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INTERNATIONAL SCIENCE AND TECHNOLOGY POLICIES

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Testimony Before the

Subcommittee on International Scientific Cooperation

Committee on Science, Space, and Technology

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TESTIMONY
SUBCOMMITTEE ON INTERNATIONAL SCIENTIFIC COOPERATION
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Mr. Chairman and Members of the Subcommittee, I am pleased to have the opportunity to testify before this Subcommittee to present my views on international science and technology policies. I had the good fortune in 1958 to be a Fulbright Scholar at the Technische Hogeschool in Delft, The Netherlands. In 1980 I became Director of the Department of Energy's Office of Energy Research. In 1987 I became the Executive Officer of the American Association for the Advancement of Science, and am now the Director of the Oak Ridge National Laboratory. The opportunities afforded by these positions for interactions with scientists of other nations has deepened my appreciation of the need for international cooperation. I believe that the United States has a great deal to gain by the appropriate involvement in international cooperation in science and technology. The organization of my testimony will provide my perspective on international science and technology policy and then focus on the particular questions contained in the Subcommittee's invitation.

Perspective on Science and Technology Policy

Science and technology are playing an increasing role in economic development, both in the United States and elsewhere in the world. Robert Solow of MIT, the 1987 Nobel Prize winner in economics, has studied the economic impact of science. In an interview (United Press International, October 21, 1987) he stated, "What I got interested in was the question of what makes a modern industrial economy grow...we owe it all to the growth of science and technology." This comment reflects the important role science and technology has in our economic well-being. Solow demonstrated that only a small portion of annual growth could be explained by increases in labor and capital. The key factor was always technology. When these results came out in the early 1950s, they had a great impact on people's thinking. More emphasis was placed on higher education and technological research. In describing Solow's work, Professor Karl-Goran Maler of the Stockholm School of Economics and a member of the Nobel selection committee said, "Solow showed us that in the long run it is not the increase in quantity that is so important. It is the increase in quality, through better technology and increased efficiency. Better technology will be the engine for increased growth." (New York Times, October 22, 1987, page D1)

The United States is not the only nation that gives science and technology a high priority. As telecommunications have improved, news of scientific discoveries and technological breakthroughs has quickly spread worldwide. For this reason, it is impossible to stop science from crossing international borders. Several significant examples of this rapid dissemination include the laser, high temperature superconductivity, and cold fusion. The laws of science are available to everyone. Frequently all that is needed is the knowledge that a process works. With the laser, all that one needed to know was that a lasing had occurred and that it had been done using ruby. Many then did go into their laboratories to duplicate the results and study the phenomenon. After many years of no progress in the laboratory, J. G. Bednorz and K. A. Mueller discovered ceramic rare earth compounds that were capable of higher temperature superconductivity. This set off a spate of activity in which not only the results were duplicated but also improvements were made in an incredibly short time. The announcement of cold fusion stimulated a great deal of activity to duplicate the results. How did news of these discoveries spread? News reports and personal contacts clearly played a more significant role than traditional scientific journals in the initial, rapid dissemination of results.

Any policy that is developed regarding science and technology must take into account both the effect of science on national economies, and the speed with which discoveries are communicated around the world. I believe that science has also been a mechanism for international communication during times of political stress between countries. It is my belief that contacts between our scientists and those in the Soviet Union and the People's Republic of China have contributed to improved diplomatic circumstances.

Title V of Public Law 95-426

Among other things, Title V of P.L. 95-426 designates the Department of State as the lead agency with respect to science and technology agreements. Scientists cooperate in different ways. First, there is the scientist-to-scientist exchange of information within or outside of an international organization. Second, there is an institution-to-institution agreement where a sister laboratory is involved. Oak Ridge National Laboratory has several of these agreements with foreign scientific institutions. These are not much different from any arrangement we have with institutions in this country. Third, there is an agency-to-agency relationship, such as that of the Department of Energy with its counterpart in some other country. The Department of State has a prominent role in this activity. Clearly this is appropriate where many requirements are present for the development of agreements. Fourth, there are agreements between governments, in which the Department of State frequently takes the lead.

The interagency process which defines U.S. policy in the science and technology area is working very well. Each agency which has an interest in a particular agreement is included in all preliminary discussions. Their views are incorporated into the final policy proposal. The purpose underlying their inclusion is to ensure scientific, security, and political/economic concerns are all addressed. I believe this purpose is being achieved. The annual report to Congress mentioned in section 2656d of Title V is very significant. I am not aware of any other document which organizes all of our science and technology agreements so effectively.

Recently, the Oak Ridge National Laboratory hosted 14 science counselors from 13 countries. These counselors are members of the diplomatic staff accredited to embassies in Washington, D.C. Their responsibilities include monitoring science and technology in the United States. During my recent tenure in Washington, I became aware that this group had an incomplete understanding of the role of the Department of Energy's national laboratories. Their visit to ORNL gave them the opportunity to view first hand our activities in robotics, waste management, spectroscopy and microscopy, materials science, nuclear energy, and environmental science. All of these diplomats have formal science or technology backgrounds, some to the Ph.D. level. I believe it is important for our diplomats in similar positions to also have these credentials, and I encourage the Department of State in this effort. Perhaps this background will allow the Department of State to have an increased awareness of the science and technology activities of the private sector and multilateral development banks.

It is the responsibility of these science counselors to communicate their observations to organizations in their countries. Although everything they see and read is public knowledge, their active participation in the United States science scene is highly beneficial to their countries. I am not aware of dissemination of trip reports made by our Department of State that reach the private sector. Perhaps the best known assessment of overseas scientific activity is the European Science Notes Information Bulletin published by the Office of Naval Research European Office. Although I don't have any particular mechanism in mind, the United States scientific community needs to be aware of current research throughout the world on a more real-time basis and not restrict itself to reading the scientific literature which can be many months out of date when it is published.

Federal Laboratories

The number of federal laboratories exceeds 700, if you include all of the laboratories of agencies like the departments of Agriculture and Energy, the Environmental Protection Agency, and the Institutes of Health. These laboratories are implementing actions and playing a critical role in looking for opportunities on an international level. For a successful international mission-oriented program, a framework must exist for intergovernmental cooperation. The Department of State provides such a framework and leads the negotiations of any agreements with the laboratories and agencies supporting this effort. After the framework is established, the laboratories and their agencies assume the lead role in understanding the area of opportunity and defining what needs to be accomplished. Once the agreement is negotiated, the laboratories take the lead role in executing the agreement.

Just as science is for everyone, technology has specific applications. There have been documented circumstances that certain areas of technology have become available in other ways than we feel is desirable. Several countries have chosen to take advantage of our science and technology base and have used it for their development. Combined with their lower costs of capital, labor, or other economic factors, their economic growth may occur at a faster rate than ours in the United States.

General Accounting Office Report on Technology Transfer

Our national laboratories perform research that is at the forefront of our national effort and consequently act as our nation's international laboratories. According to many reports, such as Workforce 2000: Work and Workers for the 21st Century (Hudson Institute, Indianapolis, IN, 1987), America's Next Crisis: the Shortfall of Technical Manpower (Aerospace Education Institute, Arlington, VA, 1989), and Changing America: the New Face of Science and Engineering (Task Force on Women, Minorities, and the Handicapped in Science and Technology, Washington, D.C., 1989), the United States faces a shortfall of scientists and engineers by the year 2000. National laboratories will be competing with U.S. industry for the best and brightest staff. While much of this shortfall will be made up by attracting minorities and women into these areas, part of it will also be filled by immigration of scientists into this country. While many laboratories have an international flavor now, I expect all of our organizations will continue to rely on citizens of other nations to be part of our national research effort.

If you have a state university that has 80 percent foreign students, the citizens of that state have every right to say that their tax dollars are not being well spent. On the other hand, if there were no foreign students, the children of those citizens would be at a disadvantage for not having the benefit of learning about international cultures from the foreign students. The international effect of science and technology that I mentioned in my overview involves attracting the finest scientists and engineers to our laboratories. The GAO report (Technology Transfer: U.S. and Foreign Participation in R&D at Federal Laboratories, report GAO/RCED-88-203BR) states that "managers and administrators at the eight federal laboratories we visited opposed establishing a government-wide policy that restricts or excludes access of foreign researchers to fields of research or facilities because of the commercial potential of the technology...their laboratories have sufficient authority to control foreign access and/or the policy runs counter to the scientific principle of free and open access and discussions among researchers seeking to advance scientific knowledge... restricting foreign access would be counterproductive" (page 51). I agree with this. The openness of the national laboratories is paramount if the United States expects symmetrical access to facilities, intellectual property, and patents in other countries. The United States gains overall if we can have their scientists visit our science facilities as well as the capability of sending our staff to science facilities in other nations.

Even so, when our government enters into international science and technology agreements, we must now be aware that these agreements also reflect technology and trade implications. With the increasing private sector investment in university and federal laboratory R&D, poorly conceived agreements could allow foreign competitors free access to research of great commercial value which has been largely funded by our private sector. The obvious effect will be to discourage the private sector from entering into cooperative arrangements with federal laboratories, thus defeating the objectives of the Federal Technology Transfer Act before it has a chance at life.

This new reality simply suggests that the government must strike a balance between the objectives of international scientific cooperation and the objectives of good technology management. There is not an inherent conflict between the two, just a need to enter these agreements with our eyes open.

Burden-sharing of Big Science Projects

The idea that several nations should simultaneously build a $3 billion or $5 billion facility to seek the same scientific results is outrageous from a financial point of view. Even if the countries (and their scientists) would do such a thing, it is a poor use of human talent. Over the long run, human talent will become a much more precious commodity than the cost of any "big science" project. It would be desirable to develop a system whereby, with trust, nation A would agree to build Facility 1. They would be joined in cost and talent by others, and the resulting scientific information would be mutually available to all who participated. Nation B might be expected to do the same with Facility 2, which would be in some sense similar in scope and character but not necessarily in the same scientific area or the same timeframe. These units of account would stretch over decades, not months or a few years.

CERN Laboratory in Geneva, which engages in high energy physics, is an excellent example of international collaboration which meets the needs of many nations. Similarly, the Joint European Torus (JET) project in Great Britain also meets multinational needs. While still in the conceptual design phase, the International Thermonuclear Experimental Reactor project will require agreements greater in scope than CERN or JET because of the involvement of the Soviet Union, Japan, and the European Community with the United States.

Equity in Technology Flow

The intent of our laws is to ensure symmetry in the flow of technology. Legislation, such as the Omnibus Trade and Technology Act of 1988 (P. L. 100-418), appears to be adequate for this purpose. Our numerous agreements covering science, technology, and energy issues with Japan indicate that, over the years, this has been the case.

The Department of State should have its traditional coordinating role in multilateral or bilateral discussions of technology flow. Other agencies, including the Department of Commerce, Department of Energy, Department of Defense, and the National Science Foundation, are deeply involved in dealing with questions of equity in the flow of technology. This results from their participation in the interagency review process that covers all proposals for international science and technology agreements. This interagency process ensures an appropriate balance is maintained, including a balance in the area of intellectual property rights.

Over the past decade, several National Academy panels have examined the effects of national security export controls. The Panel on the Impact of National Security Controls on International Technology Transfer, in their report Balancing the National Interest: U.S. National Security Export Controls and Global Economic Competition (Lew Allen, Jr., chairman, National Academy of Sciences, Washington, D.C., 1987), studied the current system of U.S. and multilateral national security export controls. It sought strategies regulating international technology transfer to achieve a desirable balance among the objectives of military security, economic vitality, and scientific and technical advance. The panel recommended that the United States exercise stronger leadership in building a multilateral community of common controls for dual use (both commercial and military) technologies among cooperating countries. This involves eliminating certain controls on trade and developing other effective control arrangements with technologically advanced nations. The Panel also recommended the executive branch accord greater importance to maintaining technological strength and the economic vigor and unity of the Western alliance than was currently done. Essentially, this Panel called for a broader definition of national security to include economic vitality of Free World countries.

Results of the implementation of this Panel's recommendations were assessed the following year by a group convened by the Aspen Institute that also looked toward the inauguration of a new President. I was fortunate to participate in this seminar and contribute to the report Economic Dynamism and Export Controls: International Technology Transfer in a Knowledge-Intensive World (Aspen Institute, Queenstown, MD, 1988). This report recommended that allied solidarity on security export controls be achieved soon after the new Administration takes office. Progress has clearly been made in areas suggested by the Lew Allen report. Continued attention needs to be focused on the recommendations of these two panels.

Intellectual Property Rights

From my experience, both the Department of State and the technical agencies believe that American intellectual property rights should be vigorously protected. How can this best be accomplished? There appears to be a divergence of opinion within the government as to how the competitive position of the United States can be maintained and advanced in science and technology. The Department of State insists on the inclusion of detailed intellectual property rights language in agreements it negotiates. It has done so over the past several years. However, only the technical agencies on whose behalf these agreements are concluded can subsequently determine that these rights are properly allocated and protected in practice without side effects that are counterproductive to their mandated interests. These technical agencies are the parties best qualified for that job: they have the expertise to know the intellectual property in a particular field. As the actual partners in the implementation of the agreements, they will also know when intellectual property has been created or furnished.

To do their job properly, the technical agencies must have the legal authority and the flexibility, in terms of both U.S. law and international commitments, to make decisions freely recognizing the varying circumstances of their foreign partners. A science and technology relationship with country A, which has protections equal to or more stringent than ours, and which has information that can be of more value to us than ours is to them, should be significantly different from our relationship with country B, which may adopt our technology without proper compensation and is protected under their laws.

By adhering to a strict set of intellectual property rights in all international science and technology agreements, we run the risk of inhibiting the free flow of scientific information. This may not only be impractical but may also have negative results. Potential foreign partners which are of major scientific or political importance to the United States may refuse to enter into such agreements. This may cut us off from potentially valuable technical and foreign relations benefits. Insistence on rigid provisions can be counterproductive and result in taking away from U.S. agencies and our private sector the same rights we seek to establish.

U.S. Collaboration

When I was at the Department of Energy, I often received delegations from other countries that were interested in determining how priorities in science and technology were established in the United States. My answer was that there was not a single policy but a collection of policies based on individual programs. Each agency tried to support those areas that it thought were the best. This led to both sensible priorities on a program basis and to a lack of overall coordination. Is that bad? This method contributes to effective science in the United States. When dealing with science and technology on a government to government basis, I can understand why the Ambassador may think it is "arbitrary."

Because we have a four-year presidential cycle and a one-year budget cycle, this allows for potential "inconsistency" in the budgeting of projects. These cycles are fundamental to our system, yet some mechanism is necessary to extend support for domestic projects beyond one year.

International science and technology agreements are primarily based on the good faith and understanding of all parties involved. Occasionally, decisions are made affecting these agreements that, in fact, appear to be "arbitrary." Many of these decisions are the result of financial stringencies that could not have been foreseen at the time the agreements went into effect. On a number of occasions over the past decade or so, the United States has changed its funding position on international projects. Decisions regarding Solvent Refined Coal, Intense Neutron Source, Fusion Materials Irradiation Test, Large Coil Test Facility, and the Fast Flux Test Facility were economically justifiable in terms of the costs to the United States' programs and other budget priorities. However, significant distress was felt by our international partners. It does not take many events such as these to arouse fears that our actions are arbitrary. Because they are part of the budget process, the options under consideration need to remain secret until the budget is sent to Congress. Can agencies receive assurances from the Office of Management and Budget that our international agreements will be honored? Probably not, unless these agreements are elevated to the status of a treaty. I understand that environmental consequences of budget items are required to be mentioned during budget preparation. Perhaps it is also necessary to include the international consequences of our proposed actions in the budget. Our international colleagues are now asking us the meaning of our agreement to participate in projects. If the United States expects to invite international collaboration in its projects, it must consistently uphold its part of the deal.

Other Opportunities

The unique advantage which the Department of State possesses is its knowledge of and sensitivity to the technical and political interests of our foreign partners and potential partners. The Department of State is in the best position to determine when and where opportunities exist for cooperation and burden sharing. It has an excellent track record in identifying and exploiting such opportunities.

The lack of adequate financial resources is one factor which makes exploitation of these opportunities uncertain. Neither the influence nor the credibility of the United States can be successfully developed without adequate funding. The Support for the East European Democracy Act of 1989 (P.L. 101-179) authorizes appropriations for science and technology exchanges with Poland and Hungary for a total of $2 million in 1990. Even this modest amount is reduced by section 614 of the Department of State Appropriations Act of 1990 (P.L. 101-162). Although SEED appropriates $300 million, that amount has been said to be small compared to the total economic development needs of those countries. I earlier mentioned that "Better technology will be the engine for increased growth." Wouldn't the return on our investment be greater if 10 percent of the total appropriations, or $30 million, were to be spent on upgrading the scientific and technical communities of those countries? The impact of this investment on the scientific community would be substantial.

Another factor limiting our ability to take full advantage of our opportunities is the use of science and technology agreements to advance our political and technical goals. There probably are opportunities being missed by the United States regarding burden sharing in science and technology. In some cases appropriate, and in some cases misguided, efforts to prevent the flow of technology from the United States have probably resulted in the prevention of agreements and exchanges that would have been benefited the United States and other countries.

Additional efforts for international cooperation abound that offer the opportunity for burden sharing. I believe animals can be used for certain types of research trials that lead to the reduction of disease. However, the idea that different sets of animals need to be used in different countries to get the same information seems foolish to me. Information and research results should be shared across national borders to minimize the use of animals in research.

Conclusions

Science and technology are dynamic international activities. The hallmark of our national strength is our capacity to produce, and disseminate knowledge. Our nation does very well in acquiring knowledge from domestic sources but there are tremendous opportunities for collaboration through international agreements based on symmetry. Our expanding environment allows the United States to increase its economic well-being through technological advancement. Rigid and uncompromising positions on intellectual property rights can cost our country dearly in the global competitiveness battle.