of other large items, such as aircraft carriers. Where up-front funding has been used, the flexibility in planning and purchasing afforded by having the full amount of funds available at the start of a project has typically enabled program managers to improve performance and save money.

For projects in areas in which technology is less certain or is changing rapidly, another approach, known as "milestone funding," whereby Congress can approve up to five years of program funding in advance, should be considered. Certain steps are spelled out in the authorization process, and money is provided for each of those major steps. For example, in 1988 and 1989 the Secretary of Defense requested milestone funding for three programs: the Trident II D-5 missile system, the Army's mobile subscriber equipment system, and the medium launch vehicle system. [34] Like up-front funding, milestone funding can also increase program stability and efficiency.

Making a large-scale shift to multiyear funding would require the one-time use of a special funding mechanism known as a "fenced allocation" [35] to assure that the one-time increase in budget authority necessary for the shift to multiyear funding is, in fact, used for multiyear funding rather than to pay for something else. The budget resolution would make the increased funding available to the appropriations committees only when they report bills containing multiyear funding. Use of this approach requires concurrence among the budget committees, appropriations committees, and the Office of Management and Budget in the Executive Office of the President.

5.3 The Two-Year Budget

- Congress should create a pilot program to determine the effectiveness of a two-year congressional budget cycle. Such a

pilot program could be conducted for a few federal departments and agencies, for a subset of authorizing committees and appropriations subcommittees, or for a selection of programs from each department and agency. For its efficacy to be assessed accurately, the pilot program should run for at least two two-year budget cycles.

Time pressures associated with the current annual budget cycle have generated support among Members for shifting to biennial congressional budgets. Vice President Gore's National Performance Review report recommended that Congress establish biennial budget resolutions, biennial appropriations, and multiyear authorizations. [36] We agree with the goal of biennial budgets, but we feel the appropriate first step toward that goal would be a pilot program.

There are several ways to organize a biennial budget cycle. In a "split-sessions" model, budget activities -- that is, budget resolution, reconciliation, and appropriations -- would be compressed into one year, leaving an entire year free for authorizations and oversight. In a "stretched session" model, the present annual budget process would be spread over two years, allowing more time for authorizations and oversight. [37] Another possible approach involves devoting half of each two-year Congress to passing two-year budget resolutions, authorizations, and appropriations and the other half to conducting policy oversight.

Many observers have noted that two-year budgeting does not automatically produce better oversight, that supplemental appropriations may be used to respond annually to changing national needs or emergencies, and that some states have abandoned biennial budgeting as too rigid. [38] Nevertheless, we believe that it would be useful to develop a pilot program for biennial budgeting, without expecting it to be a panacea for all the ills of the budget process. Alternatively, as previously noted, without changing the entire budget cycle to a two-year basis, some of the desired results can be achieved by various multiyear appropriation mechanisms. [39] Some technical adjustments would obviously be necessary for a shift to biennial budgeting.

[40]

A working group of committee members and staff within Congress should be convened by the congressional Leadership to develop appropriate procedures, to work with the executive branch departments and agencies, and to monitor the pilot program. An independent organization should be commissioned to provide an evaluation of the pilot program; the organization should conduct interviews with participants from both the legislative and executive branches and with recipients of federal funds who are intended to benefit from the changes.

5.4 Budget Categories For More Effective Policymaking

- Congress and the executive branch should develop an accurate and consistent set of funding categories that would carry through all stages of the budget process and would reflect the decisions Congress must make about science and technology and other critical policy areas. These consistent categories must begin with the "supercategories" used to set the parameters for budget planning and continue through the budget resolution to the committee and subcommittee allocations that are critical for detailed decision making.

Three structural problems in congressional decision making can be addressed by establishing an appropriate and consistent set of budget categories:

- The "supercategories" used to set the broad parameters for budgetary decisions submerge S&T within a catchall category of "domestic discretionary" spending. This category does not reflect the importance of national S&T goals, nor does it allow knowledgeable people responsible for S&T policy to have a place at the bargaining table.

- The categories used to debate national priorities and those used

to enforce actual spending limits are so inconsistent as to render such debate meaningless. The inability to carry through broad policy decisions on overall S&T investments is frustrating to Members of Congress and to the S&T community.

- The inconsistency of the categories is compounded by the fact that until the process has been completed, S&T spending is not tracked to see whether broad decisions about national priorities made in the early stages of the budget process are reflected in specific agency appropriations at the end of the process.

In the early 1980s, when federal budget decisions moved to the center of the legislative process, the following set of categories was adopted for considering the dimensions of budget plans:

- Revenues

- Entitlement spending

- Discretionary appropriations, consisting of national defense, foreign affairs, and nondefense (domestic)

These budget categories reflect two considerations: budget enforcement mechanisms (including distinctions between discretionary spending and mandatory spending, or "entitlements") and the major policy debates of the 1980s, in which issues of military policy and foreign economic and military assistance often overshadowed domestic affairs. There is no category at any stage of the budget process that shows Congress, the executive branch, and the public the total investment in science and technology and the S&T components contributed by the different mission agencies. Nor is there any way of correlating tax incentives with investments in S&T.

The current budget categories are no longer relevant for the policy debates of the twenty-first century, but they have become enshrined through long

usage and are reflected in the basic information on the budget provided by the Congressional Budget Office and the Office of Management and Budget. In addition to affecting how policymakers think about the budget, the present categories determine who is included in the discussion. Congressional and executive officials responsible for the military, for foreign affairs, for taxes, and for entitlement programs are included in budget summits and in informal leadership discussions preceding development of the congressional budget resolution. Because all domestic appropriations -- including education, science and technology, health, transportation, environmental protection, energy, public works, housing, and law enforcement -- are lumped together, only those officials with overall responsibility for discretionary appropriations come to the table. In the executive branch, this arrangement means that the Director of OMB attends budget summits but that the Director of OSTP does not. In Congress, the chairs of the full House and Senate Appropriations Committees and the chairs of the defense and foreign affairs appropriations subcommittees are involved, but not, for example, the chairs of the authorizing committees and appropriations subcommittees responsible for education or for science and technology.

Congress should adopt a new set of budget "supercategories" that both reflect a more even distribution of funds among the several categories and highlight the issues of national policy that will determine the nation's economic and social well-being in the coming decades. "Education, Science, and Technology" should be one of those categories. These components are combined for two reasons. First, they are inextricably linked in determining the nation's knowledge base. Second, together they add up to a sufficiently large category for macrobudgeting purposes.

5.5 Linking Policy Debate To Actual Policy Decisions

The budget resolution is intended to serve as the vehicle for an annual public debate on national priorities, allowing Congress to decide whether overall spending for such major missions as education, environment, energy, health, science and technology, and transportation should be increased or

decreased.

After the broad outline of a budget plan is developed by examining the relationship among the various "budget supercategories" and determining the acceptable level of deficit, the spending totals are translated into the functional categories of the budget resolution. This resolution is then considered by the budget committees, which report allocations of budget authority to the full House and Senate. The full Congress expresses its will by considering amendments to change the functional allocations of the budget resolution.

This process makes it virtually impossible to have a policy debate about overall S&T funding or the specific funding priorities within S&T for two reasons: first, S&T contributes to several budget functions in addition to the "General Science, Space, and Technology" category (budget function 250); and, second, even if such programs as health research (in budget function 550), agricultural research (in budget function 350), energy research (in budget function 270), and environmental research (in budget function 300) were combined, the problem would not be solved, because the budget functions are not binding on the committees. Once the budget resolution is enacted, its functional categories cease to have any meaningful existence.

The actual enforcement of spending limits is done through allocations to various committees; these committees cut across or combine various budget functions. The categories that create binding allocations for spending -- the allocation of discretionary spending authority to the appropriations committees and the allocation of budget authority to the various appropriations subcommittees [41] -- do not have any separate category or subcategory for S&T items. Thus, even if appropriate data and analysis regarding overall S&T funding and budgetary choices among competing investments were provided to Congress, there is no legislative vehicle that could encapsulate that information for use in an arena where decisions are made. Without a clear link to decision making, the reason for producing such analysis and for debating the adequacy of funding for S&T programs and

priorities among them would simply disappear.

Thus, once a useful set of budget supercategories has been created, the next task is to devise a consistent set of more detailed categories that can be carried all the way through the budget process from the budget resolution to the allocations to appropriations committees and to the ultimate allocation to appropriations subcommittees. Because subcommittee allocations create binding points of order that make it difficult for the full body to change the total amounts decided by the appropriations committees, Congress should consider changing the procedures for deciding those allocations.

Currently, the appropriations committees report allocations among their subcommittees to the House and Senate, but the committees can change the allocations at will. If those allocations were either embedded in a revised set of budget resolution categories, or made in the form of an amendable resolution, then the full membership of each chamber of Congress would be able to participate in the determination of discretionary spending allocations.

If an "Education, Science, and Technology" category were created or an "Education, Science, and Technology" suballocation were set for each appropriations subcommittee, it would be possible for Congress to develop an overall priority for "Education, Science, and Technology" and see it carried through all stages of the budget process. The same linkage of policy debate to decisions would apply to other national goals or missions for which major budget categories were specified. This process would not diminish the responsibility of the appropriations committees to determine the specific funding levels for particular programs and agencies.

5.6 Tracking The Total

Consistent budget categories are necessary if funding levels for "Education, Science, and Technology" (or other policy areas) are to be

followed through all stages of the budget process. It is also essential that a congressional staff member be assigned responsibility for tracking and reporting funding levels at each stage in the process. The technical budget analysis work could easily be done for Congress by the Congressional Budget Office and for the executive branch by the Office of Management and Budget. However, the responsibility for interpreting the data and deciding how to use the information during the policy process must be given to specialists in education, science, and technology. For the executive branch, this means either the Office of Science and Technology Policy or the new National Science and Technology Council, which is intended to encompass and enhance the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET).

In Congress, the policy-tracking can be done in several ways. A designated Leadership staff member could confer with the authorizing committees and appropriations subcommittees of jurisdiction and issue the report. The budget committees could also carry out this function for the Leadership. Since the bulk of "Education, Science, and Technology" funding is included in discretionary appropriations, a staff member of the full House and Senate appropriations committees could be responsible for tracking and reporting. At all stages, the process would compare the President's proposals, including multiagency initiatives developed by FCCSET (or its successor), with the budget resolution, authorizing legislation, and appropriations bills.

5.7 Nonbudgetary Factors

Not all the challenges facing science and technology are budgetary, and not all the tools at the disposal of Congress are fiscal. As it considers science and technology goals and priorities, Congress should explicitly address nonbudgetary factors that affect science and technology.

National macroeconomic policies affect progress in science and technology as well as other areas of human activity. Many other policies also influence scientific advances and technological developments, including

policies on such issues as the protection of intellectual property rights; incentives for partnerships among government, industry, and research institutions (for example, research and development tax credits); support of graduate students; and reporting requirements imposed on recipients of federal research grants.

Tax policy, for example, has a significant impact on science and technology, both directly (through R&D tax credits and other mechanisms) and indirectly (by affecting the availability of capital for research and development activities). Yet no mechanism exists for relating the policies of the revenue committees to those of the authorizing committees and the appropriations subcommittees responsible for science and technology.

6.0 A CASE STUDY: CONGRESSIONAL EARMARKING FOR RESEARCH FACILITIES AND PROGRAMS

The controversial issue of academic earmarking offers an illuminating case study of S&T policymaking in particular and of congressional procedures in general. The practice illustrates tensions that have arisen between the scientific community and the federal government, between the executive branch and Congress, and in Congress between the authorizing committees and Appropriations Committees over how to fund S&T facilities and research programs. Academic earmarking raises the most basic questions regarding national science policy: Who should decide about the distribution of federal funds for science and technology? What should be the criteria for awarding these funds? And how should funds be distributed? We feel that these questions can also be raised with respect to other areas where federal funds are expended, and in that spirit we offer this case study.

6.1 The Nature Of Earmarking

Earmarking means the allocation of S&T funds on a closed, noncompetitive basis by a few Members of Congress, with virtually no scientific or

technical review of the chosen projects. Academic earmarking undermines congressional procedures and the capacity of Congress to make wise choices in allocating limited resources, raising this question: Are the American people getting the best science for their tax dollars?

The practice in Congress of appropriating funds for specific projects without competition or merit review -- known as earmarking -- is a well-established tradition dating from the institution's earliest days. [42] Members of Congress earmark funds because they want to help the constituents, institutions, regions, and states they represent.

Most earmarks over the years have been for nonacademic projects, such as roads, bridges, and defense facilities. Until the 1980s earmarking funds for academic institutions was rare. Because there was an unwritten congressional ethic against academic earmarking, and because Members of Congress were not asked to engage in the practice, Members generally refrained from bypassing the established merit review system to earmark funds for academic projects.

In 1983, however, two major universities sought, with the help of lobbying firms, and received earmarked funds for science facilities. [43] No executive branch department or agency had planned, requested, or budgeted these funds. Nor had the universities been selected through merit (or peer) review, the competitive process traditional in academia through which proposals are judged on the basis of examination of their scientific and technical merits by individuals professionally competent to do so. [44] Thus began a practice that has caused contention among Members of Congress, within the scientific community itself, and between the two groups over how to fund S&T facilities and research programs.

The term "academic earmarking" covers a wide range of practices. There is no generally agreed-upon definition. (See Box 5 for definitions of terms used in this chapter.) The Office of Technology Assessment, for example, defines a congressional academic earmark as "a project, facility, instrument, or other academic research-related expense that is directly

funded by Congress, which has not been subjected to peer review and will not be competitively awarded." [45] This definition, of course, excludes earmarking by executive branch departments or agencies, which also occurs. A more comprehensive definition defines earmarking as "the selection of research facilities or projects for funding by any manner other than [either] external or merit review." [46] Although we recognize that earmarking is not the sole province of Congress, the recommendations in this report address only the practice of congressional earmarking for academic facilities and programs.

BOX 5: Earmarking Glossary

Academic earmark: A research facility or program, at a college or university, selected for funding by Congress or the executive branch by any manner other than merit (or peer) review.

Congressional academic earmark: A program, facility, instrument, or other academic research-related expense directly funded by Congress that has not been subjected to peer review and will not be competitively awarded.

Merit (or peer) review: The practice of judging research and the new knowledge it yields on the basis of its intrinsic scientific merit by individuals within or outside government who are professionally competent to do so.

Research facilities: The physical plant (e.g., "bricks and mortar," research vessels) in which organized research activities take place, including building infrastructure (power, heating, ventilation, and air conditioning, and so on), fixed equipment (for example, benches, fume hoods), and nonfixed equipment costing over $1 million.

Research program: A systematic study directed toward fuller knowledge or understanding of the subject studied.

Sources: James D. Savage, "Where's the Pork?" Issues in Science and Technology (Spring 1993), 21-24; Office of Technology Assessment, Federally Funded Research: Decisions for a Decade (Washington, DC: OTA, 1991); National Science Foundation Form 411 (October 1990); National Science Foundation Form 92-325; and Report of the Working Committee on Principles, Policies, and Procedures in the Award of Federal Funds for University Research Facilities and Research Projects. [44]

* * * * *

Academic earmarks may be designated for research facilities, research programs, or both. Earmarks may be designated for a single institution or a group of institutions. And earmarks may be introduced by Members of Congress at different stages of the appropriations process. Since 1980, academic earmarking has grown seventyfold, from $10.7 million in that year to an estimated $763 million in fiscal year 1993 (see Box 6). From fiscal years 1980 to 1993, a total of about $3.2 billion in funds was earmarked for academic facilities and programs. Despite the spending caps imposed by the Budget Enforcement Act of 1990, 60 percent of all academic earmarks funded during fiscal years 1980 to 1993 were appropriated in the three fiscal years 1991, 1992, and 1993 alone. [47]

BOX 6: Academic Earmarks, Fiscal Years 1980 to 1993

GRAPHICS:

Sources: Data were compiled from lists of earmarks generated from a variety of sources, including the Congressional Research Service. Among these sources were "Appropriations Enacted for Specific Colleges and Universities by the 96th through 100th Congress," Report 89-82, Senate Environment and Public Works Committee, February 6, 1989; the Chronicle of Higher Education (for example, "Congress Earmarked a Record $684 Million for Noncompetitive Projects on Campuses," April 15, 1992); James D. Savage (for example, "Saints and Cardinals in Appropriations Committees and the Fight against Distributive Politics," Legislative Studies Quarterly, August 1991; and

Congressional Research Service, Library of Congress, The Distribution of Apparent Academic Earmarks in the Federal Government's FY 1992 Appropriations Bills.

* * * * *

6.2 An End To Earmarking

- All parties involved -- Congress, the executive branch, and the academic community -- should work together to develop a system other than earmarking that will support first-class science, better reflect the goals of geographic equity and fairness in competition, and encompass the principles of scientific and technical merit review.

We believe agreement on who makes decisions about federal science funding, on criteria for awards, and on how to distribute funds would be promoted by:

- A Congressional-Executive S&T Policy Conference, as recommended earlier in this report, to facilitate discussion between the legislative and executive branches regarding long-term goals for science and technology

- Procedures in Congress to help set priorities among competing demands for federal science funds

6.3 Two Sides Of The Controversy

People on both sides of the academic earmarking controversy can be found in the academic community and in Congress. Some university presidents, trustees, and faculty members have argued that inadequate research facilities are the main impediment to the ability of their institutions to compete successfully for federal research funds. Others seek earmarked

projects because there are few merit-reviewed federal programs for modernization of academic facilities. With little funding available for competitive facilities programs, it seems necessary to seek resources through other means, including earmarking. [48]

The Case for Earmarking

There is some justification for this view. It is in large part because the federal government terminated several major merit-based competitive facilities programs in the early 1970s that earmarking is now the prevalent federal mechanism for funding university facilities. At the high point in 1968, the federal government was contributing 32 percent of funds from all sources (including state and local governments, institutional funds, private donations, tax-exempt bonds, and other debt) for academic research facilities. Currently, the federal share of funding for such facilities is about 10 percent, and most of those funds are earmarked. The National Science Foundation (NSF) reported federal expenditures of $526 million in fiscal year 1991 for renovation and construction of academic research facilities. Of that total, almost 93 percent was earmarked. Only $39 million, or about 7 percent, was awarded competitively through the sole federal program that exists to finance general-purpose academic facilities, NSF's Academic Facilities Modernization Program. [49]

Some academics and Members of Congress believe that earmarking corrects an imbalance in federal funding of academic research that favors so-called elite institutions. They question the fairness of the merit review system because it has produced an uneven distribution of federal research funds among institutions and states. [50]

According to the National Science Foundation, however, this funding pattern is not due to elitism but to the selection of the best projects through a merit review system that is also sensitive to geographical diversity. [51] Several studies of the merit review system have concluded that it is working as it should -- funding the highest-quality research. [52]

Nor is earmarking the most effective way to correct perceived inequities: earmarks are distributed not according to need but according to a university's political strength in subcommittees of the House and Senate appropriations committees. [53] The data from fiscal years 1980 to 1992 (Box 7) show that earmarking has not enhanced geographical equity. For example, earmarking has primarily benefited the states that already receive the most federal R&D funds rather than those that receive the least. (The top ten states in federal R&D funds received 32 percent of the earmarked funds. [54]) In addition, the 50 institutions that received most federal R&D funds received 26 percent of the earmarked funds, while institutions below the top 100 received 48 percent. (See Box 7 for trends in academic earmarking.)

BOX 7: Trends in Academic Earmarking, Fiscal Years 1980 to 1992, by Dollar Volume

- Almost a third (29.8 percent) of all earmarked funds for academic research programs and facilities went to five states; half (50.5 percent) of the funds went to ten states.

- Earmarking primarily benefited the states that receive most federal academic R&D funding rather than those that receive the least. The top 10 states in federal R&D funding received 32.2 percent of the earmarks.

- Ten institutions received nearly a third (29.0 percent) of all earmarked funds; 20 institutions received more than half (54.4 percent) of all such funds.

- The top 50 institutions in receipt of federal R&D funds received 26.2 percent of the earmarked funds; institutions ranked 51 through 100 received 25.8 percent of earmarked funds; the other 48.0 percent went to institutions below the top 100.

- Of the nine NSF geographical regions, the region that received the most federal R&D funds in fiscal year 1990 (Pacific) also received the most earmarked funds in fiscal years 1980 to 1992. Two of the three regions that received the least federal academic R&D funding in fiscal year 1990 (East South Central and Mountain) also received the least earmarked funds in fiscal years 1980 to 1992. However, the other region receiving the least federal academic R&D (West North Central) received a much larger percentage of earmarked funds.

Source: Congressional Research Service, Library of Congress, Trends in the Distribution of Apparent Academic Earmarks in the Federal Government's FY 1980-92 Appropriations Bills (Washington, DC: CRS, 1992).

* * * * *

One strong incentive for earmarking is the hope of Members of Congress that research projects will lead to regional economic development as in Silicon Valley in California, Route 128 in Massachusetts, and Research Triangle Park in North Carolina. [55] Many institutions believe that new research facilities will strengthen their capacity to contribute to local development and create jobs. This connection, however, is not nearly as direct as many people believe. [56] Technology development projects depend on existing markets, support structures, and scientific resources. Some research parks have failed because the region lacked adequate economic and technical support. [57]

The Case Against

It is the expansion of earmarking from bricks and mortar facilities into research programs that scientists and many policymakers most fear. Once decisions on individual research grants enter the political arena, it is asserted, the integrity and the international competitiveness of U.S. science and technology will suffer, and mediocrity will be the result. Although merit review may have flaws, it has produced a university-based

research system that is the envy of the world. [58]

Opponents of earmarking contend that the practice undermines good science, distorts agency budgets, and wastes federal resources. Scientists and engineers see earmarking as striking at the heart of a fundamental principle of the research enterprise: Research should be judged by individuals, or peers, technically competent to do so, on the basis of intrinsic scientific merit. [59]

Earmarking has begun to displace scientific projects authorized by Congress. [60] An analysis of earmarks in congressional appropriations acts and reports for fiscal year 1993 by the Office of Science and Technology Policy reported that earmarks displaced, or "squeezed," funds for budgeted research and development activities by about $600 million. [61] This "squeeze" represents the amount of congressional earmarks not covered by increases in appropriations.

According to Rep. George E. Brown, Jr. (D-Calif.), chair of the House Committee on Science, Space, and Technology, "The conference report [for fiscal year 1992] terminates a vast variety of NASA scientific projects such as the space infrared telescope . . . and the flight telerobotic servicer. These are projects that scientists have spent decades planning and developing. . . . Yet the conference report contains over $100 million in projects that were never requested by the administration, never authorized, and never discussed on the floor." [62]

Executive agencies, in general, do not like earmarks. They can take an agency far afield of its mission. Nevertheless, agencies usually comply with them (even those earmarks contained in committee reports, and not appropriations bills themselves, that are, therefore, technically not binding) because they do not wish to incur the ill will of the appropriations committees. [63]

6.4 Attempts To Curb Earmarks

Recent attempts in Congress to curb the practice of earmarking have met with mixed success. In 1992, Chairman Brown won a fight on the House floor to block an effort to add $95 million in academic earmarks to the Energy and Water Development appropriations conference report for fiscal year 1993, only to see conferees for the Defense appropriations bill reverse his action by restoring the Energy and Water Development earmarks in a Defense appropriations conference report the following week. [64] Chairman Brown and Rep. John D. Dingell (D-Mich.), chair of the House Energy and Commerce Committee, subsequently proposed changes in the appropriations process and in committee procedures to address the practice. Although the House did not adopt a rule to prohibit unauthorized location-specific earmarks in appropriations bills, it did adopt rules changes that make it easier for the relevant authorizing committees to amend appropriations bills that contain earmarks.

Other attempts to prohibit earmarking have failed. In 1989, Sen. Sam Nunn (D-Ga.), Sen. John Danforth (R-Mo.), and Sen. Terry Sanford (D-N.C.) introduced S. Res. 206, which would have established a "point of order against material that earmarks research monies for designated institutions without competition." [65] In June 1990, the Senate Rules Committee held hearings on the resolution, but the measure never emerged from committee, largely due to bipartisan opposition.

In 1993, the House Committee on Science, Space, and Technology began an assessment of earmarking in an effort to understand how academic institutions receive congressional earmarks and how recipients expend the earmarked funds. The committee held a series of hearings to address such issues as how earmarked projects have contributed to the welfare of society; how government agencies treat earmarks; how the use of earmarks affects other science programs; and why some Members favor earmarking rather than merit review. In an interim report issued on August 9, 1993, Chairman Brown concluded:

> Basically, earmarks are the result of an academic

> institution using its special access to an influential Member of Congress . . . using this advantage to gain a cash award without having to compete for the money or bear public scrutiny. The government and the taxpayer are the real losers as a result of this practice. [66]

6.5 The Balance Of Power

Not surprisingly, earmarking is a source of tension between authorizing committees and appropriations committees. Members of authorizing committees are most disturbed by the practice of appropriations committee members' adding earmarks when a conference report is brought to the floor for a vote -- consideration of a conference report allows little debate about a project and no opportunity for amendment. Members of authorizing committees believe that the legislative process should work as formally intended, with authorizations preceding appropriations.

Earmarking concentrates power in the hands of relatively few Members of Congress. In the House, the Appropriations Committee members currently constitute 14 percent of the total number of representatives; in the Senate, 29 percent of all senators are members of the Appropriations Committee. The chair of each appropriations subcommittee decides if earmarks will be awarded and who will receive them. [67] Between fiscal years 1980 and 1992, earmarked funds were concentrated in three House and Senate appropriations subcommittees: Energy and Water Development (27 percent); Rural Development, Agriculture, and Related Agencies (25 percent); and Defense (18 percent). In recent years, earmarking has spread to other subcommittees, most notably the Veterans Affairs, Housing and Urban Development and Independent Agencies Subcommittee; the Commerce, State, Justice, the Judiciary, and Related Agencies Subcommittee; the Interior and Related Agencies Subcommittee; and the Treasury, Postal Service, and General Government Subcommittee. [68]

Members have been reluctant to earmark programs in the National Science

Foundation and the National Institutes of Health because of the long history of merit-reviewed programs in those agencies. Several strong committee and subcommittee chairs have played important roles over the years in resisting earmarking in appropriations bills for those agencies. The reasons range from the belief that merit review is good public policy to the belief that, in the division of power between the legislative and executive branches, Congress should not determine which individual projects will be funded. [69]

Rep. William Natcher (D-Ky.), longtime chair of the Appropriations Subcommittee on Labor, Health and Human Services, Education, and Related Agencies, which controls funding for the National Institutes of Health, is a strong foe of earmarking. Now chair of the full Appropriations Committee in the House, he is in an excellent position to convince his subcommittee chairs to forgo earmarks in their appropriations bills. Chairman Natcher's influence became apparent in a 1993 floor debate on the House Veterans Affairs, Housing and Urban Development, and Independent Agencies appropriations bill when the subcommittee chair Rep. Louis Stokes (D-Ohio) announced in his opening remarks that he and his Senate counterpart, Sen. Barbara Mikulski (D-Md.), had agreed that their fiscal year 1994 bill would contain no unauthorized earmarks.

We believe that the congressional Leadership should reassert the congressional ethic against all academic earmarking and should consider alternative approaches to curb or modify this practice. Among the approaches Congress should consider are prohibiting unauthorized location-specific earmarks in appropriations bills or reports; submitting any proposed unauthorized earmarks to the appropriate authorizing committee for authorization, amendment, or rejection; and requiring review by scientific or technical experts before appropriating funds. As discussed in Chapter 3, if Congress enforced existing rules regarding the division of responsibility between authorizing committees and appropriations committees, the balance of power between them would be restored and tensions would be eased.

6.6 Facilities Funding Needed

Many respected groups, including the Association of American Universities, the Council on Competitiveness, the Higher Education Colloquium on Science Facilities, the National Science Board, and the White House Science Council, have said that if a set of fair, equitable, and financially adequate federal facilities programs existed, academic earmarking would decline dramatically. [70] The Commission agrees.

Such a facilities program was established by Congress in the National Science Foundation in 1988, with authorized funding rising from $89 million in fiscal year 1989 to $250 million in fiscal year 1993. Appropriations for the program, however, have been meager, totaling $94 million since its inception, and funding for the program was zeroed out in the Administration's budget request for fiscal years 1992 and 1993. The NSF facilities program is viewed with concern by researchers at some major institutions because they believe it competes with funding for NSF research programs.

Little agreement exists on the appropriate role of the federal government in funding modernization of academic facilities. Earmarking is now a significant federal method to fund construction of academic research facilities, chiefly because competitive, merit-reviewed programs to fund facilities directly either do not exist or, where they do exist, are not adequately funded.

- Congress should work with the executive branch and the academic community to develop agreement on priorities for federal responsibility in modernizing academic research facilities and on the appropriate mix of funding mechanisms, both direct and indirect. In the major S&T-related federal departments and agencies, Congress should, to the extent consistent with other budgetary priorities, fund existing competitive, merit-based academic facilities programs to authorized levels and should

establish new programs where they do not exist.

We believe that direct funding programs, in addition to reasonable indirect cost recovery, are essential to build needed new research facilities and to restore existing academic laboratories to the condition necessary to help achieve national goals. Congress should set the funding level for facilities programs in each of the major science- and technology-related departments and agencies in relation to the amount of academic research that each supports. The NSF Academic Research Facilities Modernization Program is a model for similar programs in other federal agencies in its provision for geographic balance and its tiered structure, which allows less research-intensive institutions to compete with each other, rather than against major research institutions, for awards.

Two other actions would enhance the ability of universities to finance construction and renovation of science facilities and could reduce the need to seek earmarks. The first action would be removal by Congress of the $150 million cap, imposed by the Tax Reform Act of 1986, on tax-exempt bonds issued by private, nonprofit educational or medical institutions. This limitation does not apply to public institutions. Debt financing, most of which is in the form of tax-exempt bond issues, accounted for 27 percent of facility financing in private, or independent, universities and colleges, according to a 1990 National Science Foundation survey. This important source of financing is shrinking as more and more institutions reach the cap. More than two-thirds of the nation's 30 largest independent research institutions have reached the $150 million limit.

A second helpful action would be review by Congress, the Office of Management and Budget, and the Office of Science and Technology Policy of the way universities are currently reimbursed for the costs of the laboratories and instruments used in federally sponsored research. Technological obsolescence should be factored into the use allowance for research facilities, which universities charge as overhead on federal research grants. The government should also permit buildings to be amortized over a more realistic lifespan than the fifty-year life now used.

6.7 Earmarking For Research Programs

Although most earmarks to date have been for facilities, the practice of earmarking funds for research programs is growing. In fiscal year 1992, of the total of $708 million in academic earmarks, $397 million (56 percent) was earmarked for facilities; $295 million (42 percent) for research programs; and $15 million (2 percent) for other research or academic purposes. [71]

Data published by the Office of Science and Technology Policy show that the total amount earmarked for academic research programs (not facilities) increased by 50 percent from fiscal year 1992 to 1993. In fiscal year 1993, 66 percent of the $763 million in total funds earmarked for academic institutions was set aside for research programs, not facilities. [72] We believe that these data suggest a disturbing trend: scarce federal resources are being distributed for scientific research without any review by scientific and technical experts of the competence of the investigators and their institutional resources or of the quality and significance of the work to be performed.

Earmarking for academic research programs, rather than facilities, now accounts for more than half, by dollar amount, of earmarked funds. Earmarking has begun to displace scientific research programs authorized by Congress.

- Congress and the executive branch should design competitive merit-based research programs to respond to the economic development and geographic equity needs that drive some earmarking.

Desire for local economic growth is a powerful incentive for earmarking. Federal funding for economic development programs has lagged far behind the expanding demand. To meet this need, Congress might consider, for

cooperative facility and program development with the states, technology development programs in the Departments of Agriculture, Commerce, Defense, and Energy and the National Aeronautics and Space Administration; and for critical, short-term R&D problems of interest to particular states or regions, special grants programs in each mission agency. [73] In addition, all federal departments and agencies engaged in S&T should expand research programs targeted on regions with little scientific base.

Congress has established research programs that have been successful in achieving the goal of geographic equity. For example, the Experimental Program to Stimulate Competitive Research (EPSCOR) was established in the National Science Foundation in 1979. By awarding funds to universities that need seed money to improve their research programs, EPSCOR has enhanced the capabilities of states that had not received NSF research support to compete for such funding. The EPSCOR program was funded at $24.5 million in fiscal year 1993, and, since its inception in 1979, it has received a total of $95.2 million. There are similar programs in the Department of Defense, Department of Agriculture, NASA, Department of Energy, Environmental Protection Agency, and National Institutes of Health totaling less than $60 million for EPSCOR and EPSCOR-like programs in fiscal year 1993, a modest amount in light of the need.

6.8 Criteria For Award Of Federal Funds

The controversy over earmarking is a manifestation of longstanding tensions between the insistence of science on quality and the commitment of American politics to fairness. Scientists believe that research should be judged on the basis of values intrinsic to science. Members of Congress, in making funding decisions, use values extrinsic to science, such as economic and sociopolitical criteria. The problem is that there is no explicit system for allocating federal science funding that takes into account both intrinsic and extrinsic criteria. [74]

Merit review systems vary across federal agencies, but all have one common feature -- scientific or technical experts judge the quality of the

research to be performed. Some agencies assemble groups of outside reviewers; other agencies refer proposals to individuals who submit their reviews by mail. In some agencies technical staff conduct the reviews. In all cases, once proposals are judged to be of high quality, agency staff, taking into account additional factors, exercise some discretion in deciding which to fund. [75]

The National Institutes of Health have a two-phase merit review process in which a group of assembled reviewers (the Study Section) first judges the scientific merit of proposals and then an Institute Advisory Council considers other factors, such as the mission of the Institute. National Science Foundation guidelines for reviewers recognize four criteria to be applied to proposals: (1) research performance competence, (2) intrinsic merit of the research, (3) utility or relevance of the research, and (4) effect of the research on the infrastructure of science and engineering. The relative weight given to criteria 2 and 3 depends on the nature of the proposed research. Criterion 2 is emphasized in basic research proposals; criterion 3 in applied research proposals.

> Criterion 4 . . . permits the evaluation of research proposals in terms of their potential for improving the scientific and engineering enterprise and its educational activities in ways other than those encompassed by the first three criteria. Included under this criterion are questions relating to scientific and engineering personnel, including participation of women, minorities and the handicapped; the distribution of resources with respect to institutions and geographical areas; stimulation of quality activities in important but underdeveloped fields; and the utilization of interdisciplinary approaches to research in appropriate areas. [76]

The merit review system was designed primarily to judge scientific value

and to allocate funds among small science programs. Merit review is not well suited to judge economic development or political impact. Nor is merit review alone appropriate for evaluating large-scale multi-institutional or multidisciplinary programs. For example, the largest science and technology projects, such as the space station and the Superconducting Super Collider, have been judged and funded through a range of review mechanisms, few of which adhere strictly to merit review. These mechanisms have included "a mix of expert review, systematic scoring of technical and economic criteria, program-manager autonomy, congressional activism, intergovernmental agreements, payback and recoupment plans, incentive packages and bidding, subjective assessments by experts, politicians and citizens." [77]

Earmarking results in part from lack of agreement and cooperation between Congress and the executive branch in developing explicit criteria for evaluating proposed research facilities and programs that are competing for limited resources.

- Congress and the executive branch should clearly articulate criteria and establish an evaluation system to guide decisions on federal funding of both research facilities and research programs. The system should apply different criteria to different projects (facilities and programs), taking into account the broad range of projects, from small investigator-initiated research grants to large scientific facilities, and the broad range of legitimate goals, not only scientific but also economic and sociopolitical.

Scientific and technical merit should be a factor in judging all science and technology facilities and programs. Scientific and technical merit should continue to be the primary criterion in judging small investigator-initiated research programs. Decisions for "Big Science," major university facilities, and programs of national significance should, in addition to scientific and technical merit, take into account economic, social, and political factors. [78] The relative weight given to these different

criteria should depend on the nature of the project. Agency review processes should establish a mechanism to enable Members of Congress to present for the record a justification of why they believe, in light of established criteria, that a project should be funded.

6.9 Multiple Approaches Needed

Because earmarks are distributed not on the basis of any established criteria -- scientific, economic, or social -- but on the basis of political power, earmarking subverts the capacity of Congress to set priorities. To be an effective partner in science policymaking, Congress must find more appropriate instruments than earmarking.

Academic earmarking will be difficult to stop: numerous attempts in Congress to curtail the practice have already failed. Because a variety of motivations and needs underlies the problem of earmarking, no single approach will be adequate. Solutions to the earmarking controversy will require a combination of approaches and "behavior changes on the part of Congress and the universities." [79]

7.0 CONCLUSION

> Science, by itself, provides no panacea for individual, social, and economic ills. It can be effective in the national welfare only as a member of a team, whether the conditions be peace or war. But without scientific progress no amount of achievement in other directions can insure our health, prosperity, and security as a nation.
>
> -- Vannevar Bush
> Science: The Endless Frontier
> (1945)

We believe that this report is both timely and urgent. Although reform is never easy, two key developments make this an especially favorable moment for change: the rising awareness of the importance of science and technology and the increasing momentum for congressional reform.

For example, President Clinton and Vice President Gore have made clear their view that science and technology can promote economic growth and international competitiveness and can play an essential role in successful defense conversion. Support for this attitude is growing in Congress as well. To illustrate, Congress is currently considering legislation to support R&D in areas like high-performance computing and advanced communication networks that could spawn new industries, to shift the missions of the national laboratories to aid business, to promote technology transfer, and to allow federal agencies to enter into innovative partnerships with the private sector.

Although the past two decades have seen tremendous progress in addressing environmental problems, Congress is also more aware than ever that the nation and the world are facing serious threats that will require new approaches to federal S&T policy for the environment, including more attention to environmental research. Science and technology are playing an increasingly important part in at least two other problems high on the nation's agenda: education, where advanced technology can be a powerful teaching tool; and health, where advances in basic and applied research offer promise of less costly ways to provide health care.

As we observed at the outset, this report is not a plea for more financial support from Congress for science and technology; rather, it offers recommendations to help Congress deal more effectively with issues of science and technology. The changes in procedure and structure that we propose constitute an agenda of evolutionary, not revolutionary, change that comports with the more general reforms Congress is currently considering.

If Congress does improve the way it makes S&T policy, it can add to the list of scientific advances in which it has played so vital a part in recent decades: the exploration of space, the attack on disease, the dawn of the computer and information age, and the cleanup of polluted rivers and lakes, to list only a few. By choosing reform, Congress can help ensure that the United States will enter the twenty-first century using to the fullest one of its greatest assets, the strength of American science and technology.

8.0 APPENDIXES

8.1 Appendix A: Biographies Of Members Of The Committee On Science, Technology, And Congress

John Brademas, Chair, President of New York University from 1981 to 1992, is now President Emeritus. For 22 years (1959-1981), he represented the Third District of Indiana in the U.S. Congress, serving the last four years as House Majority Whip. He also chairs the National Endowment for Democracy.

Jimmy Carter is the founder of The Carter Center, a nonprofit organization working to resolve conflict, promote democracy, preserve human rights, improve health, and fight hunger around the world. He was President of the United States from 1977 to 1981 and Governor of the state of Georgia from 1971 to 1975. He served in the Georgia State Legislature from 1963 to 1967.

Lawton Chiles is Governor of the state of Florida. He served in the U.S. Senate from 1971 to 1989 and chaired the Senate Budget Committee from 1986 to 1988. He was a member of the Florida House of Representatives from 1958 to 1966 and the Florida Senate from 1966 to 1970.

Daniel J. Evans is Chairman of Daniel J. Evans Associates. He served in the

U.S. Senate from 1983 to 1989 and was President of Evergreen State College in Washington from 1977 to 1983. He was Governor of the state of Washington from 1965 to 1977 and served in the Washington House of Representatives for eight years beginning in 1956.

Charles McC. Mathias, Jr., is an attorney with Jones, Day, Reavis & Pogue. He served in the U.S. Senate from 1969 to 1987. Before his election to the Senate, he was a member of the U.S. House of Representatives from 1961 to 1969 and the Maryland House of Delegates from 1959 to 1960.

H. Guyford Stever was Director of the National Science Foundation from 1972 to 1976; during this time he also served as science advisor to Presidents Nixon and Ford. He was Director of the White House Office of Science and Technology Policy from 1976 to 1977. Before 1972, he was President of Carnegie-Mellon University.

8.2 Appendix B: Papers Prepared For The Committee On Science, Technology, And Congress

Joel D. Aberbach, "The Politics of Congressional Oversight of Science and Technology Programs" (September 1991)

Raymond E. Barber, "Improving Dissemination of Information on Congressional Science and Technology Policy" (July 1992)[*]

Bruce Bimber, "Congressional Support Agency Products and Services for Science and Technology Issues: A Survey of Congressional Staff Attitudes about the Work of CBO, CRS, GAO, and OTA" (September 1990)[*]

Richard N. Brandon, "Improving the Information Base for Congressional Budget Decisions on Science and Technology Programs: Problem Definition" (September 1990)

Richard N. Brandon, "Establishing Operational Processes for Long-term S&T Goals: Inserting Vision in an Ecology of Games" (March 1991)

Richard N. Brandon, "Communication and Coordination Mechanisms To Improve Congressional Consideration of Science and Technology Issues" (September 1991)

Richard N. Brandon, "Multi-year Funding Mechanisms for Federal Science and Technology Activities" (September 1991)

James D. Carroll, "New Directions for the Congressional Research Service on Science and Technology Issues" (September 1990)[*]

John W. Ellwood, "The Congressional Budget Office and the Improvement of Congress's Ability to Handle Expert and Scientific Information" (September 1990)[*]

Henry Eschwege, "Analysis of Science and Technology Issues for the Congress: Future Directions for the General Accounting Office" (September 1990)[*]

James E. Katz, "Mechanisms for Providing Science Advice to Congress: Current Status, Unresolved Problems, and Possible Solutions" (September 1990)[*]

Marcel C. LaFollette, "Congressional Oversight of Science and Technology Programs" (September 1990)

Marcel C. LaFollette, "Realigning the Assumptions: Commentary on 'Science, Technology, and Congress: Strategies for the 1990s and Beyond' (Aspen, Colorado, July 1990)" (November 1990)

Paul A. Locke and Dan Berger, "Global Climate Change and Congress: Examining Decisionmaking in the Legislative Process" (September 1991)

Toni Marzotto, "Recruitment and Retention of Senior Science and Technology

Personnel, Congressional Research Service and Office of Technology Assessment" (February 1991)[*]

David C. Mowery, "Congressional Decisionmaking in Science and Technology Policy: Three Case Studies" (March 1992)

Rodney W. Nichols, "Vital Signs OK: On the Future Directions of the Office of Technology Assessment, U.S. Congress" (November 1990)[*]

Bert A. Rockman, "Congressional-Executive Interaction in Science and Technology Policymaking" (September 1991)

Mark Schaefer, "Rapid-Response Scientific and Technical Analysis for Congress" (June 1990)[*]

Willis H. Shapley, "The Budget Process and R&D" (April 1992)[*]

Jeffrey K. Stine and Marcel C. LaFollette, "Congressional Hearings on Science and Technology Issues: Strengths, Weaknesses, and Suggested Improvements" (September 1990)

Patricia S. Warren, "Merit Review and Academic Earmarking" (September 1992)

Endnote

[*] The asterisk indicates papers used primarily in the preparation of the first and second reports of the Committee on Science, Technology, and Congress: Science, Technology, and Congress: Expert Advice and the Decision-Making Process (February 1991) and Science, Technology, and Congress: Analysis and Advice from the Congressional Support Agencies (October 1991).

9.0 NOTES AND REFERENCES

[1] Felix Frankfurter, The Public and Its Government (New Haven: Yale University Press, 1930).

[2] Richard N. Brandon, background papers for the Committee on Science, Technology, and Congress: "Improving the Information Base for Congressional Budget Decisions on Science and Technology Programs: Problem Definition" (September 1990); "Establishing Operational Processes for Long-Term S&T Goals: Inserting Vision in an Ecology of Games" (March 1991); "Communication and Coordination Mechanisms to Improve Congressional Consideration of Science and Technology Issues" (September 1991); "Multi-Year Funding Mechanisms for Federal Science and Technology Activities" (September 1991).

[3] Joint Committee on the Organization of Congress, Congressional Reform Survey Results, Summer 1993.

[4] Strengthening of America Commission, The CSIS Strengthening of America Commission: First Report (Washington, DC: Center for Strategic and International Studies, 1992).

[5] American Association for the Advancement of Science, AAAS Member Survey: National Science Policy (Washington, DC: June 1993), p. 21.

[6] Office of Technology Assessment, Federally Funded Research: Decisions for a Decade (Washington, DC: U.S. Government Printing Office, 1991), p. 171, Chapter 8.

[7] Carnegie Commission on Science, Technology, and Government, E3: Organizing for Environment, Energy, and the Economy in the Executive Branch of the U.S. Government (New York: 1990).

[8] Carnegie Commission on Science, Technology, and Congress, Enabling the Future: Linking Science and Technology to Societal Goals (New York: 1992).

[9] As described in the Carnegie Commission on Science, Technology, and Government's report, Enabling the Future: Linking Science and Technology to Societal Goals, p. 26, the major components of the science and technology base are (1) general science and mathematics education; (2) scientific literacy of the public; (3) higher education in science, engineering, and the social sciences; (4) human resources (scientists, engineers, and technical personnel); (5) facilities and institutions; (6)

basic research and development of general technology; and (7) diffusion of scientific and technical information.

[10] We have followed the recommendations of a 1988 report of the National Academy complex [National Research Council, Federal Science and Technology Budget Priorities: New Perspectives and Procedures (Washington, DC: National Academy Press, 1988)] in broadly defining the "science and technology base" to include not only personnel and facilities but also the conduct of basic research and the development of generic or capability-enhancing technologies. These activities, in addition to their support of substantive areas of S&T that in turn support various societal goals, also directly advance the fundamental societal goal of increasing human knowledge and thus improving our quality of life. For more information, see Carnegie Commission on Science, Technology, and Government, Enabling the Future: Linking Science and Technology to Societal Goals.

[11] Carnegie Commission on Science, Technology, and Government, Enabling the Future: Linking Science and Technology to Societal Goals, p. 49. In a recent report, the National Academy complex reached a similar conclusion. Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, Science, Technology, and the Federal Government: National Goals for a New Era (Washington, DC: National Academy Press, 1993).

[12] In view of the need to help the scientific and engineering communities interact more effectively with Congress, the Carnegie Commission on Science, Technology, and Government and the American Association for the Advancement of Science cosponsored a guidebook to Congress for scientists and engineers: William G. Wells, Jr., Working with Congress: A Practical Guide for Scientists and Engineers (Washington, DC: AAAS and Carnegie Commission, 1992).

[13] Carnegie Commission on Science, Technology, and Government, Enabling the Future: Linking Science and Technology to Societal Goals, p. 55.

[14] Carnegie Commission on Science, Technology, and Government, Science, Technology, and Congress: Expert Advice and the Decision-Making Process (New York: 1991) and Science, Technology, and Congress: Analysis and Advice from the Congressional Support Agencies (New York: 1991).

[15] The "Five-Year Outlook," required of the Executive Office of the President by Congress in the 1970s, was one such mechanism that was designed to improve linkages between the legislative and executive branches and, within the executive branch, to help shape science and technology policy and relate it to broader national goals; however, this effort was not a total success. See Jurgen Schmandt, "The Five-Year Outlook as a Policy Document: Historical and Comparative Perspectives," Technological Forecasting and Social Change (1981), pp. 113-138.

[16] Carnegie Commission on Science, Technology, and Government, Enabling the Future: Linking Science and Technology to Societal Goals, p. 22.

[17] Ibid., p. 56.

[18] National Academy of Public Administration, Beyond Distrust: Building Bridges between Congress and the Executive (Washington, DC: 1992), pp. 98-100.

[19] Carnegie Commission on Science, Technology, and Government, New Thinking and American Defense Technology (first edition, 1990; second edition, 1993).

[20] Thomas Mann and Norman Ornstein, Testimony before the Joint Committee on the Organization of Congress, April 20, 1993.

[21] Ibid.

[22] Vice President Al Gore, From Red Tape to Results: Creating a Government That Works Better and Costs Less, Report of the National Performance Review (Washington, DC: U.S. Government Printing Office, September 7, 1993), p. 51.

[23] Joint Committee on the Organization of Congress, Congressional Reform Survey Results, Summer 1993.

[24] One possible approach to modifying appropriations subcommittee jurisdictions is suggested by Richard N. Brandon in a background paper prepared for the Committee on Science, Technology, and Congress.

[25] Thomas E. Mann and Norman J. Ornstein, Renewing Congress (Washington, DC: The Brookings Institution and the American Enterprise Institute, 1992).

[26] Joel D. Aberbach, Keeping a Watchful Eye: The Politics of

Congressional Oversight (Washington, DC: The Brookings Institution, 1990); Joel D. Aberbach, "The Politics of Congressional Oversight of Science and Technology Programs," a background paper prepared for the Carnegie Commission on Science, Technology, and Government, (September 22, 1992); and Marcel C. LaFollette, "Congressional Oversight of Science and Technology Programs," a background paper prepared for the Carnegie Commission on Science, Technology, and Government (September 1990).

[27] John F. Bibby, "Congress's Neglected Function," in Melvin R. Laird, ed., The Republican Papers (New York: Anchor, 1968), pp. 477-488.

[28] Joel D. Aberbach, Keeping a Watchful Eye: The Politics of Congressional Oversight (Washington, DC: The Brookings Institution, 1990).

[29] Joel D. Aberbach, "The Politics of Congressional Oversight of Science and Technology Programs," a background paper prepared for the Carnegie Commission on Science, Technology, and Government (September 22, 1992), Table 1.

[30] Joel D. Aberbach, Keeping a Watchful Eye: The Politics of Congressional Oversight (Washington, DC: The Brookings Institution, 1990); Joel D. Aberbach, "The Politics of Congressional Oversight of Science and Technology Programs," a background paper prepared for the Carnegie Commission on Science, Technology, and Government (September 22, 1992); and Marcel C. LaFollette, "Congressional Oversight of Science and Technology Programs," a background paper prepared for the Carnegie Commission on Science, Technology, and Government (September 1990).

[31] Marcel C. LaFollette, op. cit., p. 22-23.

[32] Carnegie Commission on Science, Technology, and Government, Environmental Research and Development: Strengthening the Federal Infrastructure (New York: 1992), p. 38.

[33] The Balanced Budget and Emergency Deficit Control Act of 1985 is often referred to by the names of its three cosponsors, Senators Phil Gramm (R-Tex.), Warren Rudman (R-N.H.), and Ernest F. Hollings (D-S.C.).

[34] Congress of the United States, Congressional Budget Office, Assessing the Effectiveness of Milestone Budgeting (July 1987). CBO notes that the push for milestone funding came from the Packard Commission (formerly the President's Blue Ribbon Commission on Defense Management) in its report of April 1986.

[35] This type of funding mechanism has been used in the past for multiphase job-creating legislation, welfare reform, and increases in military spending.

[36] Vice President Al Gore, From Red Tape to Results: Creating a Government That Works Better and Costs Less, Report of the National Performance Review (Washington, DC: U.S. Government Printing Office, September 7, 1993), p. 17.

[37] Roy T. Meyers, Staff Working Paper, Congressional Budget Office, "Biennial Budgeting" (Washington, DC: CBO, November 1987).

[38] Richard N. Brandon, "Multi-year Funding Mechanisms for Federal Science and Technology Activities," background paper prepared for the Carnegie Commission on Science, Technology, and Government (September 1991).

[39] The House Appropriations Committee, under the chairmanship of George Mahon (D-Tex.), initiated a comprehensive Appropriations Act for energy R&D in 1974, P.L. 93-322, when energy became a topic of national interest. The appropriations act funded all energy R&D for the federal government's departments, independent executive agencies, bureaus, offices, and commissions for the fiscal year ending June 30, 1975.

[40] We note that a multiyear authorization of funding does not automatically produce a multiyear request from the executive branch or a multiyear appropriation from appropriations committees in Congress. Unless the executive branch chooses to submit a multiyear request, the request must be specified in the language of either the authorization or the appropriation. Agencies often fear submitting multiyear requests. Agency budget requests must be made within limits of "budget authority" established by OMB. If funds from an annual appropriation are committed on a multiyear basis, the amount of budget authority charged against the OMB limit is the sum of spending across the several years. For example, a program with an annual cash outlay of $1 million operating for three years is charged with using $3 million of budget authority. While this convention is a reasonable accounting practice, it creates a structural bias against multiyear commitments because multiyear funding uses up a department's or agency's allocation of budget authority. This demonstrates the need for an

explicit adjustment of budget ceiling and methodologies to allow a smooth transition to biennial budgeting.

[Some structural impediments to a large-scale shift to multiyear budgeting exist in the current budget process. A shift to multiyear budgeting would require a one-time major increase in the amount of budget authority allocated to the Appropriations Committees at the time of the shift. Special arrangements would have to be made to ensure that the extra allocation would be used for a shift to multiyear funding rather than for a major increase in annual spending rates. The fear of such diversion has made OMB and the budget committees cautious about implementing such a shift.

[41] The allocation of budget authority to the House and Senate Appropriations Committees is made in accordance with Section 602(a) of the Congressional Budget Act, as amended in 1990 (P.L. 101-508); these allocations are often referred to as 602(a) allocations. The allocation of budget authority to the various appropriations subcommittees is made in accordance with Section 602(b) of the Congressional Budget Act, as amended (P.L. 101-508); these allocations are often referred to as 602(b) allocations. The committee and subcommittee allocations were formerly known, respectively, as 302(a) and 302(b) allocations because they were made under Section 302 of the Congressional Budget Act of 1974 (P.L. 93-344).

[42] For a more detailed treatment of academic earmarking, see Patricia S. Warren, "Merit Review and Academic Earmarking" background paper prepared for the Carnegie Commission on Science, Technology, and Congress (September 1992).

[43] The two universities were Columbia University and Catholic University.

[44] Association of American Universities, American Council on Education, American Association of State Colleges and Universities, National Association of Independent Colleges and Universities, National Association of State Universities and Land-Grant Colleges, Council of Graduate Schools in the United States, Report of the Working Committee on Principles, Policies, and Procedures in the Award of Federal Funds for University Research Facilities and Research Projects (Washington, DC:

Association of American Universities, 1987).

[45] Office of Technology Assessment, Federally Funded Research: Decisions for a Decade (Washington, DC: 1991).

[46] James D. Savage, "Where's the Pork?" Issues in Science and Technology (Spring 1993), 21-24.

[47] James Savage, The Distribution of Academic Earmarks in the Federal Government's Appropriations Bills, FY 1980-1989 (Washington, DC: 1991); Colleen Cordes, "Congress Earmarked Record $684 Million for Noncompetitive Projects on Campus," Chronicle of Higher Education (April 1, 1992), pp. A1, A26, A31; Congressional Research Service, Library of Congress, Trends in the Distribution of Apparent Academic Earmarks in the Federal Government's FY 1980-92 Appropriations Bills (Washington, DC: 1992); Colleen Cordes, "Academe Gets $763 Million in Year from Congressional Pork Barrel," Chronicle of Higher Education (June 16, 1993), A21.

[48] Association of American Universities, American Council on Education, American Association of State Colleges and Universities, National Association of Independent Colleges and Universities, National Association of State Universities and Land-Grant Colleges, Council of Graduate Schools in the United States, Report of the Working Committee on Principles, Policies, and Procedures in the Award of Federal Funds for University Research Facilities and Research Projects (Washington, DC: Association of American Universities, 1987); Barry Bozeman and Michael Crow, "Science Policy: Pork Barrel or Peer Review," Forum for Applied Research and Public Policy (Fall 1992), pp. 64-73.

[49] Government-University-Industry Research Roundtable, Research Facility Financing: Near-Term Options (Washington, DC: National Academy Press, 1991); National Science Foundation, Scientific and Engineering Research Facilities at Universities and Colleges: 1990, NSF 90-318 (Washington, DC: 1990).

[50] Jean Mayer, "Earmarking: A Question of Fairness," Forum for Applied Research and Public Policy (Fall 1992), pp. 84-88.

[51] James Savage, The Distribution of Academic Earmarks in the Federal Government's Appropriations Bills, FY 1980-1989 (Washington,

DC: 1991).

[52] Jonathan and Stephen Cole, Peer Review in the National Science Foundation (Washington, DC: National Academy Press, 1981); Daryl Chubin and Edward Hackett, Peerless Science: Peer Review and U.S. Science Policy (Albany, NY: State University of New York Press, 1990).

[53] Barry Bozeman and Michael Crow, "Science Policy: Pork Barrel or Peer Review," Forum for Applied Research and Public Policy (Fall 1992), pp. 64-73.

[54] Congressional Research Service, Library of Congress, Trends in the Distribution of Apparent Academic Earmarks in the Federal Government's FY 1980-92 Appropriations Bills (Washington, DC: 1992), Table 5.

[55] James Savage, "Saints and Cardinals in Appropriations Committees and the Fight against Distributive Politics," Legislative Studies Quarterly 16: 329-345 (August 1991).

[56] Testimony of Robert M. Rosenzweig, former President, Association of American Universities, before the U.S. House of Representatives, Committee on Science, Space, and Technology, June 16, 1993.

[57] Barry Bozeman and Michael Crow, "Science Policy: Pork Barrel or Peer Review," Forum for Applied Research and Public Policy (Fall 1992), pp. 64-73.

[58] Association of American Universities, American Council on Education, American Association of State Colleges and Universities, National Association of Independent Colleges and Universities, National Association of State Universities and Land-Grant Colleges, Council of Graduate Schools in the United States, Report of the Working Committee on Principles, Policies, and Procedures in the Award of Federal Funds for University Research Facilities and Research Projects (Washington, DC: Association of American Universities, 1987); Joe B. Wyatt, "Competition Favored for Project Selection," Forum for Applied Research and Public Policy (Fall 1992), pp. 82-83.

[59] Raymond E. Bye, Jr., and George T. Mazuzan, "Peer Review Favored for Research Funding," Forum for Applied Research and Public Policy (Fall 1992), pp. 74-77.

[60] According to Chairman Brown's report [Chairman George E. Brown, Jr., Academic Earmarks: An Interim Report by the Chairman of the Committee

on Science, Space, and Technology (August 9, 1993), pp. 7-8.]:

> All earmarked funds are not necessarily wasted, but it is neither a fair nor a wise way to distribute our scarce federal dollars in support of education and research. It is a process that undermines the existing system of peer and merit review. Just as importantly, earmarks are beginning to eat into the base programs of the federal agencies we rely on to fund our scientific enterprise. Finally, earmarking gets some of our agencies far-afield from their institutional mandate.
>
> For example, earmarking has put the Department of Energy (DOE) in the hospital-building business. The executive agency that is charged with meeting this nation's energy needs and supporting research on the frontiers of the physical sciences helps build things like cancer institutes and ambulatory care facilities. The Department has not asked Congress for permission to build these medical facilities; rather the Appropriations Committees have decided that DOE ought to be building medical facilities along with their work on advanced electric vehicles designs, high energy physics and the strategic petroleum reserve. As a result, between fiscal years 1990 and 1993, DOE has seen $171.8 million of its scarce research dollars directed towards strengthening medical facilities at ten different schools.

[61] Office of Science and Technology Policy, "Congressional Earmarks in the FY 1993 Appropriations" (January 1993).

[62] Richard S. Nicholson, "Pork Barrel 'Science,'" Science 254: 1433

(December 6, 1991).

[63] Chairman George E. Brown, Jr., Academic Earmarks, p. 12.

[64] Congressional Record (September 17, 1992), pp. H8711-H8717.

[65] U.S. Senate, S. Res. 206, 101st Congress (1990).

[66] Chairman George E. Brown, Jr., Academic Earmarks.

[67] According to Chairman Brown's report:

> Seventeen of the top twenty states receiving academic earmarks have Senators and/or Representatives who were Appropriations Committee Chairs or Subcommittee Chairs or Ranking Members on the Appropriations Committee. There are three exceptions: Massachusetts, Kansas and Minnesota. The top twenty states, represented on the Appropriations Committees by just twelve Senators and thirty-four Representatives, received 78.7 percent of all apparent academic earmarks -- more than $557 million -- in the fiscal year 1992 Appropriations Bills.

Chairman George E. Brown, Jr., Academic Earmarks, p. 6 (emphasis in original).

[68] Congressional Research Service, Library of Congress, Trends in the Distribution of Apparent Academic Earmarks in the Federal Government's FY 1980-92 Appropriations Bills (Washington, DC: 1992).

[69] James Savage, The Distribution of Academic Earmarks in the Federal Government's Appropriations Bills, FY 1980-1989 (Washington, DC: 1991).

[70] Association of American Universities, American Council on Education, American Association of State Colleges and Universities, National Association of Independent Colleges and Universities, National Association of State Universities and Land-Grant Colleges, Council of Graduate Schools in the United States, Report of the Working Committee on Principles, Policies, and Procedures in the Award of Federal Funds for

University Research Facilities and Research Projects (1987); Council on Competitiveness, Governing America: A Competitiveness Policy Agenda for the New Administration (Washington, DC: 1989); National Science Board Committee on Excellence in Science and Engineering, Report of the NSB Committee on Excellence in Science and Engineering (Washington, DC: National Science Foundation, 1984); National Science Foundation, Modernizing Academic Research Facilities: A Comprehensive Plan (Washington, DC: 1989); Terry Sanford et al., "Letter to the Honorable George Bush," July 26, 1990; White House Science Council, Panel on the Health of U.S. Colleges and Universities, A Renewed Partnership (Washington, DC: Office of Science and Technology Policy, 1986).

[71] Congressional Research Service, Library of Congress, The Distribution of Apparent Academic Earmarks in the Federal Government's FY 1992 Appropriations Bills (Washington, DC: 1992).

[72] Office of Science and Technology Policy, "Congressional Earmarks in the FY 1993 Appropriations," January 1993.

[73] Michael Crow, "Testimony before the Senate Rules Committee on S. Res. 206," June 1990.

[74] Barry Bozeman and Michael Crow, "Science Policy: Pork Barrel or Peer Review," Forum for Applied Research and Public Policy (Fall 1992), pp. 64-73.

[75] Government-University-Industry Research Roundtable, "Federal Funding of Academic Research Facilities: Comprehensive Merit Evaluation" (Washington, DC: July 1985).

[76] National Science Foundation, NSF Circular No. 132, April 26, 1985.

[77] Barry Bozeman and Michael Crow, op. cit.

[78] Ibid.

[79] Association of American Universities, American Council on Education, American Association of State Colleges and Universities, National Association of Independent Colleges and Universities, National Association of State Universities and Land-Grant Colleges, Council of Graduate Schools in the United States, Report of the Working Committee on Principles, Policies, and Procedures in the Award of Federal Funds for

University Research Facilities and Research Projects (1987).

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