SOURCE: Q 127 .U6 S325
AUTHOR: Carnegie Commission on Science, Technology, and Government
DOCTITLE: Science and Technology in U.S. International Affairs
SECTITLE: Science and Technology in U.S. International Affairs
DATE: 1992
SUBJECT: science technology United States international policy S&T foreign policy history
PUBLISHER: Carnegie Commission on Science, Technology, and Government
DOCTYPE: Book
TITLEID: CC4004
ISBN_ISSN: 1881054004

Text:

SCIENCE AND TECHNOLOGY IN U.S. INTERNATIONAL AFFAIRS

January 1992

A Report of the
Carnegie Commission
on Science, Technology, and Government

CONTENTS

FOREWORD

Deep-seated reforms are required in the way the United States Government is organized for international affairs. These reforms must enable the government to take full account of the transformations being wrought in the world by science and technology.

Revolutionary advances in physics have led to diverse applications in weapons, energy, materials, and medicine, with extraordinary impacts on the quality of life and on economic and political relationships among countries. As the 20th century closes, the powers of the physical and engineering sciences have been joined by equally revolutionary advances in the life sciences and by new frontiers for the environmental sciences.

These advances exemplify the ways in which science and technology transform foreign relations and usher in new choices, risks, and benefits that societies around the world must confront individually and in common. Greenhouse gases, the AIDS virus, agricultural biotechnology, advanced energy systems, new pharmaceuticals, information technologies, and a host of other scientific and technological trends shape global competition and cooperation. The research base itself, supported by each nation, also needs cooperation if it is to grow and prosper.

As a world leader in science and technology, the United States has a unique opportunity to use its S&T strengths to take international initiatives that can benefit both the U.S. and the world community. This report points the way toward a long-needed rethinking of U.S. international affairs for the 21st century. It calls for actions throughout the executive branch, within the White House and the State Department, and in the Congress. All must take bold and imaginative steps to adapt to a world in which the border between domestic and foreign affairs is crossed everywhere and most particularly by science and technology.

Where might change begin? Because the international science and technology programs are government-wide, leadership in the White House and in Congress will have to place these issues much closer to the top of their agendas. This report outlines many constructive steps that, taken together, will produce a systematic, urgent process to improve organization for priority-setting and decision-making. The Assistant to the President for Science and Technology will necessarily play a key role in facilitating Presidential decisions and orchestrating discussions with the Congress about policies at the intersection of science and technology with international relations.

The Secretary of State is the senior cabinet officer responsible for initiating changes necessary to integrate S&T in the conduct of foreign affairs. Thus, among the several complementary recommendations in this report is the proposal that the Secretary create the staff position of Counselor for Science and Technology, reporting to him, and filled by a scientist or engineer of distinguished stature or a specially qualified foreign service officer. Such an action, salutary on its own, could signal to the entire government the Secretary's intention to take bold steps toward firmly anchoring U.S. international relationships in the bedrock of America's strength in science and technology.

William T. Golden, Co-Chair

Joshua Lederberg, Co-Chair

PREFACE

This report of the Carnegie Commission on Science, Technology, and Government was prepared principally by Rodney W. Nichols, a member of its Advisory Council and Executive Committee. Jesse H. Ausubel, the Commission's Director of Studies, was the key collaborator throughout the organization of the project and the drafting process. The report was edited by Jeannette Lindsay Aspden.

The report is based in part on discussions at a Workshop, cosponsored by the Commission and the Council on Foreign Relations, held June 24-26, 1990, at The Rockefeller University. (Workshop participants are listed in Appendix B.) It also reflects the insights gained from continuing reviews carried out during 1990-1991 by the Commission's International Steering Group. The report is endorsed by the Workshop Program Committee and the Steering Group:

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Justin L. Bloom	Eugene B. Skolnikoff
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Publication of this report is one of several activities of the Carnegie Commission aimed at strengthening the institutions and decision-making processes through which science and technology are wisely and effectively applied to world affairs. On the one hand, these activities address the way in which the United States is organized within its own government for improving the applications of science and technology in international affairs. On the other hand, these activities also seek to renew a positive, long-range vision of the international institutional infrastructure for science and engineering in which the United States is a partner. In the forthcoming reports the Commission will emphasize two major areas of concern: development of the less-advanced nations of the world, and how all countries work together multilaterally on matters of common interest involving science and technology, such as global environmental change.

The Commission thanks the Council on Foreign Relations for its advice and assistance during the preparation of this report. George Shultz and Warren Christopher were very generous in sharing their wisdom and experience. The Commission is also grateful to the many people -- practitioners and analysts in foreign policy as well as advisors from the science and technology communities -- who commented on draft material; they are listed in Appendixes B and C. Georganne Brown, Margret Holland, David Kirsch, Doris Manville, and David Victor also contributed substantially to the success of the project. The Commission's Executive Director and Associate Director, David Z. Robinson and David Beckler, offered many valuable suggestions and consistent encouragement throughout the effort.

While judgments certainly will differ on the detailed paths that might be taken by the federal government, all agree that the soaring global issues assessed here are crucial for the country in the years ahead.

The report was approved by the Commission at its June 1991 meeting.

1.0 THE WAY FORWARD: SUMMARY AND RECOMMENDATIONS

Serving the interests of the United States at home and abroad calls for sharply improved incorporation of scientific and technological insight into the nation's international policies. These policies span trade, defense, energy, health, agriculture, environment, space, and other critical fields. Every one demands scientific knowledge, every one calls for fresh thinking as science and technology advance. Equally important are the ever-increasing needs for international partnerships in most research and development conducted by U.S. universities and firms. Government plays an influential role in orchestrating the success and pace of the partnerships.

The challenge for government is to organize the conduct of international affairs in order both to exploit the promise of rapid technological change and to help resolve the problems such change may generate. From pursuing the stunning economic and political benefits of the information revolution to relieving the tragic medical and social burdens of the AIDS epidemic, U.S. global policy must be technologically literate as well as diplomatically savvy.

By tradition and law, the State Department has many responsibilities for overseeing this vast domain. In practice State has had neither the resources nor the organizational culture to fulfill all its responsibilities, except in paramount issues of national security. At the same time, most of the other federal "domestic" agencies have evolved major foreign capabilities in order to carry out their missions. Yet the agencies have many constraints on their flexibility to pursue their efforts with their counterparts abroad and with the many international scientific institutions.

Overall, U.S. international relations have suffered from the absence of a long-term, balanced strategy for issues at the intersection of science and technology with foreign affairs. Sometimes this absence of analysis and policy leads to unpreparedness for major issues, bitter interagency disputes, and inadequate last-minute preparations for an international meeting. On other occasions, when diplomatic stalemates occur, American science may be used merely as a bargaining chip to achieve an underfunded, cobbled-together, disappointing technical exchange.

Recent trends bring this subject to the forefront for the 1990s. In general, rapid shifts in political and economic balances anywhere in the world may promote or hinder technological modernization, and U.S. interests inevitably are engaged. For instance, enthusiasm for democracy within the republics constituting the former Soviet Union, and throughout Central and Eastern Europe, reduces East-West military tensions. These changes open new, if complex and uncertain, vistas for trade and collective security requiring reconsideration of many policies about technology. The trend toward unification in Western Europe offers prospects for both cooperation and competition with the United States. These prospects are entangled with issues about how firms and nations proceed with research and development, and with international standards, for new products and services. Reducing the proliferation of weapons throughout the world -- and clinching the cuts in strategic arms while enhancing stability -- requires global controls, continuous monitoring, and effective response, all informed by the most current knowledge of scientific and technological trends.

Japan's technology-based economic power changes political and economic relationships for the United States in every region and offers opportunities for Japan-U.S. cooperation in international development. Environmental protection, which frequently must be transnational, demands worldwide coordination of assessments, research, and policies. Developing countries in Asia, Africa, and Latin America need extensive technical cooperation as they seek higher standards in health and education, advances in physical and financial infrastructure, improvements in centers for science, and exports into sophisticated markets.

So the situations and needs multiply countlessly. As the United States faces problems similar to those of other countries -- say, in energy -- collaboration will help to find better solutions. As the world's scientific community pursues common aspirations on the great research frontiers -- in physics and genetics, for example -- improved communications will spur mobility and exchanges involving U.S. participants as well as joint financing and planning of next-generation projects. As American openness and the tradition of an international process in science and engineering combine in U.S. global initiatives, the health of the American research and development enterprise itself will be strengthened. The private sector has often learned these lessons of interdependence more quickly than has the government.

Yet, at home, attempts to set an internationally astute agenda for government often founder on obsolete distinctions between "domestic" and "foreign" objectives involving science and engineering. These backward-looking categories mislead the public and distract officials. Forward-looking policies must integrate national with international views in order to deal effectively with the global tidal waves of information, capital, technology, and people.

Studies of American diplomacy since the late 1940s have struggled with the problem of bringing greater technological skill to bear on the organization and conduct of U.S. foreign affairs. The question is this: How can government use the nation's scientific and technological resources to plan coherent international actions, with an understanding of both American interests in the world and the influences of the rest of the world on the United States? Many constructive proposals have been made, but few have been implemented.

Today there is usually a crazy-quilt of poorly defined responsibilities, inconsistent strategies, and inadequate resources, frequently knotted up and occasionally knitted together by ad hoc mechanisms of coordination. The unintended consequences have been frustrating at both ends of Pennsylvania Avenue. Hence this report, identifying the unanswered summons of past proposals for reform and charting the actions required by the imperatives of a new international order.

The report begins with a brief description of the goals that compel a reevaluation. It then documents earlier efforts to anchor international policy in expert analysis, and sketches the areas now demanding more attention. The current patterns of activities are described and analyzed, and the need for change is illustrated by examination of specific cases. Next, recommended lines for change are traced. Finally, the premises for organizational change are restated. The study's recommendations are summarized below.

- The President should clarify the international responsibilities and priorities for S&T among the mission agencies and should ensure their overall coordination with foreign policy through the Department of State. A White House review should be undertaken in order to gather the information and establish the framework for such Presidential decisions.

Starting with an urgent Presidential request to all agencies, this year-long inquiry will lead to sharper designation of selected lead-agency responsibilities for implementing programs, operating under White House and State policy control. State must concentrate on foreign policy formulation and review, ensuring the consistency and reliability of the conduct of U.S. foreign affairs. However, because many international programs are "orphans" in the technical agencies, immediate attention must also be given to clearing away the fog of ambiguity that surrounds each agency's identified roles.

The National Science Foundation (NSF), for example, should manage many of the international basic scientific programs -- both bilateral and multilateral -- and should be given a larger budget for these activities. At the same time, clearer international responsibility for specific mission-oriented basic science should be given to Health and Human Services (HHS) and the National Institutes of Health (NIH), Department of Energy (DOE), National Aeronautics and Space Administration (NASA), Department of Agriculture (DA), Department of Commerce (DoC), and other appropriate agencies. A few projects in "big science" and the astonishing variety of internationally productive "little science" must be evaluated for their foreign policy implications. Similarly, wherever the Congress and the White House have laid down clear international mandates to individual agencies -- as for Commerce -- these activities must be regularly reassessed, updated, and woven together in order to promote the national interest for the future.

Overall, the three aims are to define afresh the U.S. international goals in and for S&T, to bring the increasingly important international programs into the mainstream throughout the S&T agencies of the government, and to orchestrate use of the nation's full technical assets in order to fulfill the goals of American foreign policy. Put another way, the Presidential decisions must integrate national policy for international S&T with bringing the nation's best S&T to foreign policy.

- To help in preparing the Presidential decisions, and to pursue the long-term follow-ups, continue to strengthen the role of the Office of Science and Technology Policy (OSTP) in the several White House councils covering international affairs, especially the National Security Council and the Economic Policy Council.

The OSTP-chaired Federal Coordinating Council for Science, Engineering, and

Technology -- through its State-chaired International Committee -- has embarked upon promising initiatives that should be buttressed and extended. This is particularly important for specific subjects such as energy, environment, relationships with developing countries, export controls, big-science projects, economic competitiveness, and the nonproliferation of weapons. Although such interagency committees typically elicit criticism, if not cynicism, about being little more than bureaucratic layers, in this case the President's Assistant for Science and Technology has crafted a useful instrument for cutting through the sensitive, irreducibly complex issues of interagency debate and decision on national assets. Modest added resources for OSTP, and continuity of policy attention, will be needed.

- Open extensive Executive consultations with Congress to assess policies, priorities, and resources regarding S&T in international affairs.

The Legislative-Executive process must elicit a firmer consensus on the resources needed by the State Department to fulfill its responsibility and by the mission agencies for their ineluctably growing international efforts. The Presidential reports to Congress on "Science, Technology, and American Diplomacy," required by law, should move further to emphasize evaluation of national trends and alternatives rather than compilation of historical facts. Congress should call upon its own support agencies -- notably the Office of Technology Assessment and the Congressional Research Service -- to deepen understanding of immediate choices and mid-range trends relating to S&T and foreign affairs.

Drift has resulted from the failure to confront priorities for greater international cooperation in science and technology by and among the mission agencies. Although there is broad agreement on the sharply increased significance of anchoring many components of foreign policy in the nation's best science and technology, neither the Congress nor the Executive has looked at the system as a whole. Congress must find new ways to explore these issues among the dozens of committees involved. To be sure, sometimes the choices concern money, and a few programs may be able to justify added resources. But the worst constraints now are erratic policy, short time-horizons, and a chronic underestimate of the benefits of international components in national S&T efforts.

- Take both immediate and long-range steps to ensure that officials of the State Department participate in more timely, continuing consideration of the aspects of science and technology pertinent to the foreign policy judgments and plans for which they have responsibility.

Improved staffing and organization should be explored and major steps taken. A new post, a Science and Technology Counselor appointed by and reporting to the Secretary, should be created. Comparable in function to the President's Science Advisor, it would enhance the stature and influence of the work of the Assistant Secretary heading the Bureau of Oceans and International Environmental and Scientific Affairs (OES). A second recommendation for strengthening State's S&T capacity is to restructure the responsibilities of senior officials. Consolidating several S&T-related sectors and long-range planning under the leadership of an Under Secretary for Economic and S&T Affairs would bring greater line management attention, as several past proposals have urged. Third, the S&T staff at State in Washington merits modest expansion; the OES Bureau's budget in constant dollars has been cut by 40% over the past decade. Finally, the number of Science Officers at embassies abroad must be increased: only about 25 missions have qualified, full-time S&T staff. With its present resources, the State Department cannot adequately assert in Washington, or represent in the field, the unified political, economic, and S&T interests of the country.

The goal is to spread throughout the State Department a lively awareness of science and technology in planning foreign policy, administering diplomatic operations, and facilitating efficient and flexible initiatives by the mission agencies.

- Supplement and restructure the technical staffs of the mission agencies in foreign posts, including the Environmental Protection Agency, Commerce, Energy, Agriculture, National Science Foundation, Agency for International Development, and Health and Human Services.

Doing this will require resolution of obstinate dilemmas arising from executive regulations about posting staff abroad. To control expenditure and assure security of personnel, there are strict ceilings on posting U.S. Government employees abroad; but to pursue U.S. interests and programs, more expertise is needed in the field. Given the nature of the international purposes of the mission agencies, a regional rather than a single-country outlook may be best, and regional coordination of technical staffs often will be cost-effective. For example, in Eastern Europe, the Middle East, and parts of Africa, inter-Embassy and inter-agency analytical planning will often be preferred. Greater decentralization into field activities by many agencies is necessary in order to translate the rising interest in technical cooperation with the U.S. into action.

At the same time, overarching political and economic issues must come together for review by the Ambassador in each country. The ambassadors' management challenges have been growing, and, because relations between most countries and the United States encompass many subjects with high scientific and technological content, ambassadors need skilled advice. Similarly, the State Department and the White House must oversee basic foreign policy decisions, building cohesion into the principles guiding the S&T efforts of multiple agencies.

- Set plans for the long-term nurturing of human resources throughout the government, and especially in State, for work on global issues with a substantial scientific and technological character.

In State, this will require an increased training budget, more aggressive and extensive recruiting of officers with technical backgrounds, more flexible exchanges with industry and universities, and enhanced incentives for those pursuing careers in international S&T. In the mission agencies, achieving this goal will demand more attention to professionalism in foreign policy and more reliable links with the foreign policymaking responsibilities of State and the White House.

A single International Science Service for all agencies might be created within the federal career structure. Following the Presidential review and decisions recommended first, this concept should be examined not only in terms of the mixed past experiences with the Foreign Agricultural Service and the Foreign Commercial Service, but also with a consistent view of the 5-10-year needs in international programs among the agencies.

- Increase the external research budget and advisory resources available to OSTP, State, and other agencies, for identifying and analyzing those functions of foreign policy that require technical expertise.

Alone among the major agencies, State has virtually no external intellectual infrastructure to assist its planning on a regular basis. A modest research program should be coupled with greater interaction between the most senior officials and outside analysts and advisors. As part of this pattern, State's present, almost moribund, Science and Technology Advisory Committee, primarily linked to the OES Bureau, must be invigorated. The Committee should be available in meaningful ways to all senior officials, and should be linked with either the proposed Science and Technology Counselor and/or the proposed Under Secretary for Economic and Scientific and Technological Affairs. Such steps would broaden State's consultations with private-sector leaders and experts who are active at the convergence of science with foreign policy. Other agencies -- including the Fogarty Center at the National Institutes of Health and the Division of International Programs at the National Science Foundation -- also need greater external advisory and research back-up for long-range international efforts.

The National Academies of Sciences and Engineering, the Institute of Medicine, and the National Research Council (the Academy complex), perhaps the premier independent reservoir of national expertise, could do more to assist the State Department and the interagency Committee on International Science, Engineering, and Technology. The White House Office of Science and Technology Policy and the State Department should consider new ways to acquire the needed longer-range analysis and planning, such as through Academy advisory boards, studies, and conferences.

Experience tempers optimism about the speed with which the desired new capacity can be built. If the pervasive connections of science and technology with international trends are to be recognized, understood, and exploited, it is high time to reverse the tendency revealed in the rueful Washington saying, "The urgent drives out the important."

2.0 INTRODUCTION

> Technology daily outstrips the ability of our institutions to cope with its fruits. Our political imagination must catch up with our scientific vision.
>
> -Henry Kissinger[1]

> For some time it has been clear that advances in science and technology are outdistancing the capacity of existing international organizations to deal with them.
>
> -Cyrus Vance[2]

Since before the Revolution, our nation has been blessed with extraordinary representatives skillfully pursuing the national interest around the world. In 1775, for example, Benjamin Franklin was appointed to the Committee of Secret Correspondence, the direct forerunner of the State Department, and he was to promote his nation's interests abroad until 1784. His replacement as Minister to Paris was Thomas Jefferson, who later served as the first Secretary of State. Both men were deeply interested in "natural philosophy," as science was then known, and Franklin was better known as a scientist than as a statesman. Indeed, his scientific eminence underlay his success as a diplomat in Paris.

Today, talented career foreign service officers and political appointees continue to work toward a world with greater prospects for peace, human rights, and economic development. Experienced negotiators often possess a combination of intensity, patience, and a deep understanding of American values. Yet, unlike Franklin and Jefferson, very few have had experience with science or technology.

It is ironic, then, at the end of the 20th century, when "everything is global" and when science and technology drive many of the central issues on the world's agenda, that the federal government -- including both the Executive branch and the Congress -- has had limited success with the integration of science and technology into American foreign policy. This new challenge -- how to meet the demands of technical change affecting international affairs -- is the subject of this study.

The State Department is by no means the only agency facing the challenge of organizational adaptation to the global effects of technological change. Most mission agencies, several key elements of the White House apparatus, and, significantly, many committees of the Congress, are involved in areas where science and technology converge with international affairs. Since science and technology will be prime tools for whichever nations lead the world in the coming decades, the crux of the matter is this: Only with broader and deeper scientific awareness and advice, achieved through education and improved organization, can American international leadership move into the 21st century.

Two notes must be given about the character of this report. First, some skepticism is justified. Given the historical difficulties in bringing science and technology into the culture and context of diplomacy -- as will be described in detail -- some experienced observers believe there is little chance of transforming the State Department, or the U.S. foreign policy community generally, into a more technologically literate navigator. If so, some of this study might be futile, or at least seriously limited. But what is the alternative? The State Department has long been acknowledged, and will remain, the lead agency in foreign policy. Thus it must master the fundamentals, but not all the operating details, that influence the formulation and execution of that policy. This is true for finance and economics, for trade, for international security. During the 1990s and beyond, these fundamentals also include science and technology.

Moreover, the programs of all the other units of government, the typically technology-intensive mission agencies, are affected every day, in a thousand ways, by international trends. Figure 1 is a reminder of the wide range of organizations involved in scientific and technological elements of international affairs. While every group needs flexibility, there ought to be high standards for S&T in each and international coherence for the whole. This, too, has proved to be such a refractory bureaucratic problem that many informed participants, in and out of government, despair of making much improvement. But the stakes are so high that the issue, fraught with uncertainty though it is, must be addressed.

FIGURE 1: Selected Executive Agencies and Congressional Committees with Interests at the Intersection of Science and Technology with International Affairs

Congressional Committees

House	Senate
Agriculture	Agriculture, Nutrition, and

Appropriations	Forestry
Armed Services	Appropriations
Banking, Housing, and Urban Affairs	Armed Services
Budget	Banking, Housing, and Urban Affairs
Energy and Commerce	Budget
Foreign Affairs	Commerce, Science, and Transportation
Intelligence	Energy and Natural Resources
Science, Space, and Technology	Environment and Public Works
	Foreign Relations
	Intelligence
	Labor and Human Resources

Executive Agencies[a]

Agriculture	Interior[c]
Commerce[b]	Justice
Defense	Labor
Education	NASA
Energy	National Science Foundation
Environmental Protection Agency	State
Health and Human Services	Transportation
Housing and Urban Development	Treasury

Endnotes

[a] White House units, such as the National Security Council, are not listed here.

[b] In Commerce, as in many other agencies, there are subdivisions showing even more visible S&T links to international trends: e.g., the National Institute for Standards and Technology (NIST), the National Oceanographic and Atmospheric Administration (NOAA), the National Technical Information Service (NTIS), the National Telecommunications and Information Administration (NTIA), and the Patent and Trademark Administration (PTA).

[c]In Interior, key units include the U.S. Geological Survey and the Fish and Wildlife Service.

A second point about the report is its scope. It reviews both policy goals and the government's operating organization. Most past and current reviews of these issues have concentrated on only one of these aspects. Unhappily. however, protestation about desirable global goals can be so abstract that it obscures the difficulty in accomplishing them; and criticism about a scattershot international program can be so scorched with petty details that it overlooks the underlying problem of pervasive organizational incapacity. In contrast, this review aims to highlight the entire situation, top to bottom, immediate urgencies and long-term aspirations. Hence its interweaving and occasional repetition of related perspectives.

Even a report of this length, however -- largely concerned with the federal government -- cannot cover the many crucial aspects of the private sector's activities in science and technology in international affairs. In universities and firms across the country, a complex process of "internationalization" is occurring; even where the process is succeeding, the institutions face problems comparable to those in the federal government.[3] More pointedly, these institutions would welcome greater clarity and purposefulness in the federal outlook.

3.0 GOALS: FOREIGN POLICY FOR THE 1990S AND BEYOND

> The revolution in communications, energy, environmental sciences and other aspects of science and technology has ... imparted an importance to S&T considerations in foreign affairs undreamed of a generation ago.
>
> -George Shultz[1]

> Just as political freedom and economic liberty go hand in hand, so, too, do sustained growth and a healthy environment.
>
> -James Baker[2]

To begin with a broad canvas extending far beyond specialized roles for science and technology, consider the goals for U.S. foreign policy over the next decade or two. This is, of course, neither an authoritative text nor a political statement, and no rank order is implied. In reviewing these international purposes, keep in mind that all agencies of the U.S. Government increasingly must consider them. The State Department, as the principal steward of foreign policy, needs people with the intellectual flexibility and specific knowledge to integrate science and technology into decisions about whether and how to proceed with political relationships.

- Resolve international security concerns. Sustaining deterrence in the face of a reduced threat, pushing ahead on arms control and disarmament with or without formal treaties, and addressing acute issues such as terrorism and regional conflict will continue to be crucial. The success of collective peacekeeping and cooperative regimes on nonproliferation will depend in part on technologies such as those applied in monitoring and verification as well as on the flows of technical knowledge and information. The stability of the world, given inevitable rivalries and access to modern weapons, will depend in part upon the continued vigor of defense research and development to assure effective U.S. capabilities.

- Maintain and enhance economic performance. The nation's economic strength will depend increasingly on its scientific and technological base. Just as foreign policy in the past was conditioned by concerns for military preparedness, foreign policy in the future seems likely to turn on trends in the global economic system. Astutely crafted international policies for science and technology will enhance competitiveness.

- Strengthen democratic institutions. Building and supporting democratic institutions will emphasize the values of an open and politically pluralist society, and schools and universities will play a special role in this endeavor. Education and research are crucial in the natural and social sciences, engineering, and medicine, as well as in the humanities. These activities have proven to be a wedge for human rights in many societies, a refuge where free thought survives against totalitarian regimes, and a reservoir for new leadership when democracy arrives.

- Liberalize world trade. This process will be acceptable worldwide only if virtually all nations believe they have the opportunity to catch up technologically. Furthermore, incentives for invention and innovation, such as patent laws and intellectual property rights, must be extended and protected consistently around the world. Market competition, together with open networks among scientists and engineers, reinforce political pluralism.

- Assess and address global environmental issues. For coping with environmental change and reversing environmental degradation, a clear understanding of the quality of the scientific evidence will be fundamental to policy setting. Moving to cleaner and more efficient energy systems will depend on shrewdly developed and applied technology, assessed in economic and social terms as well as from local, national, global, and intergenerational standpoints.

- Facilitate sustainable development. In all countries, progress will depend in large part on the evolution and diffusion of technologies. In developing countries, democratic stability also depends on success in building indigenous capabilities. Global cooperation can surmount the national, regional, and global obstacles on the path to modernization. Although the meaning of sustainability remains imprecise, an international commitment to capacity-building will permit each nation to frame informed choices for the future.

- Strengthen the base of science globally. Future gains in prosperity, health, and security will come from the productivity of research, rooted in both the philosophical aims of inquiry for its own sake and utilitarian goals set for science by society. This will entail reinvigorating old partnerships and inventing new international institutions serving science. Given the high costs of research and the uncertain distribution of its benefits, cooperative international arrangements will allow durable commitments that would stretch individual governments.

- Increase the level of public understanding within the United States of the likely evolution of the international economic and political system. The setting in which U.S. foreign policy must be made and implemented will continue to be dramatically affected by technological developments. Global systems of communications and transportation, for example, shape the operating environment over decades for businesses, for state-craft and diplomacy, and for the individual. Both Congressional and Executive leaders will have to raise the priority they give to enhancing public awareness and support of the U.S. interests in international goals.

- Strengthen the ability of the U.S. to influence the course of world events. Combined with American policies and values, U.S. leadership in science and technology will be one of the powerful assets that the nation can deploy to achieve its goals, to function as a reliable and desired partner, and to contribute to imaginative solutions of international problems. U.S. foreign policy would be lame without science, and international programs would be hollow without the U.S. commitments.

Stated so generally, such goals seem unexceptional. Yet pursuing them requires not only professional skill but also sensitive awareness of powerful enmities and cultural clashes; any inherent instability could be moderated by technological cooperation. Furthermore, stating foreign policy goals with an emphasis on science and technology does not imply that less weight should be placed on other dimensions.

3.1 Areas Of Application

Now consider three areas in which foreign policies intended to achieve these goals must take account of the extraordinary recent developments in science and technology, developments that call for major organizational changes.

ECONOMIC TRENDS

For economic reasons, the overall scope of U.S. foreign policy aims has been growing. International trade negotiators in the 1990s must wrestle with dramatically new needs and opportunities. These range at any moment from low to high technology, and from food exports to computer chip imports, interacting with all the rest of America's international relationships.

For example, in the early 1960s the combined value of imports and exports was only about 10% of GNP. By the late 1980s this had grown to more than 25%. Exports exceeded 12% of GNP in 1989 and must grow further if the economy is to thrive. Hundreds of thousands of jobs are at stake, as "foreign" economic policy relates to "national" economic performance. Diplomacy dealing with these economic issues in evitably involves a technological base.

Even in the "strictly science" international agreements from which little commercially relevant innovation might be expected, intellectual property rights loom large. This is because long-range and cumulative commercial advantages often turn on the fast-changing technological leadership that is affected by decisions about public and private investment. A new White House-level interagency group focuses on "technology and competitiveness," for reasons that are as deep as the buzzwords are common. As the well-known example of the semiconductor industry shows, the "critical technologies" being pioneered in laboratories today, such as advanced composite materials, will be translated into multibillion-dollar markets tomorrow.[3]

Furthermore, leading U.S. industries such as computers, telecommunications, professional engineering services, pharmaceuticals, and aircraft already face growing competition. The political trade-offs for freer markets in such products and services will be settled in key forums such as the General Agreement on Tariffs and Trade (GATT), long the unsung province of experienced foreign service officers.

The statistics on foreign direct investment provide further evidence that the U.S. participates more and more in a rapidly integrated one-world economy. For example, sales of U.S. subsidiaries in the countries that are members of the Organization for Economic Cooperation and Development (OECD) are five times greater than U.S. exports to these countries; even in Japan, sales of U.S. subsidiaries exceed U.S. exports to Japan by about 10%. In general, foreign direct investment is even more technology-intensive than trade, and this works both ways, as shown by the $5 billion R&D expenditure by foreign-based firms in the United States.[4]

The U.S. is deeply and irreversibly embedded in the world economy -- and in most respects, this is an asset. Yet the asset must be clearly related to foreign policies. And U.S. international negotiations must continue to build fair "rules of the game," as a Commerce official put it, for the development of the technologies that underlie economic competition.[5]

MILITARY ASPECTS

Military issues will become more complex, not disappear, in foreign policy puzzles. After all, U.S. spending for national security continues at almost $300 billion per year, and worldwide production and exports of arms show few signs yet of abating. The planned sharp decreases in U.S. defense spending -- by perhaps 25% or more within five years -- may well call for even more subtle integration of defense plans with "civilian" concerns in foreign policy. President Bush's dramatic announcements in September 1991, and the ensuing negotiations toward agreements with what was the Soviet Union on reducing strategic and conventional arms -- not to speak of building new forms of regional collective security will -- continue to test the technological and organizational savvy of staff in the State and Defense Departments.

The Defense Department has had 600 bilateral agreements, with approximately 20 countries, addressing basic research topics. In the 1970s DoD entered into several major international co-development agreements; in the 1980s, it entered into many more such agreements (most of those in the latter half of the 1980s, in response to pressures from the Congress and Executive Branch political leaders). DoD annual spending on international S&T is approximately $2 billion, depending on how one does the counting. Individual co-development projects typically range between $100,000 and hundreds of millions of dollars (billions if such projects proceed into production).[6] No matter how all of this activity may change with likely policy and budget shifts over the next few years, one thing is clear: Desert Storm's lessons about the power of military technology must be applied with subtlety and prudence at the intersection of plans for defense cooperation and foreign policy.[7]

Furthermore, direct military "aid" to the "Third World" -- about $8 billion currently -- will surely change character in the 1990s. Developing countries will more frequently think in terms of trade, finance, and immigration, rather than in terms of East-West geopolitics and military alliances. Astute analysis of high-tech and low-tech arms trading on a global scale will be required, as may entirely new concepts for limiting the arms trade and containing conflicts.[8]

NATIONAL R&D IN AN INTERNATIONAL SETTING

The 1992 U.S. expenditure on research and development is more than $150 billion, with about 45% funded by the federal government.[9] Almost three-quarters of the effort is carried out by the private sector. One might ask: should the State Department know more about this enormous effort and its implications? The answer is, surely, yes. One might also ask: does the U.S. effort, larger than the combination of the efforts of Japan, the United Kingdom, France, and Germany, assure technical leadership? The answer is, surprisingly to some, no.

Developed countries must seek exchanges about (and deals with) each other's R&D. U.S. firms must seek alliances with foreign firms, while U.S. universities must make contacts with leading investigators around the world. Much of this focuses on excellent work in Europe[10] and Japan, and the Commerce Department has been active, for example, in stimulating private sector liaison for these most industrialized regions.

Developing countries also will seek more cooperation with the United States in every field of the sciences and especially on the effective administration of market-competitive R&D enterprises. Whether the subject is environment or health, energy, or agriculture, South-North technological cooperation will he essential to meet the multiplication of needs as world population doubles over the next two generations.

To cope with such growing calls for R&D partnerships, State's role in charting foreign policy must include the "advocacy" for international concerns among the traditionally domestic agencies, as Graham Allison and Peter Szanton emphasized some years ago.[11] Yet to play this role, State must have more than superficial familiarity with the texture of U.S. science and technology at home, public and private. And the mission agencies must move ahead, flexibly and intensively, to facilitate international activities not only by government but also throughout the private sector.

GROWING DIFFICULTIES

These rough indicators of the economic, military, and technical aspects of international issues are not enough in themselves to determine the scale and form of the Department of State's staff. Nor do they dictate the scale of efforts by the mission agencies, much less the particular form of coordination across the agencies. However, such indicators do help to explain the growing difficulties associated with the government's current modest attention to these trends.

3.2 Democracy, Human Rights, And Free Markets

It is not just the quantitative scope of U.S. interests related to S&T that makes future foreign policy making so complex. Many intangibles bear on the responsibilities of foreign policy related to science and technology.

As one example, consider a linchpin of U.S. foreign policy: building democratic institutions throughout the world, and particularly reinforcing respect for human rights. To achieve this goal often involves supportive networks of active scientists. Recall the domestic and international impact of the courage shown by Andrei Sakharov and Fang Li Zhi. Ponder the awful consequences for the people, and for the technological and intellectual community so essential for growth, of human rights violations in Africa.

Another crucial U.S. goal is to encourage the spread of free markets. This requires liaison with experienced executives in the private sector, who are thinking both technologically and globally. The success of many forward-looking U.S. firms in Asia and Latin America shows what can be done. Achievements in development cooperation for the 21st century may well turn on creating patient partnerships between American foreign policy and the technology-based U.S. private sector, leveraging the modest amounts of available "aid" to achieve major goals for food, energy, health, and jobs.

3.3 A Complex Challenge

In short, the formulation and implementation of modern foreign policy requires a continuing reconnaissance of science and technology mapped onto the topography of politics, culture, and economics among both friends and rivals. The government is not now fully equipped for this task. To explore these themes, a brief outline of the historical background will be useful.

4.0 HISTORY: TRYING TO BUILD THE CAPACITY

> The brotherly spirit of Science ... unites into one family
> all its votaries of whatever grade, and however widely
> dispersed through the different quarters of the globe.
>
> -Thomas Jefferson[1]

> If we are to be one nation in any respect, it clearly ought

to be in respect to other nations.

-James Madison[2]

Just as Jefferson understood the need for openness in the one-world of science, Madison saw the need for a unified foreign policy. Both principles were essential to the well-being of the new nation. Their leadership came to illuminate how the American system could tap the many scientific and technological benefits flowing from foreign sources. For example, specialized military and engineering prowess was imported during the Revolutionary period. Over the next decades, foreign patents were licensed, and skilled immigrants arrived. Such international activities provided the foundations of the mid-19th-century industrial expansion, and later, the beginnings of American research institutions. Diplomacy helped these trends, but mostly around the edges.

Since the turn of the 20th century, to be sure, military issues often dominated technological currents in international affairs. After two wars, American leadership assured NATO's technological superiority in deterrence against East-West war. International institutions were created to control the use of atomic energy and brake the proliferation of nuclear weapons. Sophisticated intelligence-gathering techniques brought greater reliability to estimates of military threats and extraordinary national means for verifying arms control. Such defense activities, calling up large investments in R&D efforts, were associated with "international purposes." Generally, diplomacy ably understood, even anticipated, the military and political goals. But it did not regularly sense how technological trends rapidly changed the ways in which those goals would be seen, and then altered, at home and abroad.

After World War II, more and more civilian initiatives began to link U.S. science with truly global goals. For instance, promoting public health and related institutions through international cooperation has always had robust U.S. leadership. This was dramatically exemplified in the successful cooperative efforts to eradicate smallpox and to capitalize on the "green revolution." Recent progress in the life sciences -- led by the United States -- now promises even greater improvements in health and agriculture. Yet these efforts have been, and remain, rather isolated from the corridors of diplomatic power. Often, cooperative health efforts are seen as a mere subsidiary business within a conglomerate, distant from the conglomerate's central line of work. The advent of AIDS has taught a different lesson: one world, vulnerable, looking to science for help.

From Truman's Point IV program onward, heavy U.S. investments have also been made to assist developing countries. In foreign assistance, however, it was not always clear what goals were most important: shoring up geopolitical and military alliances to protect our interests and reward our friends, or giving aid and support to relieve immediate human needs, or cooperating in long-term alliances to build democratic institutions, market economies, and local technological capacity. Some of each, varying erratically, has been the pattern. The efforts of senior State officials, and of the Congress, have rarely aimed at framing a "development strategy" that integrates all U.S. scientific and technological resources in order to attain long-range objectives.

Set aside for a moment these U.S.-centered historical perspectives. Consider the spectacular growth of mega-cities throughout the world, with their pockets of deepening squalor. Such issues have brought keener awareness of the urgent need for sharing expertise across many disciplines and across natural boundaries. Each nation's cities face problems that are highly individual, yet so similar as to be "universal" -- problems of water, transportation, communications, housing, and education. For dealing with such "local" problems, greater international cooperation will be helpful. It must be founded on merging the cross-cultural assessments from social, engineering, and natural sciences. Assessments of any nation's efforts must keep a keen eye on what works elsewhere, for how long, at what cost. The goals are daunting, the needs for technological insight are great, and the complexities for diplomacy are formidable.

Bringing perhaps an even more extraordinary force to the international agenda for the next century are "global" environmental questions that cannot be resolved by purely local action, however necessary that may be. The problems include short-term and intense issues of trans-boundary pollution control, the longer-term and still fuzzy projections of climate change, and the many connections among them. International technical relations on these matters are not merely desirable, but imperative. The resulting global bargains will be ambitious, and continuous technical review will be required.

As a final example, consider the powerful technologies of communications and computing. The information revolution, led by the United States, has had stunning impacts. It has nurtured freedom of speech and fostered commercial gains, and its potential for further political, economic, and social change is immense.

To cope with these sweeping issues, individual professionals engaged in science and technology play increasingly transnational roles. In this domain of creating and applying knowledge, interactions of scientists and engineers occur in each country, in clusters of countries grouped either by region or by shared interest, and, through powerful tradition, as Jefferson knew, in the international scientific community as a whole. The education of the next generation of scientists and engineers is truly an international undertaking, and at the graduate level, the United States is the leader. American diplomacy plays a crucial role in facilitating easy international research exchanges, open mobility of students, and free choice in access to education.

4.1 Rhetoric And Resources

A general question emerges from this sketch of the history of challenges and benefits in the relationship between foreign relations and complex technical topics:

- What has been the government's capacity to anticipate the scientific needs of foreign policy, plan reliable programs and budgetary agreements, conduct imaginative and constructive negotiations, and gain a sure grasp of technical data?

The short answer is that the situation has been clouded by hopeful rhetoric and undercut by inadequate resources. Taking just two of the many major reports since World War II as diagnostic aids, it becomes clear that there is a long history of frustrated aspirations.

1949-1950 BERKNER REPORT

In 1949, at the request of the Acting Secretary of State, the eminent geophysicist and engineer Lloyd V. Berkner chaired a study of Science and Foreign Relations. His group, and their distinguished advisors and staff, which included both foreign policy and scientific experts, started with the following observation by the State Department's 1949 Reorganization Task

Force:

> The Department is dealing on the one hand with foreign policy matters which have a great effect upon United States scientific policy and on the other hand with international scientific activities which have an impact on foreign policy. These matters are being handled at various points without adequate scientific evaluation.... We believe that the extent of the Department's responsibility for international scientific matters requires top policy consideration and the aid of professional scientific judgment....[3]

In opening their report, filed in the spring of 1950, Berkner's team emphasized two important questions, both aimed at policies helping science:

> How can the potentialities of scientific progress be integrated into the formulation of foreign policy, and the administration of foreign relations, so that the maximum advantage of scientific progress and development can be acquired by all peoples? How can foreign relations be conducted in such a manner as to create the atmosphere that is essential to effective progress of science and technology?[4]

Berkner and his colleagues concluded that "present organization is inadequate to assess with accuracy the nature of the broad policy issues involving science" (emphasis added).[5] The report went on to develop "cardinal principles" upon which its recommendations were based:

1) United States foreign relations with respect to science must take on a more positive and active character than has obtained hitherto.

2) The greatest benefit in this field will emerge if the Department of State encourages and facilitates the conduct of privately sponsored programs of exchange of scientific material and persons.

3) Closer relations between the Department of State and United States science must be established in furtherance of United States objectives and improvement of our foreign relations.

4) Competent consideration must be given to the potentialities and interests of science and technology along with political, economic, and social matters in the formulation of international policy.[6]

Berkner's committee offered many constructive suggestions while noting that it was not necessary to establish "an imposing bureaucracy" for science and technology.[7] The depth and prescience of Berkner's recommendations were not recognized. Few follow-up actions were taken. One key step, establishing a small science office in State, was implemented, and a few science attaches began to be posted at selected U.S. embassies. But the overall force of Berkner's principles and, particularly, the idea of a "scientific culture" for diplomacy were not reflected during the 1950s and 1960s. Forty years on, there are few new insights into the matter. Just more, many more, reasons to move ahead.

1975 MURPHY REPORT

In 1975 -- some twenty-five years after Berkner's review -- Robert D. Murphy covered even more ground when he presented, to both the President and the leadership of the Congress, the comprehensive results of the high-level Commission he chaired on the Organization of the Government for the Conduct of Foreign Policy.

Murphy and his colleagues, who were largely drawn from the government, proceeded from a series of penetrating case studies. They argued that "the most pervasive characteristic of international affairs in the next decades will be the growing interaction and tightening interdependence among the nations of the world. Almost certainly, economic issues will loom larger on the foreign policy agendas of the future.... Technological and environmental issues will continue to grow in importance" (emphasis added).[8] The Murphy Commission went on to underscore that "foreign policy and domestic policy merge.... The organizational implications of this mingling are numerous and important.... To meet these challenges successfully, U.S. policy-making will have to embody features not easy to combine: extensive public and Congressional participation, a clear sense of purpose, and continuity over time."[9]

Then, as now, these challenges for foreign policy making were rooted in the complexities of integrating science and technology into international relations. For this reason, new leadership arrangements were seen to be crucial. Among the first specific recommendations of the Murphy Commission was a change concerning the science sector at the top of the Department of State. After exploring alternative roles for senior officials, Murphy urged broadening the post of the Under Secretary for Economic Affairs (now including Agricultural Affairs as well) into an Under Secretary for Economic and Scientific Affairs.[10]

Furthermore, in discussing "international economic policy," the Murphy Commission emphasized that "the Department of State must significantly improve its capability to deal with the foreign policy aspects of economics, business, science, energy, transportation, food, population, development and related issues" (emphasis added).[11] Every one of the listed topics has substantial technological content.

In its related discussion of "planning," the Murphy Commission suggested creating a new and regularly updated Global Systems Critical List. This was to be an "authoritative inventory of possible long-run problems or opportunities associated with such issues as food, population, weather modification, the environment, and natural resources."[12] Again, these themes are S&T-intensive.

The State Department did not follow up these recommendations. Perhaps the Murphy Commission set too broad an agenda. Perhaps reorganizing required too much time, changes in the Department's culture that were too deep, Congressional participation that was too controversial and extensive. Nonetheless, the challenge remains: analyzing subjects at the intersection of technology, economics, and foreign policy demands technical assessments that are beyond the Department's present capacity. The "fix" is not to transform the State Department into a technical agency. Rather, it is to improve State's capacity to appreciate, manage, and translate technological considerations at the interface between science and policy, orchestrating what the technical agencies know and do best with what is best for American goals internationally.

4.2 Disparate Offshoots Among The Agencies

The history of the international work of the technical agencies is so varied, and would take so long to document properly, that it is not feasible to cover the subject fully here. But the upshot of the history may be summarized quickly. Virtually every "national" R&D program has had to take account of international trends, both competitive and cooperative. The result within the government has been a checkerboard of international programs, centers, offices, exchanges, and liaison groups.

Every major unit labeled "National" -- e.g., the Science Foundation, the Institute for Standards and Technology, the Institutes for Health -- now has a responsibility for "global" activities and communications. Many of the conventional international issues formerly handled largely by one of the traditional departments -- such as the economic negotiations that used to be managed mainly by State -- have grown complex and divisive. They now involve more agencies (e.g., Commerce and Treasury) and require new White House-level coordination (i.e., Special Trade Representative). Furthermore, most of these classical issues typically require, as noted earlier, new and more sophisticated analysis of technological trends.

At NASA and EPA, to illustrate another facet of the scene, international contacts often used to be mostly ceremonial. But today, U.S. programs for space and for the environment require extensive international agreements (and, often, funding), or they do not proceed at all. Similarly, the National Science Foundation emphasized repeatedly during the 1980s that "international scientific cooperation ... bears directly on the health of American Science."[13] Yet, as subsequent sections illustrate, the international capability and organization of these agencies have been underdeveloped, undersupported, and awkwardly coordinated.

4.3 Congressional Concern

The Congress has also devoted considerable attention to these matters. During the 1960s, its growing awareness of the need for a dedicated technical staff was marked by pioneering work of the Congressional Research Service (CRS). The 1969 CRS study entitled Technical Information for Congress, for example, covered a wide range of domestic and international problems and was influential in the creation in 1972 of the Office of Technology Assessment. OTA has built a distinguished record, naturally incorporating global issues into its work, in such studies as U.S. Technology Transfer to China and Global Arms Trade.

By the mid-1970s and based upon recognition of the sharply growing significance of technical information and training for foreign policy, the House Foreign Affairs Committee developed an ambitious new charter for science and technology in the State Department. Supported by three volumes of studies led by Franklin Huddle of the CRS, this became Title V of the FY1979 appropriations statute regarding "Science, Technology, and American Diplomacy." Congress found that:

(1) the consequences of modern scientific and technological advances are of such major significance in United States foreign policy that understanding and appropriate knowledge of modern science and technology by officers and employees of the United States government are essential in the conduct of modern diplomacy;

(2) many problems and opportunities for development in modern diplomacy lie in scientific and technological fields;

(3) in the formulation, implementation, and evaluation of the technological aspects of United States foreign policy, the United

States Government should seek out and consult with both public and private industrial, academic, and research institutions concerned with modern technology; and

(4) the effective use of science and technology in international relations for the mutual benefit of all countries requires the development and use of the skills and methods of long-range planning.[14]

Although Congress may not have fully anticipated the practical consequences of these propositions, the law calls upon the State Department to:

> have primary responsibility for coordination and oversight with respect to all major science or science and technology agreements and activities between the United States and foreign countries, international organizations, or commissions of which the United States and one or more foreign countries are members.
>
> In coordinating and overseeing such agreements and activities, the Secretary shall consider (A) scientific merit; (B) equity of access ... ; (C) possible commercial or trade linkages with the United States which may flow from the agreement or activity; (D) national security concerns; and (E) any other factors deemed appropriate.[15]

For the past ten years, the State Department has been trying to fulfill this remarkable mandate, but without the resources to maintain an adequate effort. Attempts have been made, including an initiative in the late 1970s (and, again, in 1990-91) to develop a long-range planning unit within the

Bureau of Oceans and International Environmental and Scientific Affairs (OES). The record of the Department has been, at best, mixed.

Congress has expressed frustration with the Department's seeming inability to incorporate science and technology in foreign policy. For instance, congressional reviews of the annual reports required under Title V legislation have often been testy. House Foreign Affairs Chairman Zablocki, writing in 1983 with House Science Committee Chairman Fuqua, said the report "fails to meet the statutory requirements."[16] A year later, Congressmen Zablocki and Fuqua said the report "continues to be couched in the most general terms which is contrary to Congressional intent for a thorough and integrated discussion of the foreign policy implications of our international S&T activities."[17] House Foreign Affairs Chairman Fascell and Science Chairs Fuqua and Roe have said that key sections of the reports are "inadequate ... and ... oversimplified,"[18] cursory ... and ... inconsistent,"[19] and "more of a compilation of agreements rather than an in-depth analysis of the foreign policy implications of science and technology activities as required by law."[20]

In truth, most of the Congress knows and cares little about the subject, and most of the past Title V reporting is, indeed, largely a retrospective catalog of activities. Only urgent issues elicit high interest in the ostensibly arcane role of science in international affairs. Such issues include the occasional surges of concern about protectionism, exports of high-tech know-how, arms negotiations, controlling the AIDS epidemic, membership in a UN body. These concerns quickly fade. They rarely lead to inquiry about the deeper choices of long-term foreign policy, much less about the squeeze on mission agencies' resources of talent, time, and funds for international relationships involving S&T. Still, Congress was prescient a decade ago in enacting Title V. With more professional staff now on the Hill, Congress can pursue the international agendas that the new world order, however it develops, will bring.

4.4 Presidential Declarations

Despite the operational problems in the State Department, and in the other agencies, the White House has been forceful in declaring its broad intentions about most of the subjects reviewed here.

President Reagan, for example, drew special attention to scientific cooperation in his March 1988 letter accompanying the annual Title V Report:

> Science and technology can be a powerful force to enrich cooperative relations with friends and adversaries, as well as to strengthen our Nation's competitive posture in the economic arena. international cooperation can accelerate the rate of scientific discovery and the development of new technologies to meet the needs and challenges of the future. In many cases, the benefits of such cooperation accrue first to the partners in the joint effort, and such returns make it feasible to sustain a long-term commitment to cooperation. Ultimately, however, all the world's people are beneficiaries.[21]

Along similar lines, the tensions between desired cooperation and inevitable competition were clear in President Bush's reaffirmation in March 1990 of the vital role of science and technology in foreign affairs:

> A characteristic feature of our age is the unprecedented

> rate of change in science and technology.... We are moving toward a day when the responsibilities for supporting large basic science projects will be distributed around the world, reflecting the truly international character of modern scientific research and the shared financial and intellectual underpinnings of that research ... the internationalization of the marketplace emphasizes that we can no longer take our [science and technology] leadership for granted.... It has become increasingly clear that science and technology, the economy, and foreign relations are inextricably intertwined....[22]

4.5 A Clear Goal

Since 1949 a clear, simple goal has repeatedly been expressed by successive presidents, by Congress, and by the State Department itself: tap the country's extraordinary strengths in science and technology to achieve American purposes in foreign policy. Yet emphatic recommendations, reiterated over more than forty years, have not been followed by appropriate organizational changes and incentives or by provision of financial resources required for their implementation throughout the agencies and in the Department of State. Even less has any clear policy been enunciated in sufficient detail to enable the many technologically muscular executive agencies to work effectively with State to carry out foreign policy.

To diagnose the case in more detail, the next chapter reviews the functions of international action with respect to science and technology and then illustrates current patterns of operations in the field and at headquarters in Washington.

5.0 FUNCTIONS: FIELD AND HEADQUARTERS ACTIVITIES

> In this age of high technology communications and computers, it is easy to overlook the function of the diplomat ... however, negotiating success is still highly dependent on the imagination and skills of professional diplomats.
>
> -David Newsom[1]

> The overall attitudes of nations toward (international cooperation in science and technology) set the climate for person-to-person collaboration among scientists and engineers, and the involvement of professional societies, universities, and private industry. These relations may actually be the most important and positive of all.
>
> -Justin Bloom[2]

National goals have been laid out, if sometimes rather grandly, in both Executive and Legislative statements. Career officials in the State Department -- like David Newsom, former Under Secretary for Political Affairs, and Justin Bloom, former science counselor in Tokyo -- have understood clearly the context, public and private, for needed action. But what actually has been going on? Why has there been so little concrete progress in incorporating S&T into diplomatic activities? How will enhanced S&T cooperation serve the nation's interests?

To guide a search for the answers, first consider the details of achieving international objectives anchored in science and technology. The following essential tasks, not in any order of priority, must be done in many situations.

- The government should muster as much reasoned, long-range anticipation as possible about how science and technology may be applied to any and all U.S. interests. It must be able to plan for contingencies, ranging from the possibilities of surprises in defense or the environment to the consequences of advances in manufacturing or communications.

- The government should use the U.S. science base for shorter-range problem assessment. The nation's scientists and engineers assist the government's officials, acting as referees and analysts of information with respect to current international issues; this might include severity of a drought, reliability of arms disposal, or best practices for earthquake-resistant construction.

- The government should monitor S&T developments abroad, focusing on what the government itself needs to know. It also needs to help minimize barriers to the much more extensive monitoring and dissemination efforts undertaken directly by industry and academia. Indeed, the government must facilitate the national diffusion of open information from all sources.

- The government should monitor and understand the S&T policies and strategies of other nations and regional groupings. This may involve trade, research priorities, arms exports, or differing assessments of the potential payoffs from the promotion of investments in various engineering fields.

- The government should prepare to take joint action with other nations to address transnational problems, through the necessary bilateral, multilateral, formal, and ad hoc frameworks. AIDS, narcotics traffic, immigration, global warming, use of the oceans, weapons limitations, and other topics periodically surge into importance. Any binding diplomatic arrangement rests upon technically based, long-term agreements as well as on specialized provisions to assure compliance. So preparations must begin well before the urgent negotiations are held. Authentication of the scientific facts often must be done on an international basis.

- The government should be able to identify the critical needs and provide high-leverage technical cooperation with developing countries and then to evaluate the results of such programs. For too long, the science and technology components of relationships with the "Third World" have been subject to rapidly changing fashions, unrealistic hopes, and micromanagement with inadequate resources.

- The government should be able to integrate expert knowledge in science and engineering into adjudication and regulation at the international level. For example, settling environmental disputes and setting common technical standards for changing products and processes call for political, economic, and scientific skills. Sometimes dispute resolution and mediation about, say, water supplies, demands great technical skill.

- The government should use its technical expertise to support negotiation of new international agreements, conventions, and protocols in such areas as arms control, environment, trade, and migration. Sometimes, of course, negotiations take years -- even careers -- to conclude, and trained staff must stick with them, building upon institutional experience with the political issues that always arise in the governance of technologically complex regimes.

- The government should develop and implement policies that will strengthen U.S. science and engineering through international cooperation. Although the United States is still the Everest of R&D, many countries now possess front-rank scientific centers doing world-class R&D, mostly aimed at achieving or sustaining economic advantage. Research alliances can coexist with the growing technological competition, but the outlook for enduring scientific success must be guarded unless governments smooth the search for shared benefits. A high priority should be placed on assuring the uninhibited flow of scientific information and skilled professionals.

- The government should foster and participate in multilateral joint programs of monitoring and sharing of data. Understanding such issues as global climate change and ozone depletion requires global observational systems that no nation can implement alone.

- The government should have mechanisms to participate in the key fields of research cooperation for the world scientific enterprise. Cooperation is central to fields such as space, biodiversity, and high-energy physics, where there is increasingly a unified, collective, and often expensive effort by the global scientific community. When leadership springs from other nations, the government should consider joining their meritorious projects (including supporting them financially), if it is in the national interest to do so; this has occurred only rarely in the past.

Knowledgeable observers could supplement this list, and different people might assign quite different priorities to the tasks. But there is little doubt about the necessity of these science-based governmental and diplomatic functions. To produce wise policies, of course, the work must also be tackled with a sure sense of the historical and political context. In this domain there will always be conflicts: reasons either for acting too quickly (without sufficient information), or for moving too slowly (with poor understanding of the costs and consequences of delay). Technologically complex policy-making in national and international enterprises often exemplifies the iron law that "you want results and you get consequences." To minimize such risks, leadership is essential and the hard homework must be done. This means that organizational arrangements must be sound and effective for each and every one of the tasks listed above. How sound and effective are the present arrangements?

5.1 Science And Technology In The Field

Most of the functions just summarized are supposed to be performed with and by the State Department. Accordingly, the main objective in this section is to document how this effort is carried out in offices normally unseen by the public, populated by mostly unknown officials, carrying out countless negotiations and visits. This is the nature of the State Department's work in the context of "globalism" affecting government as a whole.

First, and in the interest of translating abstractions into specific situations, consider a "day in the life of an ambassador." Few outside the government, and not many inside, have a concrete notion of what such an official does. But much of what ambassadors do these days -- and, probably, what they will do even more frequently in the future -- relates to science. Figure 2, a composite of Ambassador Harry Barnes's day in Chile in 1987-88, shows the pattern.

This ambassador's calendar reveals that "foreign affairs" in the field touches every federal agency at home. From Defense to the Park Service, from the National Institutes of Health to the Federal Aviation Administration, to the Departments of Labor and Commerce, international contacts are common. Most of these are specialized -- comparing notes on particular techniques, exchanges, prior agreements, results, plans. The contacts often reflect worldwide interest in U.S. progress in subfields in science and technology as well as in the management of enterprises in a market-oriented democracy.

Few of these contacts rise to the level of "high diplomacy." Still fewer lead to foreign policy decisions by, or reports to, the Secretary of State or the President. But almost all such discussions and contacts require the participation of the State Department, in the field or in Washington, to provide informed liaison. In the aggregate, these working-level and middle-management efforts result in lessons learned, "open intelligence" gathered, expectations set, opportunities revealed, attitudes toward the U.S. changed, political and commercial networks extended in both directions. All of this must be weighed in charting the policies within which such day-to-day transactions are encouraged, tolerated, or prohibited.

FIGURE 2: An Ambassador's Day

What follows is a composite day's schedule of the U.S. Ambassador to Chile in 1987 or 1988. Uppermost in U.S. relations at that point was the question of how to assist in the return to democracy. The Pinochet government saw the U.S. as being unsympathetic to its aspirations to remain in power. The U.S. Embassy saw itself as helping to promote an early and free opportunity for Chileans to decide for themselves. Much of the day, enveloped by politics, concerned scientific and technical themes.

0730 Breakfast with AAAS-sponsored group of scientists exploring ways of reviving U.S.-Chilean scientific cooperation.

0900 Daily meeting with Deputy Chief of Mission to review current issues, including position to be taken at forthcoming World Bank meeting on loans for Chile -- to support or abstain.

0930 Meeting with NSF delegation that has just completed its review of Foundation programs in Chile.

1015 Attend opening ceremonies of conference sponsored by Embassy, Center for International Private Enterprise and Chilean Manufacturers Association on Free Enterprise and Democracy.

1200 Meeting with NASA representative, visiting U.S. professor of decision sciences, and head of University of Chile computer center to develop approach to link U.S. and Chilean universities through BIT-NET using NASA ground station.

1300 Lunch with science officials and representatives of Amcham (U.S. Chilean Chamber of Commerce) to discuss proposal for scholarships for outstanding science graduates.

1415 Lunch interrupted by phone call from Washington asking whether we can find out if Pinochet will be attending inaugural ceremonies for extended strip on Easter Island for emergency space shuttle landings (he won't).

1530 Meeting with representatives of National Endowment for Democracy to discuss assistance to the Committee for Free Elections to develop a computer network to provide a quick count at the time of the presidential plebiscite as a check on the government's tally.

1630 Call on the Minister of Commerce to explain U.S. insistence on a satisfactory set of changes in Chilean patent law if U.S. were to hold off further instituting a section 301 case against Chile for inadequate intellectual property protection for pharmaceuticals.

1715 Telephone Norman Borlaug in Mexico to fill him in on our efforts to get Chilean government agreement to reopen a Peace Corps program, one that would involve a small group of foresters to work on the problems caused by the pine shoot moth.

1830 En route home stop at Science Attache's house for reception for visiting EPA scientist who was advising regional and municipal officials on monitoring Santiago's air pollution.

2000 Dinner for a group of educationists (university rectors, research institute directors) and Ford Foundation representative to discuss role of higher education in a future democratic Chile.

2300 Phone call from director Cerro Tololo Interamerican Astronomical

Observatory confirming arrangements for visit at time when it would be possible to view Halley's Comet.

Source: Ambassador and Foreign Service Director General (ret.) Harry G. Barnes, Jr.

The United States is the "target" for S&T sharpshooting by many countries. One reflection of this priority is the staffing at foreign embassies in Washington. The estimates for selected countries given in Figure 3 do not include staff from agencies outside foreign ministries (such as Japan's several units) and they probably understate the staff devoted to space and defense topics (in the case of what was the Soviet Union, for example). But they suggest at least the magnitude of effort.

FIGURE 3: S&T Staffing at 23 Diplomatic Missions in Washington, DC[a]

Country	Number of S&T Staff
Argentina	1
Australia	3
Austria	1
Belgium	1
Bulgaria	2
Canada	2
China	8
Finland	1
France	14
Germany	10
Hungary	1

India	1
Italy	3
Japan	3
Netherlands	5
Poland	2
South Africa	2
Sweden	4
Switzerland	4
USSR	4
UK	10
Yugoslavia	1
EC	1
	--
	84

Endnote

[a] Excluding non-foreign-ministry staff.

Source: State and Defense Departments (1990-1991)

For comparison, Figure 4 details S&T positions, in relation to total staff, at some U.S. posts abroad. These data understate the total U.S. technical presence abroad: for example, they do not include multilateral agencies such as OECD or the agencies with special technical units, such as the Office of Naval Research, which covers Asia from Tokyo and Europe from London. Figure 5 illustrates the comparative diplomatic S&T effort of the United States and other nations over time. The gap, large in 1979, has widened considerably since.

The Defense, Commerce, and Agriculture departments also have many technical staff around the world. The overseas S&T presence of the Defense Department, for example, grew significantly during the mid-1980s through the Offices of Defense Cooperation administered by the Secretary of Defense; these offices and other parts of the military with responsibility for international S&T account for about 50 professionals.[3] In addition, some states have their own technologically oriented representatives abroad.

Most important for this review, such S&T outposts are not well integrated into the State Department's policy-guiding and oversight role, although they report to the U.S. ambassadors on a day-to-day basis. Neither the State Department in Washington nor embassies abroad have the resources to work closely with S&T personnel in other agencies. Further more, as will be discussed later, there is crippling interagency gridlock about the purposes and logistics of posting people abroad.

FIGURE 4: American Staffing in Selected Countries, September 1990

Country	Total Staff	State	FSO S&T[a]
Brazil	231	110	1
China	174	108	2
Czechoslovakia	46	26	0
France	383	123	2
Hungary	37	22	1
India	256	94	2
Japan	284	87	3
Mexico	554	264	2
Soviet Union	156	66	3

United Kingdom	248	100	1

Endnote

[a] Foreign Service Science and Technology positions.

Source: State Department (1990)

FIGURE 5: U.S. Science Officers Abroad and Foreign Science Officers in the United States, FY1979-FY1990

Next, consider the State Department's science and technology field positions. For some years, there have been only 25-30 full-time S&T positions, scattered from Buenos Aires to Jakarta and concentrated in Europe. Most of these slots are controlled by the geographic bureaus in the State Department. When ambassadors worldwide are instructed to scale down their embassies, as they have been during the past few years, the regional bureaus and the ambassadors start comparing S&T positions with political and economics positions. Since political and economics officers perform the core of "traditional" foreign policy functions in an embassy, S&T positions are likely to be the first to go.

Overall, most observers see a large effort devoted by governments from the rest of the world to learning about U.S. science and technology, while the U.S. State Department and other executive departments proceed hesitantly and often without much intensity or strategy to pursue U.S. S&T-related interests abroad. It is fair to ask: does this make much difference and, if so, for what functions? After all, one "price" of R&D leadership -- the U.S. spends more on R&D than all of our allies combined -- is that the leader will be watched carefully, and, sometimes, the "first followers" will save resources by learning from the leader's mistakes. Then, too, U.S. foreign policy goals are not the same as those of other countries. So a mindlessly imposed symmetry in the field offices for S&T functions would make little sense. Still, how much technical reconnaissance should be done by the State Department and why?

There are at least three factors to consider in addressing this question. The first is that for most of the U.S. private sector's specific purposes, the U.S. Government need not worry. Individual firms, universities, consultants, journalists, and scholars will carry out what may be called a "technical intelligence" function, focused on the particular goals of each firm or project. However, the often comforting vitality of the private sector reminds us of a fundamental problem: the government must not get in the way of market-fueled engines of scientific and engineering advance. And it often takes sensitive diplomacy to keep these engines tuned up.

A second consideration is that the federal mission agencies gather information on international trends for their own purposes. Each of them has in Washington (and, sometimes, abroad) a staff concerned with the foreign components of its mission. This could hardly be supervised in detail by State. In the future, the missions of many agencies will have an even greater international component; in Chapter 7.0 (Figures 17 and 18), the constraints on staffing for this are reviewed in detail. As mission-oriented international efforts expand -- in areas of science generally, or in environmental projects, or in energy planning -- mission agencies should and must depend on the State Department to assist them. This is an essential part of the rationale to be given later for a modest increment in State's staff in the field: such staff would greatly increase the effectiveness -- and the consistency with all foreign policy considerations -- of the other agencies' efforts.

In this connection, the CIA is a special case. Although its role surely will change if East-West relations continue to warm -- to emphasize economic and political trends rather than mainly military intelligence -- the agency's activities are not of direct concern here. Similarly, this review does not consider the even larger human and technological resources of the Defense Department's intelligence units. Nonetheless, it is important to recognize that these capabilities could be applied in new ways and that, whatever the changes in intelligence tasks over the next few years, the intelligence community's strong technical skills could be used to serve other foreign policy objectives.

The third and most important part of the answer to the question of scaling State's effort, however, is that State is not deeply enough engaged in tracking the overall results of the many international activities in the private sector and among its fellow federal agencies. Therefore, it cannot be aware of the often subtle contours of actions by other governments, of the private sector's experiences, or of the U.S. Government's mission agencies' hopes, gaps, flops, and jackpots.

One indication of the incompleteness of the staffing situation worth reemphasizing is the small number of State S&T officers in all our embassies -- fewer than 30 worldwide! Although some missions have an economics officer who may devote up to 25% of his or her time to S&T, there are no qualified technical officers in Africa or Central America, none in Scandinavia, only two in South America, and only a handful in Asia. As observed earlier, S&T positions have been eliminated at some posts because of overall cuts in the State Department's staff.

To give a feel for what such specialized officers do, Figure 6 is a composite of a day in the life of the Science Counselor in the U.S. Mission to the EC in Brussels. From escorting scientific visitors to explaining the technical news to lay audiences, it is a hectic schedule where science and diplomacy meet. While almost impossible to document comprehensively, plentiful anecdotes suggest that the workload of these professionals has grown, swamping them with administrative duties attributable to the otherwise welcome "globalization" of U.S. programs and to the many external requests for U.S. cooperation. Whereas most other countries view their S&T staff assigned to the U.S. as key agents in "technology scouting and transfer," the U.S. job description tends to concentrate on technical support for political and administrative functions. Unlike the situation of a generation ago, the U.S. has much to learn from others and much to do in R&D partnerships. So the State Department must provide intellectual value-added with its staff.

What are the implications of these patterns? One is that U.S. science attaches cannot carry out the interpretive analysis mandated by repeated Congressional and Executive assertions of the State Department's responsibilities. The argument is both qualitative and quantitative. State's three S&T staff in Tokyo need not, and could not be expected to, monitor all significant Japanese results and trends. Various U.S. Government agencies -- and many private firms and academics -- assess the Japanese strategies, programs, and organizations in detail. Nonetheless, the State Department is required to oversee all S&T-related foreign policies in Japan and elsewhere. Yet it simply does not have the field representatives and headquarters analysts necessary to gather and digest the information needed to fulfill its task.

Another consequence of the inadequacy of the size of the staff focused on international reconnaissance and management of S&T in foreign policy is that the United States is often caught napping. Frequently a "new issue" emerges -- such as the regulation of biotechnology, or planning for negotiations on global climate change. When this happens, the State Department's already overstretched staff must be jerked into yet another eleventh-hour exercise to catch up on the issues and assist the Secretary and President in organizing what to do, say, negotiate, and finance in international fora. Almost all of the issues that have revealed these dynamics in the past could have been better anticipated. The early preparations for the 1992 UN Conference on Environment and Development (UNCED) illustrate not only this inappropriate modus operandi but also the interagency squabbles whose resolution required an authority and competence that State did not have: much of the policy action quickly began to move to the White House's staff.

FIGURE 6: "Day in the Life" of a Science Officer

0800-0930 Participate in a breakfast briefing by the Ambassador of an MIT group touring countries to explore environmental issues.

0945-0955 In office, scan morning cables for action items. Skim newspapers for environment and S&T topics and politicians' statements about them.

1000-1045 Attend twice-weekly Country Team (CT) meeting (chaired by Ambassador and Deputy Chief of Mission (DCM) to review with section and agency heads current agenda, problems and activities). With Economic Counselor, brief CT on impending national legislation on intellectual property protection (IPR).

1055 See DCM to discuss cable the Science Officer is to write on the IPR legislation.

1110 Meeting with two USGS scientists in-country for environmental research.

1200-1250 Continue work on a cable on host country nuclear activities. Ask staff to set up meetings with French and German science counselors.

1300-1430 Lunch. Main purpose: elicit from a senior foreign official the state-of-play of his country's S&T cooperation plans with the U.S., and the EC.

1500 Back in the office. Dictate quick memo to Amb/DCM, info POL, ECON and others, reporting the official's views.

1515-1545 Conduct scheduled meeting to brainstorm with SCI American staff and FSN (Foreign Service National) employees ideas for a report about the country's leading research laboratories and their scientific contributions and to ascertain the exact status of the Embassy's close-to-deadline annual Title V Report submission to OES.

1605 To airport to meet on behalf of the Ambassador an arriving Codel (Congressional Delegation) of six congressmen and five staffers headed by Chairman Roe of the House Science, Space, and Technology Committee.

1645 Codel arrives. Science Counselor, SCI FSN and others from

Embassy USIS and Admin staffs see them through travel formalities, press, welcoming remarks, and Q&A. Science officer accompanies Chairman Roe to the Ambassador's residence.

1800 See DCM urgently re a cable to Washington on aspects of what the senior foreign official told the Science Counselor at lunch.

1900 Arrive late at the Ambassador's 1830 reception for Codel Roe.

2030 Accompany members of Code Roe to restaurant for local flavor.

2330 Arrive home. Review heavy schedule of Roe calls which the Science Counselor will accompany to take notes and write reporting cables.

0045 Awakened by phone call from Washington from a staffer of EPA Administrator Reilly to clarify details of Reilly's impending visit next week.

Source: State Department (1991). Refers to EC mission in Brussels.

5.2 Science At State

The S&T staffing situation at the embassies is obviously not the only issue: it is important to turn to headquarters in Washington. Figure 7 is the organizational chart for the State Department, as of spring 1991.

Virtually all of the thirty-five -- yes, 35! -- Assistant-Secretary-level posts have been created by law. And each reports more or less directly to the Secretary and Deputy Secretary! The core of senior officials -- and the most experienced career groups -- are responsible for major regions of the world. Other posts reflect the relentless accumulation of "priorities" on diverse subjects such as human rights and narcotics, each the prized theme of a distinct constituency that was successful in sponsoring and passing legislation. There are also some long-standing and important "sectoral" or functional areas such as economics, intelligence, and politico-military affairs.

Typically, Assistant Secretaries rotate every two or three years. That is "the system." Appointments flow out of the Foreign Service's aim of fostering excellence through broad experience and of rewarding the seniority of accomplished generalists. Occasionally, and frequently in recent years, political patronage determines appointments. Most of these officials are highly capable. Sometimes they have a background in the subjects for which they are (briefly) responsible. Although the personnel selection system generally -- and the proportion of career appointments specifically -- are not within the scope of this review, it must be said that, for dealing professionally with science and technology, this system of short tours and thin qualifications is not optimal.

State's "science office," the Bureau of Oceans and International Environmental and Scientific Affairs, was established in 1973-74, amalgamating earlier advisory and line offices.[4] As of the spring of 1991, the Assistant Secretary heading OES reports through two senior Under Secretaries, one responsible for International Security Affairs and the other responsible for Economic and Agricultural Affairs. The fuzzy reporting line has often involved, if informally, other senior officials as well, such as the Under Secretary for Management.

FIGURE 7: Organization of the Department of State, Spring 1991.

The Assistant Secretaryship has been filled by career foreign service officers and by outside appointees, alternating about equally over the past decade or two, with selection evidently based largely upon general ability rather than specialized experience in science or technology. Figure 8 provides detail on the organization of OES. As with the rest of the top of the State Department, many of the small OES units are named for -- and respond to -- specific Congressional interests. Only one small unit, three levels away from the Assistant Secretary, is devoted mainly to planning issues.

Figure 9 illustrates some of the several major issues covered by the staff. Over many years, for instance, nuclear weapons and non-proliferation have been key issues. Often, a single "politically live" topic will absorb virtually all of the Assistant Secretary's and key staff's time. This occurred, for instance, during the early 1980s in the Law of the Sea negotiations. More recently, the controversies and negotiations about climate change, along with overlapping preparations for the 1992 UN Conference on Environment and Development, have taken up the time of the leadership of the Bureau and demanded lengthy trips abroad.

Over the past decade, funding for the Bureau has decreased by about 40% in real terms, and staffing levels have risen by only 10% (Figure 10). As other countries have become aware of the importance of S&T cooperation with the United States, the Bureau's workload, as reflected in the number of international S&T agreements, has increased sharply (Figures 11 and 12). Most experienced observers agree that only a few score of these hundreds of agreements are truly significant for the U.S. But every one requires extensive political negotiation and is important to the partners (or was at the time it was signed). Further, each one needs at least a bit of nurturing by diplomats as well as by technical specialists, who on occasion are recruited from other agencies and the private sector.

Instead of being able to concentrate on key countries or on the most significant technical issues, most of the time OES deals with what can only be called "flaps," endemic to our pluralistic government and inevitable when the United States has relations with 150 or so countries. These urgencies may concern new bilateral technical exchange agreements being initiated by Presidential decisions at a summit, or a consuming dispute on, for example, forestry development. Many such topics crackle with political and commercial interests, yet seldom hinge on complex technical analysis. Why do these absorb so much time in OES? Usually, it is either because key officials at other agencies are ardently committed to one side of an international policy choice -- for instance, in a trade-off between environmental and business concerns -- or because no agency has the inclination or responsibility to deal with the international problem at all -- such as with many proposals arising from debates at the United Nations, or with the economic and immigration consequences of a civil war for neighboring countries. State must deal with "the whole" and with any problem raised by any country at any time.

FIGURE 8: Organization of the Bureau of Oceans and International Environmental and Scientific Affairs (OES).

FIGURE 9: OES -- Organization and Activities

The Bureau of Oceans and International Environmental and Scientific Affairs

(OES) is the Department of State's focal point for foreign policy development in the areas of international science and technology cooperation, environmental protection, global climate change, nuclear energy and nonproliferation, oceans affairs and population policy.

The Bureau is headed by an Assistant Secretary of State. The Principal Deputy Assistant Secretary of State (PDAS) supports the Assistant Secretary in his leadership role. The Bureau is divided into four directorates, each headed by a Deputy Assistant Secretary of State (DAS):

OES/E: Environment, Health, and Natural Resources

OES/N: Nuclear Energy and Energy Technology Affairs

OES/O: Oceans and Fisheries Affairs

OES/S: Science and Technology Affairs

A Coordinator for Population Affairs reports directly to the Assistant Secretary. and the Executive Director (chief administrative officer) communicates with the PDAS.

To illustrate one component, the Nuclear Energy and Energy Technology Directorate is headed by a Deputy Assistant Secretary of State who is responsible for policy formulation and action relating to nuclear non-proliferation policy, the application of international safeguards, nuclear export control policies, nuclear cooperative agreements, and international energy technology matters. Its activities include:

- Technical assessments of the effect of energy developments on

U.S. policies, particularly non-proliferation

- Establishment of cooperative energy development programs and energy resource/demand assessment programs

- Negotiation of international nuclear energy and energy technology agreements

- Working with U.S. government agencies in encouraging international energy cooperation

Source: State Department (1991).

FIGURE 10: OES Bureau Staffing and Funds

- Positions in 1990: 152 (105 officers and 47 support staff) -- growth of about 10% over past ten years. In 1978, there were 139 positions.

- Approximately 30 Science officers posted abroad to 25 missions -- no growth during past decade.

- FYI 990 operating budget approximately $1.6 million -- roughly constant in nominal dollars over past decade; thus roughly 50% reduction in buying power. Travel has been cut severely; little computer support; no discretionary funds for training, consultants, research, or advisory committee.

GRAPHICS: OES Budgets FY1978-FY1990, nominal dollars vs. real dollars (adjusted for inflation)

Note: the increase in fiscal year 1988 was due to a one-time allocation of $840,000 for a computer system

Source: State Department/OES (1991).

It is only fair to note that OES has enjoyed considerable success in recent years on issues in which the United States has a major interest. Perhaps most significant was the negotiation between 1985 and 1990, under U.S. leadership, of key agreements for the protection of the stratospheric ozone layer. Another major environmental accomplishment was the consummation of the Basel Convention, dealing with controls on the export of hazardous wastes. OES has also pressed forcefully over the past decade to ensure better global safeguards against the spread of nuclear weapons. While some question the effectiveness of the International Atomic Energy Agency after its apparent oversights in Iraq, U.S. efforts have been instrumental in recent decisions by Brazil, Argentina, and South Africa to accept IAEA safeguards on all their nuclear activities.

FIGURE 11: S&T Agreements by Region, FY1979-FY1989, All Federal Agencies

FIGURE 12: S&T Agreements by Subject, FY1979-FY1989

Source: State Department (1991).

The reason for emphasizing the wide-ranging and often urgent negotiating and operating responsibilities of OES is that they drive out most analysis and planning. What little time has been devoted to strategic thinking has been bootlegged by the OES professional staff. There is, as well, little sustained planning on S&T in foreign policy by the other State Department offices that might be involved, such as those concerned with Economics, Politico-Military Affairs, or Policy Planning. Indeed, these offices rarely have staff with scientific or engineering experience. They also tend to prefer the politically subtle problems of immediate concern to the Secretary, the "this morning and sensitive" issues that are the traditional meat-and-potatoes of foreign affairs and of daily intelligence briefings for the Secretary and the President.

5.3 The Big Picture

Overall, neither in the field nor in Washington are the government and the State Department able to identify, map, and respond adequately to international scientific cross-currents and the transformations they bring; they are thus unable to formulate a global strategy for the longer run, Nevertheless, U.S. foreign policy on some key issues has been farsighted and consistent. And on a few other highly visible issues, the government can and does patch together, often at the last moment, an intelligent, responsible position. But the price of thin staffing and hasty planning can be high: little evaluation of trends, fragmented preparation for contingencies, superficial anticipation of how best to use U.S. research resources, shallow preparation for negotiations, lost opportunities. As the S&T component of foreign policy increases in the 1990s, the nation can no longer afford to pay this price.

6.0 NEEDS: EXECUTIVE AND LEGISLATIVE CASES

> We must find more creative and effective ways to ensure that science and technology are an integral and important part of our foreign policy around the globe.

-George Bush[1]

> Cooperative international efforts in health, agricultural productivity, and environmental pollution produce benefits for all associated nations.... Our own economy has become increasingly dependent on global markets and industrial competitiveness can no longer be measured on a national scale.

-George B. Brown, Jr.
Dante B. Fascell[2]

No doubt about it: responsibility for foreign policy begins at the top. The President and the Secretary of State have the lead. The Congress, of course, must play a substantial role, not only because of its Constitutional responsibilities in such areas as appropriating funds and ratification of treaties, but also because the nation's domestic economy has become so thoroughly entwined with international trends. This chapter explores the broader character of current and future needs, explaining why the objectives are so pressing in specific cases.

6.1 The Executive Office Of The President

At the outset, consider recent encouraging signs of renewal. For thirty years the White House's Office of Science and Technology Policy (OSTP) has had a full-time staff member devoted to international subjects, but today there is an Associate Director for Policy and International Affairs. This is the first time in the history of the White House science staff that a senior deputy to the President's Science Advisor has been given explicit responsibility for the areas at issue here. This Associate Director and the

Director of OSTP also have long-standing personal and professional commitments to an internationalist view of the U.S. research community. Figure 13 offers a capsule description of the Science Advisor's international role.

The interagency Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) has also been reinvigorated. It has an active international group, the Committee on International Science, Engineering, and Technology (CISET), chaired by State's Under Secretary for International Security Affairs (Figure 14). CISET has five subcommittees, dealing with the following subjects: S&T cooperation and initiatives with industrialized countries; S&T cooperation with less-developed nations; "megaprojects"; preparation of the Title V Report; and technology and competitiveness (Figure 15).

FIGURE 13: Highlights of International Role of the Office of Science and Technology Policy in the Executive Office of the President

The Assistant to the President for S&T also serves as the Director of the White House Office of Science and Technology Policy (OSTP). He is informally known as the Science Advisor. OSTP, which he heads, plays a central role in the shaping of policies and programs for the integration of S&T in the conduct of foreign affairs.

The Science Advisor assesses S&T elements of foreign policy and helps the President in meetings with the heads of foreign governments that feature S&T initiatives and agreements. U.S. technical leadership is used constructively to achieve broader foreign policy objectives. The Science Advisor represents the U.S. at meetings of science ministers of OECD countries.

As Director of the Office of Science and Technology Policy, the Science Advisor is served by a Presidentially appointed and Senate-confirmed Associate Director for Policy and International Affairs,

International areas of direct concern to the OSTP include environmental change (organization of the 1990 White House international conference); S&T in economic growth; the management of international cooperation for a growing number of science "megaprojects"; international S&T negotiation and implementation of bilateral agreements and the review of technology transfer arrangements; and the facilitation of nongovernmental international cooperation.

OSTP participates in various White House groups, such as the Policy Coordinating Committee of the National Security Council (NSC) concerned with specific issues in the science, oceans, and environment area (see Figure 16).

The Science Advisor chairs the Cabinet-level Federal Coordinating Council on Science, Engineering, and Technology. The Council coordinates international S&T activities through its Committee on International Science, Engineering, and Technology (CISET), as shown in Figures 14 and 15.

Source: CCSTG staff reviews of past and current activities.

These major improvements during 1989-91 are reinforced by the similarly revivified President's Council of Advisors on Science and Technology (PCAST), chaired by the Science Advisor. The Council includes individuals with wide international experience in most fields of social, natural, and engineering science as well as representatives from industry and academe. Like the earlier President's Science Advisory Committee, which was active in international subjects ranging from arms control and food policy to space, the new PCAST is in a position to address long-term issues.

There is now, therefore, a well-designed structure within the Executive Office of the President (EOP) -- with a strong staff in barely sufficient numbers for the first time in more than a decade, and with OSTP, PCAST, and FCCSET complementing each other. Yet, especially for international efforts, steely steadiness will be required over several years to bring coherence to interagency policy. For policy coordination -- given the all-too-familiar strains of multiple national and international choices competing for squeezed resources -- often can be done only at the White House level.

6.2 Problems Among The Agencies

Following the White House lead, most Executive agencies are trying to identify, focus, and coordinate their international work with counterparts abroad and with international institutions. For example, the verve and comprehensiveness of recent initiatives to expand research on global climate change revealed the power of OSTP's leadership -- and FCCSET's ability to plan the use of added funds. The added funds did indeed smooth the coordination!

But implementation of unified policies throughout the diverse international programs of the Executive agencies will have to surmount many obstacles. Most mission agencies still regard international programs as "orphans." Such programs are usually less important to their constituencies than their domestic tasks, especially as seen by most Congressional appropriations committees. The efforts are thus more vulnerable to fluctuations in funding and politics, both nationally and internationally.

FIGURE 14: Membership of the Committee on International Science, Engineering, and Technology (CISET) of the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET)

CHAIR

Under Secretary of State for International Security Affairs,
Department of State

VICE CHAIRS

Deputy Director, National Science Foundation

Director, Fogarty International Center
National Institutes of Health,
Department of Health and Human Services

MEMBERS

Associate Director for Policy and International Affairs
Office of Science and Technology Policy

Deputy Associate Director (Special Studies)
National Security and International Affairs

Administrator of Research and Special Programs
Department of Transportation

Assistant Administrator of International Activity
Environmental Protection Agency

Office of Management and
Budget

Assistant Administrator for
Science and Technology
Agency for International
Development

Assistant Secretary for the Office
of Postsecondary Education
Department of Education

Assistant Secretary for
Technology Policy
Department of Commerce

Deputy Director for
Defense Research and
Engineering
Department of Defense

Director for Energy Research
Department of Energy

Assistant Secretary for Water and
Science
Department of the Interior

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

Associate Administrator for
External Relations
National Aeronautics and
Space Administration

Director of Governmental and
Public Affairs
Nuclear Regulatory
Commission

Assistant Secretary for Science
and Education
Department of Agriculture

U.S. Trade Representative for
Europe
Office of the United States
Trade Representative

Source: State Department/OES (1991).

Indeed, in the past the White House science office, with the State Department, has sometimes been unable to obtain complete and reliable data on the agencies' existing international programs. This lack of information has been frustrating to everyone, including Congress, as the State Department has tried to cope with its statutory Title V reporting requirements. More significantly, the gap in information about internationally pertinent programs actually reveals a deadly quicksand in which most foreign efforts of most agencies are sinking. Bureaucratic fearfulness has even led to passive acceptance of drastic cuts in funding the international travel essential for knowing global trends. In short, battles over a few issues, and fuzzy priorities on programs and budgets, combine to undermine analytical work to shore up policy coordination.

6.3 A Tradition Of Impasse

Many aspects of past interagency work on international priorities have caused "no win" standoffs that jeopardize U.S. interests. Lest such a generalization be unconvincing, consider the following five illustrations. Even without full details, each underlines the need to manage the complexities of the international domain with greater clarity and cohesion.

BIG SCIENCE: NATIONAL GOALS AND EQUITABLE INTERNATIONAL ALLOCATION OF BENEFITS AND COSTS

The proposed multibillion-dollar high-energy physics effort called the Superconducting Super Collider (SSC) has generally been seen as an international enterprise.[3] Yet negotiations about international cost-sharing have been stalled. Delays, lasting years, have occurred. This is partly because some powerful forces in the United States oppose full foreign participation in a "high-tech" project -- the funds, jobs, and knowledge would have to be shared! -- and partly because Congressional groups (both skeptics and sympathizers) know that the U.S. commitments must be large and long-term. Moreover, the project may be at risk simply because domestic competition for funding all other science is so brutal.

The issues include American physicists' ambitions (occasionally nationalistic) on the frontiers of science itself; U.S. governmental goals for scientific and financial cooperation; delicate diplomacy with nations who are both political allies and commercial competitors; financial and budgetary uncertainties, both at home and abroad; and the sometimes arcane terms of technological transfers, cross-licensing arrangements, and lucrative contracts that have stiff requirements on intellectual property rights. Resolution of the SSC planning impasse, and the eventual management of the project, will involve the Department of Energy, the State Department, the White House, technical participants from the government and private sector in Japan, Europe, and elsewhere, and, of course, the Congress.

Similar complexities affect the large efforts planned for NASA's Space Station as well as for the joint NIH -- Department of Energy (DoE) program for mapping and sequencing the human genome. More broadly, in what might be called "extensive, but medium-sized science," there are comparatively obscure, yet quite significant, international projects in subjects such as oceanography, earthquake prediction, and assessment of the world's tropical forests. In some of these fields, the United States will have to consider joining projects originating elsewhere, and this will surely require a radically different U.S. outlook from that seen recently.

All of these global research efforts require elaborate intergovernmental administrative structures, large-scale scientific exchanges, and the intermeshing of diverse science policies among the mission agencies. If this weren't complex enough, it is only fair to note that U.S. domestic science priorities -- balancing fields, missions, and "big" vs. "little" science -- are hardly stable or crystal clear. Managers of U.S. foreign policy must keep abreast of the ongoing debates about U.S. science policy at home.

NSF: STRUCTURING INTRAGOVERNMENTAL CAPABILITIES TO PROMOTE INTERNATIONAL COOPERATION SERVING THE U.S. SCIENCE BASE

Despite frequent discussions and thoughtful reports by the National Science Board, the international roles of the National Science Foundation remain ambiguous. Some see little more than bureaucratic turf-squabbles among NSF, State, Defense, Interior, Commerce, Health and Human Services, and others about responsibilities and staff management. But there are deeper dilemmas.

On the one hand, NSF has considerable skills (and administers about $2 billion) for almost all of the physical, engineering, social, and biological sciences. This should put it in a good position to act as the government's principal agent in most international arrangements for basic science. It has also developed superb quantitative indicators of international trends in science and technology. It has a small staff dedicated to international programs, conferences, exchanges, and pilot projects, with a few field units and thousands of contacts around the world. Indeed, its governing National Science Board asserted a decade ago that, to be superior, U.S. science "requires" international cooperation.[4]

On the other hand, NSF is the "national" science agency and tends to be seen that way by Congress. It is science and, increasingly, science education at home that is critical, NSF's international roles seem secondary. Further, its technical experience in many of the internationally crucial mission-relevant fields could be (and is) questioned by various larger agencies such as Agriculture, or Health, or the Environmental Protection Agency. Thus the other agencies claim, certainly when added resources are at stake, a dominant role internationally in their respective sectors. Making matters even muddier, the Title V law says that State oversees all international S&T agreements, and executive regulations give State the authority to control all personnel posted abroad. This leads to sometimes bitter stalemates when NSF and other agencies wish to use their funds to expand efforts and place staff in the field.

In general, since State is preoccupied with the political dimensions of foreign policy and does not have much scientific depth, while NSF and the mission agencies have little interest or expertise in the whole of foreign policy and few clearly defined government-wide responsibilities for the international area, planning for research partnerships often results in vacuums or feuds. Too often this means missed opportunities at the interface of basic science with long-range foreign policy interests. As this report was being completed in the fall of 1991, a notable example of such a missed opportunity was the absence of interagency cooperation, flexibility, and imagination to meet the rising needs for S&T cooperation with Eastern Europe and the republics of the former Soviet Union.

DEFENSE: CHANGING PARADIGMS FOR THE MILITARY IN FOREIGN POLICY

The Defense Department necessarily has wide-ranging foreign S&T activities -- from tropical medicine in Egypt to support for Antarctic studies, and from internationally orchestrated system development and procurement to military sales and controls on arms exports. These efforts are treated gingerly by the State Department.

The State Department has not regarded the DoD's international programs as appropriate for detailed coverage in its annual Title V reports to the Congress, and Congressional critiques have complained about this omission. Even after setting aside the budget for the uniformed military, and the highly classified and sensitive programs, it is still hard to imagine the State Department meeting its obligation to assess all scientific and technological activities with foreign policy implications without taking account of a fair chunk of the Defense Department's activities, and certainly the efforts that are R&D-intensive. Indeed, the Title V mandate requires such review.

However, there are complications on this point, too. For many years the State Department and its associated Arms Control and Disarmament Agency has had great competence in arms control negotiations: this is one of the extraordinary exceptions to the general criticism here, because State has assigned this topic, for understandable reasons, a high priority and has brought together all the necessary expertise. Moreover, State plays a key and well-informed role in most military assistance, and has a voice in refereeing technology exports.

But in light of the welcome recent trends throughout Europe and in the former Soviet Union, many technological policy issues of dual military-civilian character are ripe for reevaluation. These include revision of high-tech trade restraints; concern about arms proliferation in nuclear, chemical, biological, and the almost-conventional "smart munitions" categories, especially to "Third World" nations; cooperation in science and technology with those developing countries that may be able to stabilize regional conflicts or set the pace for patterns in economic development; and mechanisms for cooperation in the verification of arms limitations and collective security agreements. State's role in such subjects touches both the national security and business communities, ranging across Commerce and the Special Trade Representative to AID and DoD.

Long-range planning is bound to be more complex in the multi-polar post-old War era, still "a dangerous place," this "new world order."[5] The State Department cannot be technologically on crutches in the race to rethink foreign policies for a new framework of international security. Many bureaus in State will be involved. Each will need more S&T professionalism. All will have to focus more creatively on the principles that can unify, safely and deeply, the technological connections between defense plans and foreign policies.

PRIVATE SECTOR: GOVERNMENTAL AWARENESS AND INVOLVEMENT

The private sector carries out a rich array of international activities spanning high-technology manufacturing, sophisticated engineering services, science-intensive training, foreign investments, development cooperation, and exchanges of executives.

Naturally, thousands of businesses, universities, and nonprofit agencies could not and should not be "managed" by any single part of the government -- and surely not by the State Department. But their goals and ideas could be surveyed and assessed more perceptively by the State Department through energetic groups of advisors and regular links with the external contacts of the governmental agencies that clearly have the leading role in each field, such as Commerce, NSF, Agriculture, and NIH. The State Department has had neither the resources, nor the traditions and mechanisms, to keep up with any more than rare crises in this highly dynamic system, now expanding and bearing ever more importantly on foreign policy.

Private actions will inevitably be at the leading edge of U.S. "foreign relations" during the coming decade. Freer markets will open, newer technologies will move more quickly, and the already rising mobility of people will increase further. The government has a crucial role to play in facilitating these trends: encouraging cooperation between the U.S. public and private sectors; fostering reciprocal access by the private sector to other countries; and smoothing out the inevitable inconsistencies among international standards and regulations.

All of these tasks draw on expertise in science and technology. All are the essence of "foreign relationships." The State Department cannot be the last to know, for it has a "need to know" how U.S. policy moves ahead with private partners. The cost of not knowing is that other countries, with their private sectors, move ahead faster, with better information producing more effective initiatives.

TECHNOLOGICAL INDUSTRIAL ADVANTAGES: GOVERNMENTAL PROTECTION AND ADVOCACY

Consider the life sciences and biotechnology: in these fields, the United States is the clear global leader and aims to pursue its strong national interests. NIH and the American academic biomedical research community are outstanding. Pharmaceutical firms are among the few in the U.S. private sector that successfully sustain long-range R&D, maintaining worldwide sales and profits in the face of rising competition.

State notes these trends, but it would be hard to find many examples of the Department seizing the international opportunities they present. Who could imagine State joining AID and HHS in presenting to Congress a case for removing constraints on NIH working on internationally pertinent research?

But the weak U.S. effort on parasitic diseases, and on many infectious diseases rarely seen in the industrialized countries but crippling in many developing countries, reduces the effectiveness of U.S. foreign assistance. Indeed, the thinness of U.S. effort on Third World health (despite AID's roughly $300 million per year) contributed to the tragic "surprise" of AIDS; although rampant abroad, it was recognized there only after it had become entrenched in the United States. The pursuit of forward-looking foreign policies requires the analysis of global medical markets and global health trends.

Protecting the international ethos regarding scientific exchanges -- and advocating U.S. intellectual and business interests in open and reciprocal programs -- is a key function for every agency, and for State as well. Typically, the U.S. Government has fulfilled this role well. Recall that about 30% of NIH's intramural scientific staff are short-term visiting foreign nationals. This mobility of people is good for science generally. It shows the priority given by foreign governments to their expectations for social and commercial applications of the biomedical sciences. It also reveals their need to train young investigators, and their recognition of the importance of building communications with the U.S. research base while establishing their own indigenous capabilities. The U.S. benefits through an enlivened research community and through the opportunities for diffusing American ideas.

Another objective, sometimes controversial, is the protection of intellectual property rights. This is extremely important to U.S. software, pharmaceutical, and chemical firms, among others. The defense of patents and copyrights has been shored up in countries such as China, Thailand, India, and Japan. Such economic issues, always critical to the Commerce Department, are becoming more and more important in the scores of bilateral negotiations that the government undertakes. But State's sophistication in coordinating the advocacy of market incentives by the Trade Representative, Commerce, the Patent Office, and others involved with economic rights will continue to be vital as negotiations proceed in GATT and elsewhere. For reinforcing rule-based competition, reducing unfairness in subsidies, and expanding many export markets -- tasks often conditioned by scientific advances -- State will need even more technological skill to undergird U.S. foreign economic policy. The cost of not providing such skill will be loss of hard-won technological advantages, hence reduced economic performance and weakened potential for international political leadership.

6.4 Gentlemen And Technocrats

This handful of cases underscores a deceptively simple twin truth running throughout every section of this review: there are international threads in almost all of the science and technology activities of the United States, and there are technical dimensions to almost every component of U.S. foreign political, economic, and social policy. Yet the government is just not fully equipped to cope with these trends -- what the White House's OSTP Associate Director Ratchford[6] has called "the rapid pace of change in both foreign policy and S&T ... in light of new global realities."

The State Department's culture -- its underlying tendencies and priorities -- has rejected, or at least resisted, transplants of technical skill. Unhappily, the reasons are elusive. But at the risk of some oversimplification, a key part of the explanation is that its culture has been grounded in the 19th-century tradition of gentleman diplomats: political, verbal, and linguistic ability have been valued more than technocratic, analytical, and strategic skills. Moreover, the senior officials in State have large (and largely thankless) obligations to pursue quintessentially political relationships, frequently at unexpected times set by political leaders elsewhere or by the White House. The mission agencies, in contrast, often tend to ignore (at their peril) the political elements of international relationships even as they try to respond ambitiously to the new technological opportunities and the new global economic realities. The tradition, incentives, and setting are a formula for complexity and incoherence.

From a practical viewpoint, for the 1990s the challenge for the mission agencies is to rethink what they do best, to recognize how the imperatives of international competition and cooperation mesh with their missions, to settle into more clearly defined lines of coordination with the foreign-policy-making machinery, and to declare more forcefully how priorities will be set when resources must be allocated to the international elements of their national responsibilities. The challenge for the Foreign Service is to sustain its skills, still essential, in traditional communications and political analysis while building a stronger base of scientific and technological awareness to support the activities of diplomats.

6.5 The Congress

What to make of the Congressional role in this arena? Of course, Congress is central. It has many mechanisms, such as hearings and investigations, for exploring the contending ideas about strategy-setting for science in foreign affairs. It appropriates funds, defines new standards, sets out goals, and frequently assigns new jobs for agencies to manage (often without adding new resources). Congress probably will continue to immerse itself more and more in foreign relations. The rationale is clear: international systems for health, trade, environment, monetary arrangements, population movement, space travel, and other matters affect the lives and jobs of American voters. The classic issues determining domestic elections will increasingly reflect international trends.

More thematically, many scholars and politicians have observed the continuing struggle between the Executive and Legislative branches over power in foreign affairs. This is hardly the place to review that historical debate in detail. Nonetheless, the Persian Gulf conflict of 1990-91 brought out again the endless tugging and balancing among American democratic institutions. The war also revealed the strengths of modern technology in complex organization, in logistics, in combat, and in the public diplomacy made feasible by instant worldwide information flows. Constitutional doctrine leaves ample ambiguity about Congress in foreign affairs, always producing elbow room and consequently much elbowing. Science and technology aggravate some ambiguities and resolve others.

Sometimes forthrightly and occasionally disingenuously, Congress asks that goals be articulated, and that it be informed and consulted, as in the Title V mode. The new complexities inherent in modern technological power exacerbate the chronic tensions long associated with formulating and implementing well-informed foreign policy in a democracy, so it is hardly surprising to see large potholes in the road of "consultative relationships" between the Legislature and Executive about international science and technology.

Compounding the problems of Executive management and Executive-Legislative consultation is the fragmented nature of Congressional committees. Multiple jurisdictions abound. The Congress rarely speaks with a single voice. Further, in hearings about foreign relations, science is on the outer circle, while in hearings on science and technology policy, international concerns often take a back seat. Hearings are held many times on every topic, and divisive voices express worry mostly about short-run winners and losers at home.

As noted earlier, budgets for any international effort are also in constant jeopardy. When domestic funding may be traded off against international purposes or when U.S. "control" may seem to be weakened by forming a partnership or coalition, many Congressional committees fall victim to the same growing perplexity as the Executive agencies. Yet which Congressional committees cover fields (energy, or environment, or health) that can be seen as "merely domestic"? Most programs carry global budgetary tradeoffs, and painful they are for U.S. science and its global partners. Moreover, because the public usually does not favor "international" projects -- and this critical attitude is growing, according to recent polls[7] -- Congress understandably reflects this view by budgetary cuts and micromanagement.

Genevieve Knezo, of the Science Policy Division of the Congressional Research Service, outlines the Congressional agenda in her periodic "critiques" of the State Department's annual Title V reports on Science, Technology, and American Diplomacy. She notes the statutory requirements and carefully comments on the reports. In 1988, for example, Knezo emphasized several shortcomings, among them the fact that "only selected items were discussed in any detail and the report does not identify criteria used for determining which federal agency programs, international agency programs, or current policy issues received attention."[8]

As most commentators note, Congress asks for historical accounts, but then complains when State's reports offer no evaluations or recommendations on key themes ripe for decision. In practice, as noted earlier, State's hands are often tied because of the sensitivity of many issues in interagency disputes on policy and money. Yet Congress does want State to collect and sift critical information on funding, personnel, training, and priorities for international programs across all agencies. How else can foreign policy be formulated? How else could Congress have a panoramic view? Congress is not insisting, of course, that the State Department build the capacity for writing an exhaustive catalog of everything that is going on. That probably wouldn't be read widely on the Hill. A better approach would be an insightful record of options, successes, and failures. But that might be either too embarrassing or too academic.

6.6 Congressional-Executive Interaction

The best objective would be a forward-looking "systems integration" of technical information with foreign policy recommendations. In this sense, Congress is correct: the Executive agencies together, coordinated by the State Department and OSTP, must do this integration and then, after obtaining funds, carry out negotiations and operations, reporting periodically on results. This objective, the underlying intent of Title V, could be met in a variety of ways. The CISET and the State Department planned a new approach along these lines, focusing on a few broad "themes," and the 1991 report reflects this revised format.[9] In fairness, however, it would be unwise for the single Title V reporting procedure to be held up mindlessly as a grading system for the international activities of the State Department and all other agencies. More flexibility is needed, and circumstances change too rapidly -- or too slowly -- for annual narratives and scorecards to be meaningful.

For improving Congressional-Executive interactions in this field, the crucial job now is simply to break a vicious cycle: State's performance as the hoped-for moderator of the Executive agencies' actions on S&T in foreign policy is inadequate, and this leads to a frustrated Congress being unwilling to reward these sub-par performances with added resources, which in turn further compromises the ability of all the agencies and of State to fulfill their emerging roles. Put this another way: with current policy and resources, the stated Congressional goals cannot be achieved. And with science and technology on the periphery of State and with international programs vulnerable in the mission agencies, Executive goals cannot be fulfilled, either.

As then-Secretary George Shultz put it in a compelling 1984 cable to all missions, "Foreign policy decisions in today's high technology world are driven by science and technology ... [so] in foreign policy we simply must be ahead of the S&T power curve,"[10] He had in mind not just State, but the entire federal government, including Congress.

The next chapter outlines recommendations for integrating science and technology in foreign policy and new organizational structures for ensuring coherence in the pursuit of national goals in this area.

7.0 RECOMMENDATIONS: COMMITMENT ACROSS GOVERNMENT

> A mission statement should not commit [an organization] to what it must do in order to survive but to what it chooses to do in order to thrive.
>
> -Russell Ackoff[1]

> The long-term outlook is for further increase in the role of science and technology in foreign policy.
>
> -George Bush[2]

There is, of course, never a single or permanently optimal solution to the problem of effectively organizing the U.S. Government. Styles and circumstances change too frequently. Several promising possibilities exist for improving performance in integrating science and technology into international affairs and U.S. foreign policy. Yet it would be folly to believe that the rising complexities of the 1990s can be addressed with no added effort, no restructuring, no shifts in resources. This section offers recommendations, covering both urgent steps and longer-range outlooks, along with explanations of how a new process might work. Senior officials undoubtedly will adapt these suggestions in light of their own preferences.

The upshot of the following discussion is this: the conduct of U.S. foreign affairs must be so organized that, as in chess, the whole board of domestic and international scientific and technological relationships can be seen at once. This will not happen overnight. But decisive steps must be taken, beginning with a strategy announced at the top. First, the main-line domestic agencies must see their international relationships as integral, not peripheral, to their missions. Second, the international elements of the programs in the agencies must be coordinated with foreign policy, in a lasting and thorough manner, by State. And third, State's traditional functions must expand to incorporate S&T as a mainstream, a sector important for most issues, not a sidestream or a mere technicality. In short, what is needed is a commitment across government to incorporate into operations the globalization that everywhere depends so strongly upon technological change.

Thinking about improved organization of S&T in international affairs and foreign policy can be grouped into five related clusters:

- Executive Office of the President: leadership on goals

- Mission Agencies: responsibilities for S&T action

- Department of State: integration and execution of foreign policy

- Supporting Capabilities in State: planning and analysis, advisors, and the development of human resources

- Congress: partnership in strategy and resources

7.1 The Executive Office Of The President

The Executive Office of the President, largely through OSTP, has recently accorded international S&T subjects a higher priority, as described earlier. Figure 16 illustrates the federal S&T policy organization. The White House councils related to international affairs in which OSTP officials are, and should continue to be, vital participants are clearly shown. To fulfill its international responsibility, it will be especially important for OSTP to concentrate on policy guidance affecting:

- "Technology policy" with respect to national economic performance in the international competitive context

- Shifts in national security R&D priorities

- Multilateral cooperation in science and technology with industrialized nations (e.g., knowledge- and cost-sharing)

- Opportunities for S&T-based initiatives with developing countries

- Cooperation on global issues

Earlier sections have touched on the first two topics. So, before going further, consider the role of Executive leadership in relation to the last two topics, and, in particular, the field of energy.

OSTP has a role, with the Departments of State and Energy, in considering national energy R&D in relation to international efforts on energy. It is essential for the United States to be alert to accomplishments elsewhere and to consider collaborations with others. For instance, the U.S. nuclear electric-generating industry -- accounting at present for about 20% of the U.S. supply of electricity -- is hostage to a severe nuclear accident anywhere in the world. The United States carries out R&D on safeguards against proliferation of weapons, on nuclear plant safety, and on waste disposal. The draft 1991-92 National Energy Strategy released by the President and the Secretary of Energy in February 1991 requires that civilian nuclear power development (and waste disposal) must be carried out in close coordination with international regimes, which in turn require highly sophisticated diplomacy.[3] Furthermore, the actual nuclear plant operating experience in major countries, such as France and Japan, must continue to be shared so that the best practices can be identified and adopted globally as economic growth multiplies demand for energy.

FIGURE 16: Federal S&T Policy Organization

Source: OSTP, the White House (1991).

Consider also the many R&D programs in the Department of Energy. In most, there must be international partnerships. This includes partnerships not only in the costly efforts to push ahead in the SSC, discussed earlier, but also in the more applied, yet highly advanced experiment moving to demonstrate fusion, and in the scores of smaller projects ranging from tests of solar energy to campaigns to enhance the public's awareness of and participation in conservation. Both less-developed and industrialized countries wish to cooperate with the United States in such R&D. For instance, the Department of Energy spends about $500 million per year on "critical technologies" such as those related to energy -- environment tradeoffs.[4] This work will become even more crucial for what is called "sustainable" global development. Because of the number and significance of such efforts, and because of public interest in them, often only the White House (NSC and OSTP) can be effective in delineating the national objectives in international terms.

Accordingly, as noted earlier, it will be crucial for one Associate Director in OSTP to continue to have the explicit "international" portfolio. This is the indispensable bottom-line requirement for OSTP's White House roles. In parallel, the other three statutory Associate Directors -- covering physical and engineering sciences, life sciences, and industrial technology -- must be alert to pursuing the international components of their responsibilities, as has been the recent practice. A few more professional staff in OSTP will probably be required for these assignments.

Moreover, for the Executive Office to provide leadership, there is an overarching and still-unmet need: to clarify and formalize the many crucial details of a new distribution of international responsibilities among the departments and agencies. Accordingly, the President, with the help of OSTP, NSC, OMB, State, and CISET, should begin a major review soon. The first step could be a directive to heads of agencies. Such a Presidential statement could call on each department and independent agency to review:

- The adequacy of the international office in the agency to handle technical issues

- The sensitivity of relevant parts of the agency to international developments and issues

- The quality of ongoing coordination with State, NSC, OSTP, and other agencies, taking key past cases as illustrations of problems and opportunities

- The adequacy of the government's technical personnel abroad to serve the agency's needs

- The resources and barriers along the path to strengthened performance linking the agency's S&T missions with U.S. international activities and foreign policy

In opening this government-wide review, the President should also encourage "mainstreaming" of international S&T issues in the programs and budgets of the mission agencies. As the review proceeds, over a period perhaps as long as a year, there would be detailed staff work involving OSTP, NSC, the Economic Policy Council, the Domestic Policy Council, OMB, FCCSET/CISET, possibly PCAST, and State. The EOP would then issue a follow-up statement establishing lines for policy, adjusting responsibilities, and setting the framework for coordination of programs.

As will be discussed more fully later, one consequence of this process will be clarity about State's optimal roles. But a key premise here is that the

Department of State should delegate more of its present operational duties to others. The National Science Foundation, for instance, almost certainly should be the lead agency for many basic science agreements (with exceptions such as medical science at NIH and high-energy physics at DoE). As various agencies prepare plans for pursuing programs and monitoring agreements, State would be relieved of many burdens that it is not best equipped to bear. On the chronically cantankerous subject of fisheries, to cite an example, the detailed work now done by State might be transferred to the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). At the same time, many of the major agencies -- such as the NIH and Agriculture -- already have mature programs, and they need greater flexibility, even within fixed resources, to operate internationally. The proposed Presidential review would develop a coherent plan for this new framework.

Finally, White House leadership is needed on the personnel front. The OSTP should launch, through CISET (and with the cooperation of federal personnel executives), a feasibility study of a multi-agency "International Science Service." Such a service would facilitate movement of skilled personnel between agencies. The career structure for those with interest and expertise serving mostly outside the United States would be akin to both the domestic Senior Executive Service career system and the Senior Foreign Service.

The aim would be to set new incentives for entry and more visible rewards for distinguished work in international efforts throughout the federal government. In this way, the development of human resources to fulfill international S&T roles and missions would be encouraged. Practical difficulties, in law and in management, would have to be surmounted. But the present uncoordinated staffing systems, ranging from ONR and Commerce to NASA, Agriculture, Health and Human Services, and AID, must be reevaluated. An International Science Service could become one of the most important action -- symbols of the integration of science and technology with international policies and programs.

There is, in addition, an especially thorny issue of conflicting interpretations of Executive Orders on posting technical staff abroad. This issue, discussed later, could be resolved best through overall evaluations of both the missions and the related human resources that must be committed across the government.

7.2 The Mission Agencies

The programs among the mission agencies are so far-flung, and are being internationalized so quickly and so relentlessly, that it would be impossible to assess every agency in detail here. Yet this is where the action is, and it is possible to make three main observations.

The first regards staffing. As a baseline, Figure 17 gives rough counts (1990) for a few of the key agencies that have substantial "international bureaus." According to the State Department, many of these offices were established or enlarged because of State's inability to respond adequately to the international opportunities, concerns, and goals of the various agencies. Most of these personnel allocations have not been planned with a view of international programs as a whole. Note that Defense and the intelligence community are not included in Figure 17.

FIGURE 17: Size of "International S&T Bureaus" in Selected Departments and Agencies

For the future, both in Washington and in the field, the mission agencies will probably continue to expand their international groups. In Washington, for example, the Environmental Protection Agency has recently added about 40 staff who are concerned with several aspects of global climate change and the cooperative initiatives aimed at containing environmental damage at the international level. There are likely to be similar needs for added international staff at NASA, NIH, and DoE.

In the field, however, there are crunching conflicts about the personnel ceilings at embassies. Two key Executive Orders contradict each other, putting everyone in a bind (Figure 18). One policy encourages greater international efforts in S&T, and the other discourages posting more staff abroad. NSDD-38, in particular, has become a major roadblock. Figure 19 illustrates the interagency issues faced by those caught in this bind. Here again, an incomplete and contradictory strategy for S&T in international relations as a whole frustrates implementation of policies that otherwise may be desirable. Only a White House-level review, as suggested here, can resolve dilemmas on such issues and set a clear path for needed action.

FIGURE 18: Executive Directives Regarding S&T Personnel Abroad

The rules governing assignment of non-Foreign Service staff respond to multiple -- and sometimes divergent -- national objectives. With respect to science and technology, several objectives come into conflict.

One objective is to increase access to foreign science and technology. This was expressed in Executive Order No. 12591, "Facilitating Access to Science and Technology," signed by President Reagan on April 10, 1987. It intended to ensure "... that the United States benefits from and fully exploits scientific research and technology developed abroad." The Executive Order instructs the Secretary of State to "... develop a recruitment policy that encourages scientists and engineers from other federal agencies, academic institutions. and industry to apply for assignments in embassies of the United States." It directs the Secretaries of State and Commerce and the Director of the National Science Foundation to devise a mechanism for prompt and efficient dissemination of science and technology information developed abroad.

A second objective is to contain costs and to ensure, under the authority of the State Department, overall coordination of activities by federal personnel in other countries. This is governed by National Security Decision Directive No. 38 (NSDD-38). NSDD-38 was first issued June 2, 1982, and confirmed on January 30, 1989. Its provisions were further affirmed in a memorandum from President Bush on July 12, 1990. Instructions from the State Department during 1990 identified key points:

- Chiefs of Mission have the authority to make decisions on formal requests from all agencies for any change in the size, composition, or mandate of mission staff.

- The Administration and Department of State are determined to resist staffing increases in overseas posts.

- The agency requesting a change is required to identify offsets to the addition of new staff, and the Chief of Mission should seek to identify other positions in his or her mission that could be abolished to offset the staffing change.

A final objective is the safety of U.S. Government employees working abroad. Assuring a working environment secure against terrorism and other threats limits placement abroad.

Source: State Department (1990) and National Science Foundation (1991).

FIGURE 19: Interagency Issues in Expanding International S&T Missions Abroad

According to accounts of the experience at several agencies, and confirmed generally by many observers, important issues need to be addressed in the wider federal context with respect to US global interests in science and technology.

- The central issue is the appropriateness of the State Department unilaterally making decisions that affect the ability of other agencies to allocate resources internationally in order to fulfill their missions. A government-wide strategy is needed.

- A related issue is the ability of the State Department to distinguish between its foreign policy mission vis-a-vis other national interests. For example, while science and technology, per se, may not be a high priority within a given embassy's mission, taking advantage of science and technology worldwide is a major concern of the U.S. Government.

- A third issue is the appropriateness of requiring another agency's personnel to adopt reporting practices that conform to organizational divisions (usually with a geographic focus) within the State Department. The missions and interests of S&T-related agencies typically cut across geopolitical lines.

- Fourth is the question of costs and compensation. If the Department of State has subsidized the costs of accommodating personnel from other agencies, the appropriate solution must lie with a system that clearly accounts for and prorates all expenses billable to other agencies.

Source: Adapted from Marta Cehelsky, unpublished case study, February 1991, prepared for the International Steering Group of the Carnegie Commission on Science, Technology, and Government.

A second observation, and a promising line for enhancing the effectiveness of science activities in foreign affairs, concerns the interagency Process. The process involves policy setting and resource allocation.

In the early 1980s, under the NSC system, among the Senior Interagency Groups (SIGs) established were three led by the Department of State, These were in the fields of Export Control, Telecommunications, and Arms Transfer. State-led management of the interagency process permitted State to retain command of what it does best -- providing the international "face" of the U.S. Government abroad, while incorporating the advice and cooperation of mission-oriented agencies. An "appeal" process allowed disputes to work their way up through the NSC system, with the President as ultimate arbiter. The SIG process enabled the resolution of virtually all but the most contentious and politicized questions at that level. The structure of subcommittees and working groups chartered by the SIG was highly effective at implementing interagency decisions reached at the SIG level. Such an arrangement could work equally well for science-related activities. It could be conducted through the President's Science Advisor -- perhaps reporting through a Cabinet-level committee, such as FCCSET, that could adjudicate, or pass on to the President, an issue for final decision. The White House Science Advisor has already taken steps in this direction through CISET.[5]

On resources -- for each individual agency's ongoing programs as well as for interagency negotiations in the annual budget review -- the OMB should work with OSTP to "legitimize" international S&T programs. Rather than viewing most international efforts as justifiable only in terms of their domestic origin or benefit, OMB should assess the larger international interests and purposes into which S&T programs fit.

For example, building long-term cooperative S&T relationships with Eastern Europe, or with Africa, is a goal that the NSF, NIH, and NIST find hard to justify in competition with their domestic missions. But these agencies need international partners, and the countries involved need U.S. expertise. The agencies can pursue modest science-intensive efforts in ways that AID usually cannot, with professional networks State does not possess, and over the time-periods required to make a difference, all helping U.S. foreign policy (a "win win" result). As another example, NSF's general support of the National Academy of Sciences' links with the International Council of Scientific Unions -- it is, inter alia, a key clearinghouse for analysis of global climate change -- is always endangered by the budgetary pressures on NSF's disciplinary divisions, which have many worthy research grants with domestic principal investigators waiting for funding.

The point here is not to deny that tight budgets mean economic choices. The point is to underscore the credibility of the fact that international S&T purposes are integral to the "domestic" agencies. That is what "mainstreaming" international S&T must be. Yet the interagency outlook on budget preparations has always carried the opposite message: international work is secondary, sidestream, an orphan. Only an interagency budgetary cross-cut, with the authority of the OMB and OSTP, can bring legitimacy to the idea of national programs conducted internationally.

Finally, then, what is needed is much more detailed differentiation of responsibilities to clarify the cloudy international roles of the mission agencies. An insightful federal career officer has pointed out that "international science and technology policy is made, de facto, by the operating technical agencies. A principal set of problems is to aggregate and bring some measure of coherence to separate de facto agency policies so that: (1) they can better serve the national interest, however defined; and (2) complement and reinforce, rather than be in conflict with, the science and technology-related activities and responsibilities of the State Department."[6] Of course, this thought applies primarily to the goal of improving policy for international S&T.

The Presidentially authorized review, recommended first, should more firmly set the precise operating responsibilities for the mission agencies and reestablish State as the foreign policy planning, guiding, and coordinating agency. Every agency, of course, would retain its line responsibilities for the funds appropriated to its designated programs. At State, this clearly includes development assistance and security assistance, both of which would benefit from other agencies' S&T expertise. In most agencies, however, international policies and funding are quite diverse. For instance, despite Commerce's extensive work on international S&T-related responsibilities -- from oceans to the census, and from the atmosphere to forbidden exports -- there is no single office in Commerce overseeing all international efforts.[7] Sorting out such lines of differentiation within each agency and across all agencies will foster, in turn, clearer public and Congressional understanding of the interests, programs, and funds that reflect U.S. foreign policy goals. Only after clear responsibilities have been set can the key specific problems in the domain of international S&T be resolved decisively.

7.3 The State Department

For the State Department, at least three new organizational paths are desirable. Before discussing these, it is only fair to acknowledge again the deeply ingrained cynicism, perhaps hopelessness, voiced in some quarters about State's "growth potential" in science and technology.

As outlined earlier, high-level proposals to strengthen science in State have been made for forty years, with only modest gains to show for the campaign. Along comparable lines, many note, State actually has lost clout in economic policy over the past generation to Treasury, Commerce, and the Special Trade Representative. Thus, so the argument goes, if any technological issues must be dealt with more fully in international contexts, don't go to State, go to the individual mission-agency powerhouses. Further, perhaps it would be best (or at least easier) to add a "mini-foreign ministry" to every Cabinet department. The nucleus of exactly such an organizational format already exists and is growing.

It would be easy to let the present centrifugal forces dominate, but the resulting pattern would not be healthy pluralism. Indeed, the likely outcome would be embarrassing at best and disabling at worst. The President doesn't want three separate agencies visiting Tokyo, without coordination, to request major funding for their individual programs. Agencies shouldn't negotiate varied terms for intellectual property rights. The nation can't go to GATT with multiple viewpoints on selling computers and related services. Agriculture, Energy, AID, and EPA shouldn't arrive in Brazil for the 1992 United Nations Conference on Environment and Development with "independent" U.S. positions. True enough, these tendencies exist: the interagency disputes are sometimes so bitter that the international negotiations seem simple. In this connection, State's office of the Assistant Secretary for International Organizations plays a key role in setting the terms and selecting the delegations for many negotiating forums; but its S&T competence, as with most offices at State, is modest.

The only way to resolve the problems created by domestic pressures on foreign policy is to ensure that State's staff becomes, in the judicial system's sense, a "special master" helping the Secretary and President (with their senior staffs, including NSC and OSTP) to judge the issues and resolve differences among the agencies about "the national interest. The recent strengthening of FCCSET and CISET goes some way toward creating such a unifying analytical mechanism, but much more must be done.

RETHINKING STATE'S RESPONSIBILITIES

The following three complementary steps depend upon rethinking the Department's organization for science and technology. Taken together, ambitious as that would be, implementing these recommendations will prepare State for 21st-century international relations.

Science and Technology Counselor to the Secretary

One path is the creation of a new senior post, Science and Technology Counselor to the Secretary (and Deputy Secretary) (Figure 20). It has been considered briefly in the distant past, and even implemented sporadically, but because of the generally low priority accorded by State to science, the idea was rarely taken seriously.[8] There are, nevertheless, persuasive arguments in its favor. Most important substantively, the Science and

Technology Counselor would press for, and indeed undertake, high-level cross-cutting reviews of new or continuing issues to provide the best advice on scientific and technological dimensions of foreign policy issues that reach the office of the Secretary. The idea also has the appeal of organizational symmetry with the White House's Assistant to the President for Science and Technology. It would confer welcome visibility on the subject of science on a Department-wide basis. For the long run, it would aid the recruitment of technical staff for many bureaus and foreign posts. It also would serve as a point of contact for the diverse technical communities inside and outside government, especially the private sector's technologically intense economic interests in foreign policy.

FIGURE 20: Science and Technology Counselor to the Secretary of State

This recommendation reflects a top-down approach to providing central S&T policy advice for Department-wide coordination at the level of the Secretary.

Because of the special nature of S&T and its pervasiveness in decision making throughout the State Department, the requirements of S&T policy formulation cut across the Bureau structure. Significant S&T considerations come within the purview, for example, of all four Under Secretaries, at least twenty Assistant Secretaries, the Counselor, Director for Policy Planning, Legal Advisor, the Representative to the Organization of American States (OAS), and the Director of the Bureau of International Communications and Information Policy. Common S&T threads need mutual reinforcement and synthesis. Fully pursuing the approach would entail:

1. Appointing a Counselor for Science and Technology with a small professional staff in the Office of the Secretary.

2. Possibly appointing an International Science and Technology Advisory Committee of well-qualified citizens reporting to the Secretary.

3. Creating an International S&T Coordinating Committee at Assistant Secretary/Director level, chaired by the Counselor for S&T, to facilitate coordination of S&T-related policies and programs within the Department.

The Counselor for S&T would perform the following principal staff functions:

- Advice: to the Secretary and his principal staff (other functions follow from this key role)

- Policy: help formulate foreign policy involving S&T

- Liaison: with the President's Science Advisor and the Office of Science and Technology Policy, and with diverse outside S&T groups.

- Coordination: on S&T-related activities within the Department, and chairmanship of the Committee on International Science, Engineering, and Technology (CISET) of the Federal Coordinating Council on Science, Engineering, and Technology

- Implementation: e.g., tracking the implementation of S&T-related policies and preparing the Title V report

- Early warning: alerting the Secretary to significant developments in S&T and their foreign policy implications

- Emergencies: cooperating with foreign governments in responding to emergencies such as environmental threats and natural disasters

One of the most compelling elements of the case for the new post is the powerful resource and symbol -- that is, an intellectual asset and an organizational boost -- it would become for S&T in foreign policy. After all, the President has direct interaction with his Science Advisor. Strong Presidential interest in S&T was reflected in the decision to elevate the post of Science Advisor, to reestablish a Presidential Council of Advisors on Science and Technology, and to give a high priority to S&T in annual budget submissions. The President meets monthly with his S&T Advisors, and the Science Advisor participates daily in the morning meetings of the senior White House staff. The Secretary of State should realize similar benefits from a comparable top-level S&T structure in the Department.[9]

In the past, then, why didn't the Department find such a position useful? Most recent Secretaries have devoted enormous time to the international travel demanded by sensitive negotiations and sudden crises. Many have had neither the time nor the inclination for day-to-day management of the Department's operations or for the typically less-urgent, cross-cutting functional issues such as science and technology. These duties usually go to the Deputy Secretary, whose small staff's in-boxes (and now E-mail) have always been overflowing. Other sectors (such as population or terrorism or information management) have also claimed a need for special rank and access, so bureaucratic channels have been competing, as usual, for policy attention. Furthermore, the OES Bureau has, in fact, assembled a substantial portfolio and staff for its "line" role as a special sector; over the years, it has successfully struggled for greater access to the top echelons. Given these realities about the actual dynamics and traditional stresses in the Department, some believe that even a very able Science and Technology Counselor, in an essentially "staff" role, might be isolated and ineffective.

There are other reasons for careful analysis of the situation. The "products" of the State Department and of foreign policy can generally be seen as political process and agreement: that is, they are largely intangible in comparison with the "products" of, for example, Health or Defense. There is also no organized research program serving the State Department, and thus no naturally recurring operational line responsibility for a "chief scientist." In contrast, the White House S&T office is perceived as having a measure of line responsibility for the character, level, and policies of the entire $75 billion federal R&D program (in addition to providing "staff" assistance to the President). In State, the critical "line" roles are the regional bureaus and ambassadors, the political core of foreign policy.

On balance, despite these concerns, the case for a Science and Technology Counselor to the Secretary (and Deputy Secretary) has considerable merit because of the growing importance of major policy issues with technological dimensions. The position could be filled in either of two ways, as has, in fact, the OES Assistant Secretaryship in the past. One selection could emphasize a distinguished "insider" presumably drawn from the ranks of well-qualified science counselors (or S&T-savvy career ambassadors) who have served in several embassies. If this were done, the individual would presumably know how to navigate the straits of Foggy Bottom. This arrangement would also reward the career staff, in a way comparable to the recognition of career officers who have served as Under Secretary for Political Affairs. However, it may be preferable to fill the post with an outside scientist or engineer. In this case, the individual might be selected from a slate of top-flight candidates prepared by the National Academy of Sciences and National Academy of Engineering, and screened by the Secretary of State with assistance from the White House's Science Advisor and Personnel Office. An outside appointee would bring not only powerful expertise in whatever fields are most important at any time (such as environmental and energy issues in the early 1990s), but also sensitive awareness of the broad U.S. and international scientific networks, including professional societies, business R&D alliances, and universities.

Whatever the background of the incumbent, the OES Bureau would remain -- and, as will be discussed, must be strengthened -- as the major operational unit for S&T activities. Indeed, given the OES group, only a small staff would be needed by the S&T Counselor, whose role would be high-level advice, not operational input.

Line Management for Science and Technology in Planning

For the Department as a whole, a second and complementary path for change is to emphasize the integration of S&T with existing "line management." In doing so, it is important to distinguish the groups concerned with planning from those involved with political and operating functions. A possible reorganized structure, reflecting these and other considerations, is shown in Figure 21. (The present organization is shown in Figure 7.)

A key point of this concept is the integration of science and technology (OES Bureau), with economics and business (EB Bureau). Modeled on one of the 1975 Murphy Commission's themes, this combination reflects a likely, some say the most important, thrust of foreign policy for the 1990s and beyond: the unification of economic and technological planning with foreign policy. In any case, this merging respects the realities of what goes on in most missions around the world.

FIGURE 21: An Alternative Organization for the State Department

The proposed structure also resembles State's informal "paper flow" chart (Figure 22) published in State's magazine for August-September 1990. It reflects the relationships among Assistant Secretaries and Under Secretaries that evidently had been effect since the fall of 1989. However, in contrast to the formal and informal lines today, the proposal here has the functions of Policy Planning, Intelligence and Research, and Telecommunications coming together into a central staff with Economics and S&T, all under one Under Secretary. This permits a consolidation of the most S&T-intensive topics. For integration of science in policy, this organizational approach provides a powerful base for analysis and planning. It must be noted that the "policy planning" function for some years has focused largely on comparatively short-range, if highly significant, issues; a point here is to establish a new unit for such urgent "current policy" work and to consider separately and independently the requirement for longer-range plans as well.

This organizational approach encompasses much else in addition to S&T. It puts the roughly 35 present units into four main clusters. For illustrative purposes there are also three key staff functions (Current Policy, Executive Secretary, and Counselor), two critical "liaison" units (Legislative Affairs, and Public Affairs), and the Inspector General (who must report to the Secretary). In this connection, and to repeat, the sensitive tasks (such as organizing the 1991 Middle East peace talks in

Madrid, and preparing speeches and policy papers) now carried out by Policy Planning might be continued by the Counselor's office or the Current Policy unit shown in Figure 21.

The Under Secretary for Political Affairs would coordinate all regional bureaus and embassies -- the core political functions -- as well as other closely related tasks and arrangements with international organizations. The Under Secretary for Development and Security Cooperation would integrate development assistance, security assistance, nonproliferation, and arms control planning. These two Under Secretary roles are, in a sense, group vice presidents for operations.

Such a sweeping proposal should not be interpreted as deriving only from evidence in this review, which is focused on science and technology. But it does emerge from trying to see where best to place technical skills in the service of foreign affairs.

A wholesale reorganization raises a thicket of legislative and political issues. Among these issues would be bringing the Agency for International Development (AID), the United States Information Agency (USIA), and the Arms Control and Disarmament Agency (ACDA) more squarely "back into State." Yet their present reporting relationships (the dotted lines in Figure 7) are often ambiguous, and their consolidated planning often is fragmented. For the future, foreign policies guiding these agencies must be framed with full awareness of the many long-range S&T strands affecting their work and the integration of their goals and programs. The early 1990s is a time to ask how the institutions at home must change in order to seize the dramatic new opportunities abroad -- and, to be more specific, how better analytical capabilities at headquarters would permit better results in the field.

FIGURE 22: "Paper Flow" Chart, Department of State

To give an example, AID's annual budget of about $6 billion for "development assistance" includes at least several hundred million dollars for explicitly S&T programs. Yet both Congress and senior State/AID officials concede that the debilitating combination of heavy legislative earmarking with obsolescent strategies of "foreign aid" means that the time has come for a new approach to development cooperation in foreign policy for the 1990s. (A separate CCSTG Task Force is examining issues of development in detail.)

Similarly, the roles of ACDA are likely to change as arms control moves away from preoccupation with lengthy superpower negotiations on a few major strategic systems. Instead, there are worldwide concerns with genuine disarmament and with braking the proliferation of many kinds of weapons. As a matter of policy, the U.S. and the other major industrialized democracies will be encouraging the developing countries to shift funds away from military spending and toward economic and social purposes.[10] All of these new security imperatives demand full understanding of their S&T dimensions.

Recall that the principal idea emphasized in this option -- i.e., the new grouping of S&T with economics and with other planning, shown on the left of Figure 21 -- would not inevitably require all the major changes shown. The purpose of presenting the broader organizational recommendation is to underscore the nagging question: how best to manage S&T in the complex operations of foreign policy for the 1990s and beyond?

Strengthen S&T in Other Bureaus and Selectively Enlarge the OES

A third recommendation, overlapping many considerations of the first two paths, recognizes that the present statutory constraints make it difficult to carry out any reorganization, much less a major one. Yet the Department can improve its capacity for S&T in many incremental ways. Within this overall recommendation about the OES Bureau's present functions, there are three actions: selectively expand OES; restructure other bureaus to include S&T expertise; and transfer certain international operating functions to other agencies along the lines that would flow from the Presidential review and decisions recommended earlier.

Largely independent of any reorganization at the top of the Department, there is ample justification during the next 2-5 years for an increase of, say, 20% in OES's professional staff (now about 110) in Washington. One reason OES needs to be fortified is that, realistically, the White House's OSTP cannot and should not take on the day-to-day duties of overseeing the interactions among all of the agencies' growing international S&T agendas. State and OES must meet the challenge of assisting in the formulation and execution of policy guidance.

For example, it is plausible to imagine OES adding five staff working on the environment and energy, three on long-range trends, two supporting a renewed State advisory committee (which also could be done by a new S&T Counselor), five strengthening links with multilateral institutions, three focusing on developing countries, and five assisting in interbureau analytical work. Of course, a top-level reorganization of the Department (and any associated shift in priorities for OES) would alter this sketch. If OES spun off even more of its detailed operating tasks to the mission agencies -- as would be desirable -- some present staff should be reassigned to more policy-sensitive tasks that are now neglected.

Equally important, virtually all of the other major bureaus of the State

Department in Washington need at least one full-time S&T professional to facilitate Department-wide policy reviews. To prepare negotiating strategies, and to carry out planning, it is simply no longer possible for the Foreign Service to be largely oblivious to technological trends.

In the field, there is a case for adding up to 50 additional science officers. Many embassies would benefit from expert technical staff. As the government comes to terms with a long-range plan for each agency's goals, it will be clearer how much State staffing will be placed where, and who is accountable for what. Some of the additional field staff could come from other agencies -- and might form the nucleus of the International Science Service that was outlined above.

In general, the premise here is that providing more technical staff to embassies will produce benefits similar to those evident in sending more Science and Engineering Fellows to the Congress: anticipating likely consequences of technical change and answering specific technical questions will be done more effectively and quickly.[11] An especially critical point is to ask each ambassador for a thorough evaluation of "the country market," i.e., to review S&T needs in each mission now and for the future -- and then to restructure all staffing from all agencies, with special attention to the rising interest in the roles for American science and technology. Just as State needs more professional expertise in Washington, the ambassadors need skilled assistance in their country programming.

Since there are severe budgetary strains on the federal government, it may seem astounding to propose adding up to 75 professionals -- 25 for OES and other bureaus in Washington and 50 in the field. But the State Department is starved for staff. Indeed, as long ago as 1976, when T. Keith Glennan submitted a report on "Technology and Foreign Affairs" to Deputy Secretary

Charles Robinson, the carefully documented verdict was that OES was "woefully undermanned."[12] Although the staff has increased by about 10% since then, it has not grown nearly as much as or in the ways that Glennan recommended. The enlarged responsibilities -- the result of the rapidly changing foreign policy challenges of the 1990s -- have grown much faster.

RESOURCES TO SUPPORT ORGANIZATIONAL IMPROVEMENT

Overall, the three lines of change recommended above for the Department of State lead inexorably to the requirement for the Department to ask for new supporting resources. State should invite Congressional backing for the initiatives to build the substantial S&T capabilities that Congress itself has demanded:

- Providing the capacity for analysis and planning

- Building a vigorous advisory apparatus

- Adding funding and incentives for human resource development

Analysis and Planning

For analysis and planning, the State Department needs to deepen its organization in several related ways. First, it must focus on the major likely trends, looking ahead 5-10 years. This must be accomplished to meet the Title V mandate. Moreover, it is a task akin to preparing the "Global Problems" list envisioned by Murphy and to the "technological planning" outlined by Glennan. A substantial in-house effort must be mounted and sustained, involving the active participation of senior officials. The resulting reports should be released for expert criticism, Congressional review and hearings, and public debate.

A second related task is to launch a dedicated long-range planning effort outside government, using external research funds from the Department. Just as most agencies employ outside analytical groups to supplement their in-house planning, State and OSTP might, for example, commission the National Research Council to establish a new Board on S&T in Foreign Affairs. There are already precedents for this in the NRC's Board on Science and Technology for International Development (BOSTID) and the recently established Board on Science, Technology, and Economic Policy (STEP). The NRC complex also has an Office of International Affairs with units covering many technical fields and geographic areas such as Japan, China, and Eastern Europe.[13]

Such groups at NAS, NAE, and IOM make valuable contributions by studying broad themes over one or two years as well as by being ready to assist on an urgent basis whenever critical issues arise. State's internal staff would be responsible for managing the external studies and integrating them into the Department's planning with OSTP. Tasks might include the analysis of worldwide energy trends in relation to foreign policy; the organization of regular briefings and courses on S&T for diplomatic officials; and long-range assessments of fields such as telecommunications, biotechnology, and environmental agreements, all with their specific consequences for U.S. international interests. Moreover, to enhance the public debate on such topics, OSTP and State should accept the recommendation of Alexander Keynan that the NRC hold an annual or biennial convocation to review trends in international S&T collaboration.[14]

Third, and closely related, the Department needs the flexibility in funding to carry out a variety of special studies on topics that need either rifle shot expertise or patient exploration. Today, unlike the situation 25 years ago, there are essentially no funds for such purposes. Individuals from the academic community participate, of course, in an ad hoc way in many State Department projects; groups such as the American Association for the Advancement of Science (AAAS) have worked with the State Department on topics like arms control and regions such as China and Africa. But there is little or no concerted research sponsorship to build and maintain a broad-based, national intellectual infrastructure required for deepening the understanding of the themes reviewed here.

Comparatively modest funding for these three analytical activities (perhaps $10 million per year) would bring large benefits. No matter how gifted and experienced diplomats may be, many problems require sustained attention by specialists.

Vigorous Advisory Apparatus

To reinvigorate the advisory apparatus in State's OES Bureau, four steps are essential: (a) reconsider the membership of the Advisory Committee and arrange appropriate coverage of contemporary fields and issues; (b) provide for a dedicated secretariat, for full-day meetings scheduled at least four times per year, and for the formation of subcommittees to carry out studies; (c) arrange in-person, regular exchanges and follow-up consultations by the Advisory Committee with the most senior officials -- including the Secretary -- to enable an informal exploration of the context for framing central, Department-wide questions, short and long-term, for advisors to try to answer; and (d) ensure some continuity in the information provided to panels of specialized advisors about how policies are working and what new problems are encountered. Modest funding is essential.

None of these steps has been taken during recent years. As a result, the Advisory Committee is essentially moribund. This is just another remarkable symptom of how the Department's senior appointees and career officials lack the well-tuned, reliable, and trusty antennae for S&T that serve almost all other S&T-pertinent Executive agencies. Building the advisory apparatus will strengthen both the planning activity and the interagency coordinating functions mentioned above. Many of the advisors will assist directly in information-gathering and quality controls on analysis of policy issues. They will also provide indispensable human ties to a wide variety of other institutions and individuals that State should deal with.

As the larger organizational changes are adopted -- such as the three major paths outlined earlier -- considerable power will be gained from the regular use of an Advisory Committee. For example, there is a parallel between the S&T advisory mechanism proposed for the Department of State and the S&T advisory structure serving the White House.

Advice to the President has three interrelated components: the Assistant to the President for Science and Technology; the President's Council of Advisors on Science and Technology; and the Federal Coordinating Council on Science, Engineering, and Technology. To coordinate within the Executive Office, the Science Advisor chairs a senior White House staff committee on S&T that reports jointly to the Domestic Council and the Economic Policy Council. The Office of Science and Technology Policy, headed by the Science Advisor, provides staff and analytical support to this entire structure. Similarly, a State Department Advisory Committee -- especially when linked to a senior official, such as an Under Secretary or the proposed Counselor for Science and Technology -- would respond to the Secretary's or Deputy Secretary's requests and initiate studies in areas of foreign policy significance. It would convene ad hoc panels for in-depth examination of particular subjects. Use of the Advisory Committee would provide the Secretary and other senior diplomatic officials with broad-gauged assessments of critical issues involving S&T in foreign relations and a longer-range, coherent view of S&T in foreign policy that should combat the effects of bureaucratic inhibition and fragmented responsibility within and outside the Department.

Human Resources Development

For the long-term development of human resources within the Department, arguably the only path to lasting improvement over 10-20 years, many actions are needed. A few are already under way and will produce immediate benefits, among them the effort during the late 1980s to raise the visibility of S&T officers in the formal personnel system of "cones" for advancement. Others are likely to pay off within several years, certainly within a decade. This longer-range effort is the best way to "change the culture" in the State Department.

At the Foreign Service Institute, for example, short and long courses (i.e., one day to one month) on S&T should be reinstituted and should be planned to include a structured syllabus. The basic objective is to raise the general level of scientific and technological literacy among all foreign service officers (FSOs). The idea is to enhance their sensitivity to the S&T dimension of foreign policy issues, to illustrate the ways in which technical trends affect international affairs, and to demonstrate how FSOs in their regular work can and should seek technical advice most efficiently whenever they need it. Some courses would be optional. Others should be mandatory, so that all FSOs receive at least a modicum of technical review every year or two, perhaps for at least a week when changing assignments. (Keeping abreast of changing technologies, after all, has become as important as learning languages in international affairs.) Outside faculty could design and conduct most courses. Over a few years, a bank of basic tutorials and case studies could be developed for use by anyone in the Department. Funding for this purpose, now minuscule, must be increased, and senior State management must "bless" this effort visibly and continuously.

More extensive exchanges of personnel also should be arranged with industry, with academe, with federal and state agencies, and even with other governments. To conduct such exchanges, funds will be needed for advertising, selection committees, and professional support such as subscriptions to journals, travel to conferences, and access to computers. There are many reasons for nongovernmental professionals at various stages of their careers to be interested in a 1-3-year stint in Washington or abroad. These reasons include the growing need for international experience by midcareer business executives, the desire by academic scholars to participate in policy analysis on-line, and the growing ambitions of state governments to extend their foreign commercial and cultural links. The point is to ensure fresh air from outside and the evolution of advanced skills inside, creating among generalists and specialists a deeper awareness of goals and methods in contemporary technology relevant to international affairs.

Finally, let it be noted that there are long-standing personnel disincentives within the State Department associated with posts in science and technology. These posts were not seen as being on the route to the top. Such disincentives must be junked. To be blunt, the Department needs more specialists: diplomacy cannot be conducted well by generalists alone. The career incentives, in fact, have been improved slightly over the past decade. After all, two recent Assistant Secretaries for OES were career FSOs, achieved further distinction, and apparently are glad to have had the OES experience. As Foreign service selection opens up to scientists and engineers, decisions on assignment must continue to offer recognition to those who pursue the important goals mentioned here.

In short, the highest officials in State must make clear the priority they place on the long-range "cultural" changes in human resources that are necessary if the Department's efforts in science and technology are to reach the standard of excellence maintained so long and so well in the traditional political functions of diplomacy.

7.4 The Congress

For Congress, the overarching issue is how to improve two-way communications with the Executive agencies and, then, how to establish a working consensus on reasonable expectations for managing S&T in international affairs.

The present gaps for the State Department are exemplified by the conflict between the exacting Congressional demands exemplified by the Title V legislation and the Congressionally imposed budgetary constraints that inhibit the Department's attempts to meet these demands. The challenge for State is to continue to pull together integrating ideas for S&T in foreign policy and pursue them with sufficient depth and authority to justify added resources.

On the one hand, there is little evidence that Congress has ever explicitly rejected any strong S&T-related foreign policy priorities established by the Executive agencies. Yet with only a few exceptions -- in 1979 with the

Title V legislation, and in 1989 with Congressman Lee Hamilton's penetrating Task Force's proposals about reforms in foreign assistance, for example Congress also has not confronted the need for major conceptual changes in America's international efforts for the 1990s. In fact, specific international research partnerships are usually not welcomed on the Hill if domestic jobs or contracts might be lost. Larger global issues -- such as the environment or developing countries -- are subjected to repeated reviews by many committees whose jurisdiction is comparatively narrow. Further, as noted earlier, the science-related committees rarely focus on foreign policy implications, and vice versa. (A Task Force of the Carnegie Commission on Science, Technology, and Government is producing reports on S&T and Congress; in Science, Technology, and Congress: Expert Advice and the Decision-Making Process, the creation of a Science and Technology Study Conference is recommended, an ideal way to begin to get a handle on international themes.)

From the crucial viewpoint of appropriations, the overall "international affairs" budget is chronically under pressure. This may worsen because of rising domestic demands, persistent deficits, and new requests for aid to Eastern Europe and to the nations that used to constitute the Soviet Union. The public favors cuts in most international programs. This pattern of budgetary stringency has many effects. It undercuts AID programs and seems to make it almost impossible to reverse the generation-old inertial forces in much of the international affairs appropriation. This appropriation was about $20 billion in 1991, as shown in Figure 23 -- of which State's own share was about 20%.

It hardly needs to be added that tight domestic research budgets also limit long-range international partnerships. Domestic science has pressing needs, and multiyear commitments abroad are not feasible. But many agencies would spend at least modest additional sums on international efforts, even with constant budgets, if they did not fear the possibility of any nondomestic project being cut almost arbitrarily.

There will have to be frank talk over many months among Legislative leaders about the policy options and organizational weaknesses reviewed here. Congress will have to make decisions about the resources required to carry out its mandated search for a strategy governing international S&T and for a foreign policy anchored in relevant technical data. Two steps should be taken to prepare and support Congressional thinking.

One step is to call upon the Congressional support agencies, especially the Office of Technology Assessment (OTA) and the Congressional Research Service (CRS). Both agencies have strengths in the needed fields, and both have demonstrated their ability to integrate national with international lines of science and technology policy, though more capability is needed (see Science, Technology, and Congress: Analysis and Advice from the Congressional Support Agencies). CRS senior staff were pioneers, during the 1960s and 1970s, in calling attention to the growing Congressional requirements for better technical information; and in these early studies, international issues and cases figured centrally. The Science Policy Division of CRS no doubt is again ready to fulfill such a role today. OTA has been developing a series of distinguished reports on many of the subjects touched upon here. In fact, one of the Carnegie Commission's parallel studies recommends that OTA expand its analytic and clearinghouse functions in the international area, serving multiple Congressional committees and providing mutually beneficial links to the growing number of OTA-like entities abroad.

FIGURE 23: U.S. International Affairs Budget, FY 1991 (budget authority in

$ billions)

Multilateral assistance		1.914
Bilateral economic assistance		7.386
AID	6.412	
Other programs	0.974	
Military assistance		4.797
Export-Import Bank		0.170
PL480 Food for Peace		1.011
State Department		4.364
Conduct of Foreign Affairs	3.124	
Foreign Information and Exchange	1.240	
Trust Funds and Receipts		0.151
TOTAL		19.793

Source: State Department (August 1991).

A second step for the Congressional leadership is at once broader and more specific: laying the basis for whatever statutory changes may be necessary in a coherent "internationalization" of policy, programs, and budgets for the mission agencies. This process might begin broadly. For example, perhaps the Senate Foreign Relations Committee and House Foreign Affairs Committee could join with other key committees -- such as the House Science and Senate Commerce Committees -- to hold a yearlong series of special hearings. Alternatively, an ad hoc Task Force could be charged with placing on the record diverse assessments of the national strategies, budgets, and Executive-Legislative reforms required to deal with the array of issues covered in this report. Such a record would provide the raw material for formulating a more cohesive policy for science and technology in foreign affairs. Then, and only to the extent necessary, legislative changes could be made and committee jurisdictions could be adjusted.

These are not, of course, simple steps. Yet the conceptual basis and the resource-allocating reflexes of at least two generations of legislators -- all proceeding in good faith, and often creatively, to define and fulfill the "national interests" -- must now be rethought as a promising new international era dawns.

8.0 PREMISES: THE CASE FOR ORGANIZATIONAL ACTION

> Good organization does not insure successful policy, nor does poor organization preclude it. But steadily and powerfully, organizational patterns influence the effectiveness of government.
>
> Where organizational structure is logical and clear, the twin dangers of deadlock and of neglect are both minimized. Where processes of decision are orderly, decisions profit from the participation of the knowledgeable, and from the resulting confidence -- even among those who sought a different result -- that all relevant views were considered. Organization affects more than the efficiency of government; it affects the outcome of decisions. Organizational patterns determine whether an issue will be handled at one level rather than another, and in one agency instead of another. Since perspectives differ from level to level in government, and from agency to agency, the resulting decisions will differ also.

-Commission on the Organization of the Government for the Conduct of Foreign Policy[1]

This study underscores the imperative of organizing to integrate science and technology into foreign policy and to develop more coherent policies for U.S. involvement in international S&T activities. To meet this imperative, the government must consider the following seven ideas. These are, in effect, a restatement of the premises, the case for organizational action, implicit in all of the foregoing discussion. Although mainly directed at the Executive Branch, the basic notions can be implemented fully only if Congressional leaders embrace the goals.

- Use technological assets. The U.S. Government's foreign-policy-making apparatus must understand well the nation's assets in science and technology. It must draw upon American strengths consistently, and understand American weaknesses analytically in order to correct them constructively. It must help the nation deal with fields in which it chooses not to be the leader.

- Stress science-rich diplomatic opportunities. The international agenda will encompass not only the nuclear threat but also problems such as economic reform, drugs, health, terrorism, anarchy and civil war, regional conflict, public infrastructure, and environment. Thus, the specific technical knowledge and expertise required for diplomacy in the next generation are likely to be both broader than and different from that upon which the U.S. Government has drawn over the post-World War II period. For example, environmental scientists knowledgeable about forests and oil spills now will be needed in elucidating foreign policy options, just as physicists expert in weapons design were essential for shoring up deterrence. Technologies for peacekeeping and the verification of arms reductions will remain important.

- Guide global cooperation and competition. There is no clearly stated government-wide policy on international cooperation and competition in technology or science. Pluralism and competition in domestic R&D has been and will remain an American asset. But the welcome trend toward greater economic competition in the global marketplace is complicated by domestic budgetary stringency and by the rising costs of research. There must be greater purposefulness and clarity in the government's outlook on where, when, and how to foster cooperation.

- Recognize the consequences of R&D leadership. Notwithstanding the strengthening of research and engineering practice in Japan, Europe, and elsewhere, the United States remains the leader in most respects with regard to science and technology. As a leader -- "bound to lead," as Joseph Nye[2] said -- it is not always possible to learn much from the mistakes of others, and one must accept a certain amount of experimentation and inefficiency. The United States will continue to experience the risks inherent in being a pathfinder in such areas as space exploration and biotechnology. It is reasonable to spread such risks and costs more widely, but this will affect the benefits gained. In national priority-setting, the United States will have to choose even more carefully the areas that will reward substantial pioneering efforts.

- View science and education as global investment. Basic research and advanced education in science and engineering are in some respects international "public goods" whose benefits accrue not only to those who fund them but also to anyone who is ready to take advantage of them. There may be a tendency at the global level, just as there is at the national, to underinvest in fundamental science and human resources. Some nations will seek to be "free riders" on those making large investments in "big science" as well as in research generally. This classic social trap can be avoided by cooperative behavior among key governments. Devising workable incentives to foster such behavior will be as essential as it will be difficult.

- Consider expanding notions of security. The concepts of national and global "security" are gradually being extended, especially into the economic and environmental spheres. In parallel, the meaning and exercise of "national sovereignty" are limited by global forces of many kinds, often springing from technological change in areas such as the electronic transfers of capital and of information. Accordingly, the high priority accorded military considerations may diminish at ministries of foreign affairs. Drawing upon the private international community, new mechanisms for multilateral cooperation will be needed to assure mutual advantage, and minimize friction, in resolving global problems.

- Clarify international roles of S&T-intensive mission agencies. Much internationally important S&T has been associated with the Department of Defense and the Agency for International Development, but the missions of these organizations will be undergoing major reorientation. As a result, and with the internationalization of most science and technology, U.S. diplomacy will change. For the 1990s, all agencies -- including the National Science Foundation, the National Institutes of Health, the Department of Commerce, the Environmental Protection Agency, and the Department of Energy -- confront new global choices. Here, as emphasized, the Executive Office of the President must take the lead and set a strategy.

In light of the recently unfolding international challenges for the nation, it is not surprising to find gaps in the decision-making processes. Organizational steps have been suggested to improve the situation for science and technology. But adopting any one of them -- or all of them -- will not be as vital as seeing and grasping the opportunities for international leadership with a traditionally American mix of principle, originality, and pragmatism.

9.0 APPENDICES

9.1 Appendix A: Biographies Of Authors And Contributors

Jesse H. Ausubel is Director of Studies of the Carnegie Commission on Science, Technology, and Government and a Fellow in Science and Public Policy at The Rockefeller University. He has served as Director of Programs for the National Academy of Engineering. Mr. Ausubel was one of the principal organizers of the first United Nations World Climate Conference and is the author of numerous publications in the field of environment.

Harry G. Barnes, Jr., served as Ambassador to Chile, India, and Romania. A career foreign service officer, he was Director General of the Foreign Service and Director of Personnel of the Department of State from 1977 to 1981 Earlier he was stationed in Prague, Moscow, and Katmandu. Mr. Barnes is currently a senior fellow of the Conservation Foundation and executive director of the Critical Languages and Area Studies Consortium.

Justin Bloom is president of Technology International, Inc., a consulting firm specializing in international technology transfer studies. Mr. Bloom served as the Counselor for Scientific and Technological Affairs at the U.S. embassies in Tokyo and London. He also worked for the Atomic Energy Commission on the control of nuclear materials and the development of radioisotope applications, and later held the position of technical assistant to the Chairman of the AEC. Along with his consulting practice, Mr. Bloom has been active as a member of several government and private advisory committees and boards.

Harvey Brooks served as dean of engineering and applied science at Harvard University from 1957 to 1975. A solid state physicist, he worked in atomic power for the General Electric Company before joining Harvard. After his tenure as dean Dr. Brooks became Peirce Professor of Technology and Public Policy and one of the founders of the program in science, technology, and public policy at the Kennedy School of Government. Dr. Brooks has served on the President's Science Advisory Committee and the National Science Board and is a member of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Kenneth H. Keller is professor of chemical engineering and materials science at the University of Minnesota and is leader of the science and technology program of the Council on Foreign Relations. An expert in biomedical engineering, he has been active as a researcher, teacher, and educational administrator, serving as president of the University of Minnesota. Dr. Keller is one of the authors of the 1991 book Sea Changes:

American Foreign Policy in a World Transformed.

Rodney W. Nichols served as vice president and executive vice president of The Rockefeller University from 1970 to 1990, following several assignments in the Office of the Secretary of Defense. Trained in applied physics at Harvard, he has been involved in many studies of the application of technology for civilian and military purposes. He has had full-time and consulting experience with industry, and has been a frequent advisor to the U.S. Government. One of the leaders of the U.S. delegation to the 1979 UN Conference on Science and Technology for Development, he also served on the UN Advisory Committee on Science and Technology for Development. Currently, Mr. Nichols is a scholar-in-residence with Carnegie Corporation of New York.

Victor Rabinowitch was trained as an avian ecologist, receiving his advanced degrees from the University of Wisconsin in Madison. He received a PhD in the unusual combination of zoology and international relations. Dr. Rabinowitch served as director of the National Academy of Sciences' Board on Science and Technology for International Development, Committee on International Security and Arms Control, and Office of International Affairs. Currently, he is Vice President for Programs for the John D. and Catherine T. MacArthur Foundation.

Walter A. Rosenblith is former foreign secretary of the National Academy of Sciences and provost emeritus of the Massachusetts Institute of Technology. Dr. Rosenblith's major fields of interest are brain research and biophysics, science and technology in the university and society, and international science, its structure and partners. He served as Vice President of the International Council of Scientific Unions from 1984 to 1988, and he chairs the advisory panel for the World Bank's Chinese

University Development Project. Dr. Rosenblith is a member of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Eugene B. Skolnikoff is professor of political science at Massachusetts Institute of Technology; he directed its Center for International Studies from 1972 until 1987. He served on the White House staff in the Science Advisor's office in the Eisenhower and Kennedy administrations. Originally educated as an electrical engineer, he studied economics and politics at Oxford on a Rhodes Scholarship, and later received a PhD in political science at MIT. His work has focused on the interaction of science and technology with international affairs.

John Temple Swing is a lawyer and executive vice president of the Council on Foreign Relations, where he has worked since 1963. He has served as a senior advisor to the State Department for Law of the Sea and was a member of the U.S. Delegation to the Law of the Sea Conference. He is the author of numerous articles on public international law, law of the sea, Afghanistan, and other topics in international affairs.

John C. Whitehead was deputy Secretary of State from 1985 to 1989, and he took special interest in Eastern Europe, the United Nations, and administrative reforms within the Department. From 1947 to 1984 Mr. Whitehead worked at the banking and brokerage firm Goldman, Sachs and Co., where he became co-chairman. He has served on the board of numerous companies, has been President of the Board of Overseers of Harvard University and of the International Rescue Committee, and now chairs the United Nations Association of the USA, the Andrew W. Mellon Foundation, and AEA Investors. While serving in the U.S. Navy during World War II, Mr. Whitehead participated in the invasions of Normandy, Iwo Jima, and Okinawa.

9.2 Appendix B: Participants, Workshop On Organization And Resources Of The U.S. Government For Science And Technology In International Affairs, June 25-28, 1990[*]

The following individuals not only participated in intense exchanges during a three-day workshop held at The Rockefeller University in June 1990 but also commented later on the initial drafts leading to this report. No attempt was made to craft a "committee consensus." Thus, none of these participants is responsible for the conclusions. Nonetheless, this group contributed a remarkably diverse range of professional perspectives to the process of considering the problems and choices addressed here.

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U.S. Department of State

John Whitehead
AEA Investors, Inc.

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U.S. Department of Commerce

Endnote

[*] Affiliations as of June 1990.

9.3 Appendix C: Reviewers And Commentators

In addition to the participants in the June 1990 Workshop, other individuals generously reviewed drafts circulated during 1991. Of course, none bears any responsibility for the published assessments and recommendations.

Special thanks go to the senior officials and staff in the State Department's Bureau of Oceans and International Environmental and Scientific Affairs: Assistant Secretary Curtis Bohlen, Ambassador Richard Smith, John Boright, and particularly Andrew Reynolds, Sharon Stanley, Janet L'Hereux, and Patrick McHale, who frequently provided both data and conceptual perspectives.

As the study got under way in late 1990, Ivan Selin, then Under Secretary of State for Management, encouraged a broad appraisal that would keep both long-range science and current operational problems in view D. Allan Bromley, Director of the White House Office of Science and Technology Policy, also encouraged this review, and helpful contributions were received from OSTP Associate Director J. Thomas Ratchford and from Sara Bowden.

Comments on various drafts were given by:

Graham T. Allison, Jr., Harvard University

William O. Baker, AT&T Bell Laboratories

Frederick M. Bernthal, National Science Foundation

McGeorge Bundy, Carnegie Corporation, former NSC Advisor

William D. Carey, Carnegie Corporation and former Executive Officer, AAAS

Warren Christopher, former Deputy Secretary of State

Brewster Denny, University of Washington, Seattle

John H. Gibbons, and colleagues, Office of Technology Assessment

General Andrew Goodpaster (Ret.), former White House Chief of Staff

Pierre Perolle, Office of Science and Technology Policy

Thomas Pickering, U.S. Ambassador to the United Nations

Mary Proctor, State Department

Benjamin Read, former State Department Executive Secretary

William Salmon, National Academy of Engineering

George Shultz, former Secretary of State

H. Guyford Stever, former White House Science Advisor

Mitchell Wallerstein, National Research Council

10.0 NOTES AND REFERENCES

10.1 Endnotes

2.0 INTRODUCTION

[1] Speech at United Nations, 24 September 1973, cited in Science, 17 May 1974, p. 781.

[2] Science and Technology in an Era of Interdependence, United Nations Association of the U.S.A., January 1975, p. 6.

[3] The business trends of global technology, finance, and trade are covered consistently in numerous books and periodicals; for a brief, authoritative digest of many such trends, see National Interests in an Age of Global Technology, T. H. Lee and P. P. Reid, (eds.), National Academy of Engineering, Washington, DC, 1991. Less well reported are the comparable

trends on U.S. campuses: see, for example, John Deutch, "The Foreign Policy of U.S. Universities," Science, 2 August 1991; and Dorothy Zinberg (ed.), The Changing University: How Increased Demand for Scientists and Technology Is Transforming Academic Institutions Internationally, NATO, Series D, Vol. 59, Kluwer, 1991.

3.0 GOALS: FOREIGN POLICY FOR THE 1990s AND BEYOND

[1] Secretary's cable # 153134 to all posts (24 May 1984) and Department Notice (13 June 1984), U.S. Department of State.

[2] Address to National Governors' Association, Washington, DC, 26 February 1990, re-printed in U.S. Department of State Dispatch, 3 September 1990, p. 18.

[3] See, for example, Advanced Materials by Design: New Structural Materials Technologies, OTA-E351, Washington, DC, U.S. Government Printing Office, June 1988.

[4] The author thanks Professor Harvey Brooks, Harvard University, for sharpening this point and for summarizing data developed by a number of other scholars. According to a report from the United Nations, at the end of 1989 the U.S. had the largest stock of overseas investment, about $345 billion, compared with $332 billion for the EC and $110 billion for Japan; see Far Eastern Economic Review, 3 October 1991, p. 57.

[5] Deborah L. Wince-Smith, Assistant Secretary for Technology Policy, Department of Commerce, Remarks at OECD Symposium, mimeo. 4-5 February 1991.

[6] The author thanks Francis M. Cevasco, formerly an official in DoD and now Managing Director of the International Partnerships Group in Arlington, Virginia, for supplying these estimates from trends during the late 1980s on DoD's international effort.

[7] See, for example, the powerful review by William J. Perry,

"Desert Storm and Deterrence," Foreign Affairs, fall 1991.

[8] See, for example, Arming Our Allies: Cooperation and Competition in Defense Technology, OTA-ISC-449, May 1990; and Global Arms Trade: Commerce in Advanced Military Technology and Weapons, OTA-ISC-460, June 1991; both from Office of Technology Assessment, Congress of the United States. Negotiations among the major arms exporters (U.S., USSR, China, UK, and France) during 1991 led to new guidelines for arms transfers to the Middle East; see The New York Times, 20 October 1991, p. 11.

[9] For readers who are not aficionados of the statistical series about national and international R&D, see Science and Engineering Indicators -- 1989, National Science Board, NSF-89, U.S. Government Printing Office, 1989. Related sources include the AAAS: see AAAS Report XVI: Research and Development, FY 1992, Intersociety Working Group, Washington, DC, 1991.

[10] See, for example, Science and Technology Integration in Europe and Influences on U.S.-European Cooperation, National Science Board, November 1990, NSF-90-172; and Europe 1992: The Implications of Market Integration for R&D-Intensive Firms, National Academy Press, 1991. For a succinct statement of "principles" for R&D cooperation with special reference to Japan, see George R. Heaton, Jr., International R&D Cooperation: Lessons from the Intelligent Manufacturing Systems Proposal, Discussion Paper Number 2, Manufacturing Forum, National Academy Press, June 1991.

[11] Graham Allison and Peter Szanton, Remaking Foreign Policy: The Organizational Connection, Basic Books, 1976.

4.0 HISTORY: TRYING TO BUILD THE CAPACITY

[1] Dumas Malone, Jefferson the President: First Term, 1801-1805, Little Brown, Boston, 1970, p. 179. This quotation comes from his letter

accepting election as president of the American Philosophical Society.

[2] Federalist Papers, No. 42 (22 January 1788), Bantam, 1982, p. 211.

[3] Report of the Steering Committee of Reorganization Task Force No. 2, 2 May 1949, p. 30.

[4] Science and Foreign Relations: International Flow of Scientific and Technological Information, International Science Policy Survey Group, Department of State Publication 3860, Released May 1950, p. 1.

[5] Ibid., p. 4.

[6] Ibid., p. 5-6.

[7] Ibid., p. 6.

[8] Commission on the Organization of the Government for the Conduct of Foreign Policy ("Murphy Commission"), U.S. Government Printing Office, June 1975, Summary (Policy Issues of the Future), p. 2.

[9] Ibid., p. 2.

[10] Ibid., p. 5.

[11] Ibid., p. 7.

[12] Ibid., p. 13. Readers will find the case-studies and multiple appendixes of the Murphy Commission to be a rich source of material on these issues.

[13] National Science Board, NSF, NSB-84-132, 11 May 1984, Abstract, p. ii.

[14] PL95-426, Department of State Authorization for FY 1979, Title V -- Science, Technology, and American Diplomacy, Amended by PL100-418, 23 August 1988, para. 2656a.

[15] Ibid., para. 2656d.

[16] Science, Technology, and American Diplomacy -- 1983, U.S. Government Printing Office, September 1983, p. iii.

[17] Science, Technology, and American Diplomacy -- 1984, U.S. Government Printing Office, April 1984, p. iii.

[18] Science, Technology, and American Diplomacy -- 1985, U.S. Government Printing Office, July 1985, p. iii.

[19] Science, Technology, and American Diplomacy -- 1987, U.S. Government Printing Office, July 1987, p. v.

[20] Science, Technology, and American Diplomacy -- 1988, U.S. Government Printing Office, April 1988, p. iii.

[21] Letter of Transmittal, The White House, 14 March 1988, Science, Technology, and American Diplomacy -- 1988, U.S. Government Printing Office, April 1988, p. vi.

[22] Letter of Transmittal, The White House, 23 March 1990, Science, Technology, and American Diplomacy -- 1990, U.S. Government Printing Office, April 1990, pp. ix and xi.

5.0 FUNCTIONS: FIELD AND HEADQUARTERS ACTIVITIES

[1] Foreword, in Richard Elliot Benedick, Ozone Diplomacy, Harvard, 1991, p. x. This lucid account by a brilliant negotiator shows what can be accomplished when high professionalism in both science and diplomacy come together.

[2] Justin L. Bloom, "Past Lessons and Future Challenges," background paper for CCSTG-CFR Workshop, mimeo, June 1990, p. 3.

[3] Estimate from Francis M. Cevasco, formerly in DoD and now Managing Director of the International Partnership Group, Arlington, Va.

[4] For an excellent review of the historical evolution, see Science and Technology in the Department of State, Science Policy Research Division, Congressional Research Service, Committee Print, U.S. Government Printing Office, June 1975. See also Murphy Commission, Appendix B, Eugene B. Skolnikoff, "History of U.S. Government Organization for Conduct of Foreign Policy in Technology-Related Subjects," pp. 243-258.

6.0 NEEDS: EXECUTIVE AND LEGISLATIVE CASES

[1] Letter of Transmittal, White House, 23 March 1990, Science, Technology, and American Diplomacy -- 1990, U.S. Government Printing Office, April 1990, p. xi.

[2] Science, Technology, and American Diplomacy -- 1991, U.S. Government Printing Office, July 1991, p. v.

[3] In the opening announcements about the SSC, no mention was made of the full scientific, financial, and managerial "internationalization" of the project. Its cost was estimated at about $4.4 billion over 10 years when President Reagan announced his major commitment in January 1987; see, for example, Energy Secretary John Herrington's detailed statement of 10 February 1987. The early design efforts began in July 1983 with DoE's High Energy Physics Advisory Panel recommendation that the SSC R&D was "highest priority." Although in 1983 the Economic Summit Working Group said, cautiously. that "Participation of other countries in the construction of (this) accelerator could be envisaged," the main emphasis was on American funding for American purposes, while endorsing the tradition of international participation in experiments (with separate national funding for detectors). By 1990-91, however, as estimated costs had risen to $10 billion (plus or minus $1 billion), Congress was insisting that at least $3 billion be provided by other nations. This produced headlines such as "Japan Wary as U.S. Science Comes Begging" (New York Times, 27 October 1991, p. E16). Full partnership was seen to be the only path to building the machine. For example, White House Science Advisor D. Allan Bromley reinforced the Administration's position that: "... Japan buy an equity position in the SSC.... The Japanese would not only be part owner of the SSC but also share the responsibility for supporting the SSC on a continuing basis.... This idea ... moves us in the direction of internationalizing our science megaprojects from now on (Physics Today,

October 1991, p. 97). Similar accounts can be mustered to explain the other cases of "big science" mentioned in the text.

[4] "Statement on Science in the International Setting," National Science Board, 16-17 September 1982.

[5] George Bush, National Security Strategy of the United States, The White House, August 1991.

[6] J. Thomas Ratchford, Statement before the Subcommittee on International Scientific Cooperation, Committee on Science, Space, and Technology, House of Representatives, 26 April 1990.

[7] John E. Rielly, ed., American Public Opinion and U.S. Foreign Policy -- 1991, Chicago Council on Foreign Relations, 1991.

[8] Science. Technology, and American Diplomacy -- 1988, U.S. Government Printing Office, April 1988, p. 301.

[9] Op. cit., note 2 above.

[10] Quoted in Rodney W. Nichols, "Science and Two-Armed Diplomats," editorial, Science, 12 October 1984.

7.0 RECOMMENDATIONS: COMMITMENT ACROSS GOVERNMENT

[1] Russell L. Ackoff, Management in Small Doses, Wharton School, University of Pennsylvania. John Wiley & Sons, 1986, p. 38.

[2] The White House, Letters of Transmittal, 21 June 1991, Science, Technology, and American Diplomacy -- 1991, Twelfth Annual Report submitted to the Congress by the President Pursuant to Section 503(b) of Title V of PL95-426, U.S. Government Printing Office, July 1991.

[3] Professor Harvey Brooks of Harvard University commented generously and constructively on successive drafts of this report and, in particular, underscored this key point about civilian nuclear energy in U.S. being seen necessarily in an international context.

[4] Robert M. Simon, Department of Energy, Testimony, joint hearing

of Committee on Science, Space, and Technology with Committee on Armed Services, House, mimeo, p. 3, 25 April 1991.

[5] William Schneider, former Under Secretary of State for Security Assistance and Science and Technology, and a participant in the CCSTG-CFR Workshop in June 1990, provided excellent thoughts about how the past NSC interagency mechanism would be a helpful precedent for the needed future coordination.

[6] William A. Blanpied, private communication, 5 July 1990. The authors are indebted to Dr. Blanpied for his tireless dedication to the subjects covered here.

[7] Deborah Wince-Smith, Assistant Secretary -- Technology Policy, Commerce Department, private communication, 21 June 1991, and remarks to OECD Symposium 4-5 February 1991. This example is by no means intended to criticize the agency. Instead, the point is to underscore the needs for simultaneous efforts to decentralize international activity and to draw together in each agency an overall international outlook.

[8] William T. Golden, special consultant to President Truman and to the Director of the Bureau of the Budget, suggested on 6 February 1951 (the date is correct) in a memorandum to Roger W. Jones, Assistant Director of the Bureau of the Budget, that the position of "Science Advisor to the State Department" (as described in the Berkner Report -- see Chapter 2 above) should be filled "promptly" with a "properly qualified individual." For a lucid review of the early experiments -- four individuals, each an able scientist or engineer from a major university, appointed between 1951 and 1964 for terms that turned out to be short -- see Eugene B. Skolnikoff, Science, Technology, and American Foreign Policy, MIT Press, 1967, pp. 249-265. Also see Science and Technology in the Department of State, prepared for the Committee on International Relations, House of Representatives, Library of Congress, U.S. Government Printing Office, Washington. DC, 1975.

[9] David Z. Beckler, the Carnegie Commission's Deputy Director, and William T. Golden, Co-chair of the Commission, have clarified many ramifications of the case for the post of Presidential Science Advisor (see the Bibliography), and the author is grateful for their comments on the analogous post of S&T Counselor to the Secretary of State.

[10] For an excellent quantitative digest and sprightly analysis of worldwide trends affecting developing countries, see Ruth Leger Sivard, World Military and Social Expenditures -- 1991, World Priorities, Washington, DC. More comprehensive data with an emphasis on economic and technological trends appear in World Bank, The Challenge of Development: World Development Report 1991, Oxford University Press, June 1991.

[11] The AAAS plays a key role in selecting Congressional Science and Engineering Fellows and has placed several in State and AID. Twenty national professional societies are participating in the 1992-93 program, which could be expanded.

[12] Technology and Foreign Affairs, a report by T. Keith Glennan, December 1976, p. 42. In many respects, Glennan's excellent study arrived at the same conclusions and recommendations derived independently in this report.

[13] See complete details in Organization and Members -- 1991, NAS, NAE, IOM, NRC, Washington, DC, 1991, pp. 260-280.

[14] Alexander Keynan, "The U.S. as a Partner in Scientific and Technological Cooperation: Some Perspectives from Across the Atlantic," June 1991, CCSTG.

8.0 PREMISES: THE CASE FOR ORGANIZATIONAL ACTION

[1] Commission on the Organization of the Government for the Conduct of Foreign Policy, U.S. Government Printing Office, June 1975, Summary (Policy Issues of the Future), p. 1.

[2] Joseph S. Nye, Jr., Bound To Lead: The Changing Nature of American Power, Basic Books, 1990.

10.2 Bibliography

To promote more study and debate on the themes of interest in this review, the following short list of references has been compiled. While not exhaustive, it includes many of the most frequently cited works of the past few decades. The Notes and References for each chapter include a number of additional sources.

U.S. GOVERNMENT REPORTS

Congressional Research Service, 1975. Science and Technology in the Department of State: Bringing Technical Content into Diplomatic Policy and Operations. Subcommittee on International Security and Scientific Affairs, Committee on International Relations, U.S. House of Representatives.

Congressional Research Service, 1976. Science, Technology and Diplomacy in the Age of Interdependence. Subcommittee on International Security and Scientific Affairs, Committee on International Relations, U.S. House of Representatives. Washington, DC: U.S. Government Printing Office.

Congressional Research Service, 1977. Science, Technology and American Diplomacy. Committee on International Relations, U.S. House of Representatives. 3 volumes. Washington, DC: U.S. Government Printing Office, stock number 052-070-04350-4.

Foreign Service Institute, 1984. Science, Technology and Foreign Affairs. 4 volumes. U.S. Department of State.

Glennan, T. Keith, 1976. Technology and Foreign Affairs. Washington. DC: U.S. Department of State.

International Science Policy Survey Group, 1950. Science and Foreign Relations: International Flow of Scientific and Technological Information. The "Berkner Report." Washington, DC: U.S. Department of State, Publication 3860.

U.S. Commission on the Organization of the Government for the Conduct of Foreign Policy. The "Robert D. Murphy Report." U.S. Department of State, 1975. 8 volumes. Washington, DC: U.S. Government Printing Office, stock number 022-000-00108-6.

NONGOVERNMENTAL REPORTS

Basiuk, Victor, 1977. Technology, World Politics and American Policy. New York: Columbia University Press.

Blumenthal, W. Michael, 1988. "The World Economy and Technological Change," Foreign Affairs 66:529-550.

Committee on Science, Engineering, and Public Policy, 1991. Finding Common Ground: U.S. Export Controls in a Changed Global Environment. Washington, DC: National Academy Press.

Derian, Jean-Claude, 1990. America's Struggle for Leadership in Technology. Cambridge: MIT Press.

Golden, William T. (ed.), 1980. Science Advice to the President. New York:

Pergamon Press.

Golden, William T. (ed.), 1988. Science and Technology Advice to the President, Congress, and Judiciary. New York: Pergamon Press.

Golden, William T. (ed.), 1991. Worldwide Science and Technology Advice to the Highest Levels of Governments. New York: Pergamon Press.

Granger, John Van Nuys, 1979. Technology and International Relations. San Francisco: W. H. Freeman.

Guile, B. R., and H. Brooks (eds.), 1987. Technology and Global Industry: Companies and Nations in the World Economy. Washington, DC: National Academy Press.

Hamilton, E. K. (ed.), 1989. America's Global Interests: A New Agenda. New York: Norton.

Haskins, Caryl P., 1964. The Scientific Revolution and World Politics. New York: Harper and Row, for the Council on Foreign Relations.

Haskins, Caryl P., 1971. "Science and Policy for a New Decade," Foreign Affairs 49:237-270.

Keatley, Anne G. (ed.), 1985. Technological Frontiers and Foreign Relations. Washington, DC: National Academy Press.

Keller, Kenneth H., 1990. "Science and Technology," Foreign Affairs 69:121-138.

Kuehn, Thomas J., and Alan L. Porter (eds.), 1981. Science, Technology and National Policy. Ithaca: Cornell University Press.

Laurenti, J., and F. Lyman. 1990. One Earth, Many Nations: The International System and Problems of the Global Environment. New York: United Nations Association of the USA.

Mansfield, E., et al., 1982. Technology Transfer, Productivity, and Economic Policy. New York: W. W. Norton.

Muroyama, J. H., and H. G. Stever (eds.), 1988. Globalization of Technology: International Perspectives, Washington, DC: National Academy Press.

National Academy of Engineering, 1987. Strengthening U.S. Engineering through International Cooperation: Some Recommendations for Action. Washington. DC: National Academy of Engineering.

National Research Council, 1983. Scientific Communication and National Security. Washington, DC: National Academy Press.

National Research Council, 1987. Balancing the National Interest: U.S. National Security, Export Controls, and Global Economic Cooperation. Washington, DC: National Academy Press.

Nelson, Richard, 1984. High-Technology Policies: A Five-Nation Comparison. Washington, DC: American Enterprise Institute.

Rosenberg, Nathan, and L. E. Birdzell, Jr., 1986. How the West Grew Rich. New York: Basic Books.

Salomon, Jean-Jacques, 1973. Science and Politics. Cambridge: MIT Press.

Salomon, Jean-Jacques, 1988. "Technology and Democracy," in J. Annestadt and A. Jamison (eds.), From Research Policy to Social Intelligence. New York: Macmillan, pp. 49-68.

Schilling, Warner R., 1962. "Scientists, Foreign Policy, and Politics," American Political Science Review 56:287-300.

Skolnikoff, Eugene B., 1967. Science, Technology, and American Foreign Policy. Cambridge: MIT Press.

Skolnikoff, Eugene B., 1972. The International Imperatives of Technology: Technological Development and the International Political System. Berkeley: University of California, Institute of International Studies, Research Series No. 16.

Skolnikoff, Eugene B. (in press). The Elusive Transformation: Science, Technology, and the Evolution of International Politics. Princeton: Princeton University Press.

Smith, Bruce L. R., 1990. American Science Policy Since World War II. Washington, DC: The Brookings Institution.

Szyliowicz, J. (ed.). Technology and International Affairs. New York: Praeger.

Vernon, Raymond, 1977. Storm Over the Multinationals: The Real Issues. Cambridge: Harvard University Press.

Wallerstein, Mitchel B. (ed.), 1984. Scientific and Technological Cooperation among Industrialized Countries: The Role of the United States. Washington, DC: National Academy Press.

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[*] Through April 1990

[**] Through January 1989

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