INTERNATIONAL SCIENCE AND TECHNOLOGY COOPERATION

HEARING

BEFORE THE

SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

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CONTENTS

April 2, 2008

	Page
Witness List	2
Hearing Charter	3

Opening Statements

Statement by Representative Brian Baird, Chairman, Subcommittee on Research and Science Education, Committee on Science and Technology, U.S. House of Representatives	8
Written Statement	9
Prepared Statement by Representative Vernon J. Ehlers, Ranking Minority Member, Subcommittee on Research and Science Education, Committee on Science and Technology, U.S. House of Representatives	10
Prepared Statement by Representative Eddie Bernice Johnson, Member, Subcommittee on Research and Science Education, Committee on Science and Technology, U.S. House of Representatives	11
Prepared Statement by Representative Russ Carnahan, Member, Subcommittee on Research and Science Education, Committee on Science and Technology, U.S. House of Representatives	11
Statement by Representative Randy Neugebauer, Member, Subcommittee on Research and Science Education, Committee on Science and Technology, U.S. House of Representatives	10
Written Statement	11

Witnesses:

Dr. John H. Marburger, III, Director, Office of Science and Technology Policy	
Oral Statement	12
Written Statement	14
Biography	16
Dr. Arden L. Bement, Jr., Director, National Science Foundation	
Oral Statement	17
Written Statement	19
Biography	25
Dr. Nina V. Fedoroff, Science and Technology Advisor to the Secretary of State, U.S. Department of State; Administrator of USAID	
Oral Statement	26
Written Statement	27
Biography	32
Mr. Jeff Miotke, Deputy Assistant Secretary for Science, Space, and Health, Bureau of Oceans, Environment, and Science, U.S. Department of State	
Oral Statement	33
Written Statement	34
Biography	45
Mr. Michael F. O'Brien, Assistant Administrator for External Relations, National Aeronautics and Space Administration	
Oral Statement	46
Written Statement	47
Biography	50
Discussion	51

Page

Appendix: Answers to Post-Hearing Questions

Dr. John H. Marburger, III, Director, Office of Science and Technology Policy . 78
Dr. Arden L. Bement, Jr., Director, National Science Foundation 79
Dr. Nina V. Fedoroff, Science and Technology Advisor to the Secretary of State, U.S. Department of State; Administrator of USAID 80
Mr. Jeff Miotke, Deputy Assistant Secretary for Science, Space, and Health, Bureau of Oceans, Environment, and Science, U.S. Department of State 81

INTERNATIONAL SCIENCE AND TECHNOLOGY COOPERATION

WEDNESDAY, APRIL 2, 2008

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:06 a.m., in Room 2318, Rayburn House Office Building, Hon. Brian Baird [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
RANKING MEMBER

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SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION

International Science and Technology Cooperation

Wednesday, April 2, 2008
10:00 a.m. - 12:00 p.m.
2318 Rayburn House Office Building

Witnesses

Dr. John H. Marburger, III
Director
Office of Science and Technology Policy

Dr. Arden L. Bement, Jr.
Director
National Science Foundation

Dr. Nina V. Fedoroff
Science and Technology Adviser to the Secretary
U.S. Department of State

Mr. Jeff Miotke
Deputy Assistant Secretary of State for Science, Space and Health
Bureau of Oceans and International Environmental and Scientific Affairs
U.S. Department of State

Mr. Michael F. O'Brien
Assistant Administrator for External Relations
National Aeronautics and Space Administration

HEARING CHARTER

SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

International Science and Technology Cooperation

WEDNESDAY, APRIL 2, 2008
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

1. Purpose

The purpose of the hearing is to examine the mechanisms by which federal priorities are set and interagency coordination is achieved for international science and technology cooperation, and to explore the diplomatic benefits of such cooperation.

2. Witnesses:

Dr. John H. Marburger, III, Director, Office of Science and Technology Policy.

Dr. Arden L. Bement, Jr., Director, National Science Foundation.

Dr. Nina V. Fedoroff, Science and Technology Adviser to the Secretary of State.

Mr. Jeff Miotke, Deputy Assistant Secretary of State for Science, Space and Health, Bureau of Oceans and International Environmental and Scientific Affairs.

Mr. Michael F. O'Brien, Assistant Administrator for External Relations, National Aeronautics and Space Administration.

3. Overarching Questions:

- What is the scope of current efforts in international science and technology (S&T) cooperation? What is the scope of efforts in the Middle East and the developing world? To what extent is S&T cooperation integrated into our diplomatic activities in the Middle East and the developing world? What makes S&T cooperation successful as a diplomatic tool? What makes it unsuccessful?
- What are the respective roles of the Department of State, the U.S. Agency for International Development, the mission agencies (such as Department of Energy and National Institutes of Health), and the National Science Foundation in international science and technology cooperation? How does each agency set its priorities for S&T cooperation? What is the role of the Office of Science and Technology Policy in fostering international science and technology cooperation and in coordinating federal activities?
- How is interagency coordination of international S&T cooperation currently achieved? In what ways could interagency coordination be improved? Is there value in reinstating the Committee on International Science and Technology under the National Science and Technology Council? In what other ways can the Federal Government increase and improve the use of S&T in its diplomatic missions?

4. Overview

Science and technology were closely tied to American diplomacy in the early years after the founding of the United States. In fact, the first Secretary of State, Thomas Jefferson, was also designated the administrator of the Nation's first patent law, and the first efforts to establish a bureau of weights and measures were also associated with the Department of State. By the 1830's, this close relationship between diplomats and scientists seems to have diminished. It was not until World War II that science and technology (S&T) once again began to play a prominent role in the State Department. Nevertheless, the U.S. continued to engage in international science and technology cooperation for other purposes. For example, the first International Polar Year, a coordinated international effort to collect and analyze data

about the polar regions, occurred in 1882–83. We are currently in the middle of the third International Polar Year.

There are a number of reasons why the United States has and will continue to engage in international science and technology (S&T) cooperation, including:

- to strengthen U.S. science by providing our own scientists access to the best scientists and research sites around the world;
- to enable construction of and participation in prohibitively expensive world-class research facilities (either on U.S. soil or foreign sites) by partnering with foreign countries to leverage their funds and scientific talent;
- to address U.S. interests in global matters, such as non-proliferation, water resources, climate change and infectious diseases, in part by ensuring that foreign and international (e.g., U.N.) decision-makers have access to the best science;
- to help build technological capacity and address health and resource crises in other countries in order to help maintain U.S. national security and economic interests; and
- to help build more positive relationships with other countries - what is often called "science diplomacy."

This is certainly not an exhaustive list nor the only way to break down the rationale for engaging in international S&T cooperation. One former State Department official prefers the following categories: science for science's sake; science for the decision-maker; science for development; and science for diplomacy. The witnesses for this hearing are likely to provide their own lists of reasons why the Federal Government broadly, or their respective agencies specifically, engage in S&T cooperation.

In addition to the Department of State and the U.S. Agency for International Development (USAID), every federal agency that either does its own research or funds academic research (or in most cases, both) supports international S&T cooperation, including Departments of Agriculture, Defense, Energy, Commerce (includes NIST and NOAA), and Health and Human Services (includes NIH) as well as NASA, the Environmental Protection Agency, and the National Science Foundation (NSF). The Office of Science and Technology Policy advises the President on matters of science and technology as they relate to international issues, and provides intellectual support to the Department of State and USAID on S&T matters. State and USAID also turn to NSF and the mission agencies for intellectual input on S&T-related issues that fall within those agencies' areas of expertise, such as health, energy or water. The mission agencies, on the other hand, turn to the Department of State for assistance in negotiating formal agreements with other nations. A more detailed description of the different agencies' roles is provided below.

The National Science Board (NSB) recently issued a report, "International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and our Nation's Innovation Agenda,"[1] in which the Board makes a series of recommendations for increased coherence and coordination of federally sponsored international science and engineering activities.

5. Roles of Federal Agencies

Office of Science and Technology Policy

The Director of the Office of Science and Technology Policy (OSTP) is, by statute, the President's adviser on science and technology matters for all areas of national concern, including foreign relations and national security, as well as for "emerging international problems amenable to the contributions of science and technology."

The OSTP Director, through the National Science and Technology Council, is also responsible for interagency coordination of federal research and development programs, which includes programs, such as the International Polar Year, that are part of an international partnership. But OSTP does not have an explicit mandate for coordination of all international activities, nor does the office have any program budget or management responsibilities of its own.

The NSB report mentioned previously calls on OSTP to take a more active and prominent role both in setting federal priorities for international science and engineering cooperation and in coordinating efforts across agencies. For example, the Board recommends that OSTP "should directly charge federal agencies to include specific components of international R&D in their integrated programs" and urges the National Science and Technology Council to reestablish a Committee on International Science, Engineering and Technology (CISET). Staff participated in con-

[1] *http://www.nsf.gov/nsb/publications/2008/nsb084.pdf*

versations in which three former high-level officials familiar with CISET during the Clinton Administration (it was dissolved in 2000) expressed concern that a new CISET would have the same difficulty as its predecessor in carving out a unique role for itself, but did add that it was a useful place for information sharing across agencies. One of the CISET subcommittees, for example, developed an inventory of all federal S&T programs related to developing countries. No other organization has taken on responsibility for updating that inventory.

National Science Foundation

The National Science Foundation (NSF) supports science for science's sake; like the other research agencies, NSF's mission does not include diplomacy or development, although it certainly supports research in many areas that are critical to policy-makers across the globe. NSF has an Office of International Science and Engineering (OISE), housed within the Office of the Director. In addition to having region-knowledgeable staff at NSF headquarters, OISE manages three overseas offices in Paris, Tokyo and Beijing. The FY 2009 budget request for OISE is $47 million, a 15 percent increase over planned spending for FY 2008. Approximately $10 million of the OISE budget goes to the Office of Science and Technology Policy (OSTP) to pay dues in international organizations. The rest of the research budget goes toward two types of international science and engineering collaboration: support for U.S. scientists to travel to foreign sites for collecting data and scientist-to-scientist collaboration. NSF does not fund foreign researchers directly.

In particular, OISE supports:

- International research experiences for U.S. undergraduate and graduate students;
- Doctoral dissertation enhancement projects for U.S. students at foreign sites;
- International postdoctoral research fellowships;
- Partnerships for International Research and Education (PIRE) grants of $500,000 per year for five years for the development of models for long-term international partnerships; and
- International planning visits and workshops.

In addition to supporting such activities directly, OISE helps facilitate and provide some supplementary funds for international research collaborations supported by all NSF directorates. According to NSF, the agency in total supports $300–$400 million annually on research grants involving international collaborations. In addition, NSF can support the Department of State and non-governmental foundations (such as the Civilian Research and Development Foundation) by helping to identify leading academic scientists and engineers (U.S. and foreign), reviewing proposals, and otherwise providing intellectual support and credibility.

Department of State

The Department of State has S&T diplomatic strategies related to a number of international issues, including water management, energy, agriculture, natural resource management, infectious diseases and biodiversity. It also promotes international scientific cooperation through bilateral and multilateral science and technology agreements to "promote the precepts of sustainable development, enhancement of the role of women in science and society, science-based decision-making, good governance, and global security more broadly."

The Bureau of Oceans, International Environmental and Scientific Affairs (OES) is responsible for coordinating the formal S&T agreements. There are currently 39 formal bilateral agreements, most of which are not funded and some of which are inactive altogether. Some of the newest agreements, including an agreement not yet signed with Saudi Arabia, are part of a State Department policy to enhance relations with the Middle East.

Distinct from OES is the Office of the Science and Technology Adviser (STAS).[2] Dr. Nina Fedoroff became the agency's third S&T Adviser in July, 2007. The goals of STAS are to enhance S&T literacy throughout the Department; build partnerships with the S&T community; provide accurate S&T advice to the Department;

[2] The Secretary of State's Advisory Committee on Transformational Diplomacy: State Department in 2025 Working Group recently issued a report that includes a discussion of how S&T could be better integrated into the State Department. The working group raised concerns about having a science adviser outside of OES and without any real power of her own, and suggested that the same person could serve as both Science Adviser and the Assistant Secretary for OES, or alternatively that the Science Adviser could be the Principal Deputy Assistant Secretary in OES. (*http://www.state.gov/documents/organization/99879.pdf*)

and help shape a global perspective on the emerging S&T developments anticipated to affect current and future U.S. foreign policy.

U.S. Agency for International Development

The U.S. Agency for International Development (USAID) is the primary agency supporting science for development. Many USAID initiatives on S&T related issues, such as infectious diseases, energy, natural resources management, and agriculture, draw on or build up local and regional S&T capacity in addition to contributing American know-how and resources.

USAID used to have a separate Bureau for Science and Technology, but several years ago that Bureau was dismantled and the science and technology activities spread among the appropriate functional and regional bureaus. However, when Dr. Fedoroff was appointed Science and Technology Adviser to the Secretary of State, she convinced Secretary Rice to assign to her the additional role of S&T Adviser to USAID Administrator Henrietta Ford.

Mission Agencies

Aside from NSF, the National Institutes of Health (NIH) and the USDA are the only research agencies with explicit international programs. In fact, NIH has a separate Fogarty International Center for Advanced Study in the Health Sciences, which addresses global health challenges through collaborative research and training programs and international partnerships. USDA has many international programs, including international offices and overseas laboratories, in addition to the Foreign Agriculture Service.

The remainder of the mission agencies also engage in international science cooperation, but wrap those projects into their domestic programs rather than having separate programs or offices. NASA in particular has international partners for most of its big projects due to the tremendous costs of building and launching into orbit the kinds of telescopes and other research and exploration equipment required for their mission. All of these domestic mission agencies are careful to state that they only engage in science cooperation for the sake of science and do not have or want a role in diplomacy or development.

6. Questions for Witnesses

Dr. Marburger

- What is the role of the Office of Science and Technology Policy (OSTP) in fostering international science and technology (S&T) cooperation and in coordinating federal activities? What is OSTP's role relative to that of the Department of State?
- How does the Administration set priorities for international S&T cooperation? Is there any regular, forward-looking process by which goals are set by OSTP or by the National Science and Technology Council (NSTC)? What is your response to the National Science Board's recommendation to reconstitute the Committee on International S&T under NSTC?

Dr. Bement

- What is the role of the National Science Foundation (NSF) in fostering international science and technology cooperation? What is NSF's role relative to that of the Department of State and of the mission agencies? To what extent does NSF coordinate its efforts with other agencies?
- How does NSF set its own priorities for international collaboration? How does the Office of International Science and Engineering coordinate its activities with the various research directorates?
- What is the extent and nature of NSF supported collaborations in the Middle East and in the developing world? How can NSF best support the growth of science and engineering research capacity in developing countries without compromising its own rigorous merit review system? Does, or could, NSF play any role in institution building—that is in helping to build NSF-like organizations—in such countries?

Dr. Fedoroff

- What is the role of the Science and Technology Adviser to the Secretary of State in fostering international science and technology (S&T) cooperation?

What is the role of your office relative to that of the Bureau of Oceans, Environment and Science?

- How do you coordinate your efforts with other agencies, including the Office of Science and Technology Policy, the National Science Foundation, and the mission agencies? How do you coordinate your efforts with non-governmental science organizations such as AAAS and The National Academies, and with private foundations?
- What is the Science and Technology Adviser's role at the U.S. Agency for International Development (USAID)? What is USAID's role in international S&T cooperation and how does it differ from that of the State Department?
- What makes S&T cooperation successful as a diplomatic tool? What makes it unsuccessful? To what extent is S&T cooperation currently integrated into our diplomatic activities in the Middle East and the developing world? How could the Federal Government make more effective use of S&T in its diplomatic activities?

Mr. Miotke

- What is the role of the Department of State in fostering international science and technology (S&T) cooperation? What is the role of the Bureau of Oceans and International Environmental and Scientific Affairs (OES)? How does OES set priorities for S&T cooperation?
- How does OES coordinate its efforts with other agencies, including the Office of Science and Technology Policy, the National Science Foundation and the mission agencies? How do you coordinate your efforts with non-governmental science organizations such as AAAS and The National Academies, and with private foundations?
- What is the extent and nature of OES sponsored S&T collaboration in the Middle East and in the developing world? What benefits have you seen from your S&T efforts in those regions? In what ways might OES better engage and leverage the U.S. science and engineering enterprise in its diplomatic activities, especially in the Middle East and the developing world?

Mr. O'Brien

- Please provide an overview of the types of international science and technology partnerships and cooperative agreements in which the National Aeronautics and Space Administration (NASA) participates. Does NASA have any presence in the developing world?
- Why does NASA engage in international science and technology cooperation? What are the benefits to NASA and to the broader scientific community? How and based on what criteria does NASA set its priorities for international cooperation?
- What are the roles of other agencies, including the Department of State and the Office of Science and Technology Policy, in supporting or helping to develop NASA's international activities? Does the process of working with the Department of State to negotiate science and technology agreements with other countries work well? Do you have any recommendations for how this process could be improved?

Chairman BAIRD. We have been joined by Roscoe Bartlett, Dr. Bartlett, and also, by Dr. Jerry McNerney, as well. I am Congressman Brian Baird.

This is a topic that I am tremendously excited about. It has a proud history in our country. It has great importance to our future, and we have been learning a lot about the topic, and today, we have an extraordinarily distinguished panel of guests.

One of the reasons I am excited about this is that, if you look at the history of America, one of the most famous Americans, maybe the most famous worldwide American, apart perhaps, from George Washington of course, was Ben Franklin, and it wasn't because of Poor Richard's Almanac. It was because of his scientific work, and I am searching the annals of Ben Franklin's writings for a substitute quote for Tennyson up here, because Tennyson didn't have a lot to do with U.S. science, last I checked, but we believe passionately on this committee, and particularly, this subcommittee, that science and diplomacy should intermix—that they should be co-equals and co-partners, and an essential part of the soft power strategy of this country.

And I am sure that that is a position likely shared by our witnesses here today. We have had a series of hearings. We had a very productive hearing about the whole issue of visas, and how student visas and other visas relate, and can either add to or detract from our efforts to attract scientists, and to collaborate with other countries.

Today, we want to hear about a different topic. We want to—obviously related, but we want to hear about how various departments within the government and various agencies, perform the collaborative mission, and the mission of sharing scientific information. As I have read the testimony, and thank you all, it is outstanding testimony, very insightful—the take home message for me is, on a very positive front, to be honest. I think our country had kind of gone through periods, as probably any effort does, but we had been, for a while, in maybe a bit of a dip in our profile, in our commitment to scientific diplomacy, but I think that is on the upsurge by a darn sight. And the people here today are largely responsible for that, and I give you great credit for it, and pledge the support of this committee in further developing that.

But at the same time, it is fairly clear that there are some areas that we ought to at least consider ways in which we can further enhance this mission; issues of lines of authority within the various agencies, issue of explicit mission, in terms of certain agencies, issues of funding, where funding comes from, how it is allocated, to what extent is funding able to be used not just to fund U.S. scientists, but to fund collaborative efforts, issues about where we may need more or different personnel, for example, in embassies abroad. Do we need a stronger science profile in our international embassies? Do we need designated people at multiple agencies who are in charge of the international exchange in scientific diplomacy? These are some of the core questions that have emerged, as I have looked at your testimony and others, at experts, and we look very much forward to your comments today.

I would also say that I personally believe that science has a role in our diplomacy, particularly in areas of the Middle East, can be

especially valuable, and my colleagues have sometimes heard this story, but I will share it, because it was so impressive. I was at the World Economic Forum in Sharm el-Sheikh. I was with my good friend, and we all know, Chairman of the Foreign Relations Committee, Howard Berman, and we were meeting people there, and we met, I think, a woman who was Egyptian. She had a head scarf on, and we were just doing informal introductions, and we said this is Howard Berman. He is from Southern California. Her response was to raise a proud fist in the air, and say, I am a mighty Trojan. Now, she did not say, oh, how do you do, I went to school in Southern California. No, no, this woman was a mighty Trojan. She had just totally internalized the commitment and the values of a U.S. school. That sort of passion and friendship and intrinsic understanding of our system is literally invaluable.

We can talk about where the budget lines are, and how much we spend, et cetera, but to have people internationally who not only know our system, but love it, and have a personal commitment to it, is the measure, we just cannot measure the merit of that, and I will tell you, that was one striking example of literally thousands. And I know all of you have had those same experiences as you've traveled the world. It is something we must not lose in this country and in our scientific mission. And so, this committee, certainly this Member, is very, very committed to that.

With that, I want to introduce Mr. Neugebauer, who is filling in as Ranking Member for Vern Ehlers. Dr. Ehlers is very sorry he couldn't be here. As you know, he was Chair of this committee previously, and has a long, long and strong history of commitment to international science cooperation.

Mr. Neugebauer, thank you.

[The prepared statement of Chairman Baird follows:]

PREPARED STATEMENT OF CHAIRMAN BRIAN BAIRD

Good morning. Welcome to this Research and Science Education Subcommittee hearing on *International Science and Technology Cooperation.*

This is the second hearing that this subcommittee has held on the role of the Federal Government in fostering international scientific cooperation and science diplomacy. At the first hearing we focused on how we might improve visa policy to facilitate the open exchange of students and scholars.

More recently we hosted a roundtable on the broader topic of international science cooperation with four distinguished former State and USAID officials who have since left government. They were able to provide me and our colleagues who attended the roundtable with insightful observations about what has and has not worked, as well as engage in creative brainstorming free from the political and time constraints of a formal hearing. I learned a great deal and was very impressed with the amount of international science and technology cooperation that is already going with the assistance of the Federal Government. We will hear more about some of this today.

Unfortunately, I also learned that we must do more to maximize the effectiveness of science and technology cooperation. Cooperation should not be pursued simply as a means of achieving bigger and better science. It should also be pursued for the sake of development, diplomacy, and informing decision-makers around the world about critical environmental, security, economic, resource and health issues. It seems to me that the Federal Government might need an organization and a process dedicated to setting government-wide priorities and overseeing implementation of those priorities. One of my goals for this hearing is to understand how—or if—the Federal Government sets priorities for international science cooperation, and who is or *who should be* responsible for coordinating and overseeing the entire effort.

There have been some attempts in the past—such as the creation of a Committee on International Science, Engineering and Technology under the President's National Science and Technology Council—to assign that task to a dedicated organiza-

tion. Some experts have suggested assigning this task to the State Department itself. To that end, Congress created a Science and Technology Adviser to the Secretary of State in 1999. Dr. Nina Fedoroff is the third renowned scientist to hold that position. In a demonstration of her commitment to better integrate science in our diplomatic activities, Dr. Fedoroff personally lobbied Secretary Rice to broaden her job description to include Science Adviser to the Administrator of USAID.

While the State Department may be at the center of many of these efforts, I would be remiss to downplay the critical role played by a number of other agencies, including the National Science Foundation; the mission agencies, represented here today by NASA; and the Office of Science and Technology Policy, which has responsibility both for advising the President on the science and technology components of national and international issues, and for coordinating research and development activities across the Federal Government.

Today, representatives from these agencies will tell us about current efforts and opportunities in international science and technology cooperation and help us understand how such cooperation benefits the United States and the world. I want to thank all of the witnesses for taking the time to appear before the Committee this morning and I look forward to your testimony.

Mr. NEUGEBAUER. Well, thank you, Mr. Chairman, and good morning, and Dr. Ehlers is sorry he could not be here to greet these esteemed—to hear these great witnesses today, and hear their testimony, but he is giving his own testimony before a committee this morning, and cannot be here. Hopefully, we will have the benefit of his presence shortly, but in the meantime, I ask unanimous consent that his opening statement be inserted into the record.

Chairman BAIRD. Without objection.

[The prepared statement of Mr. Ehlers follows:]

PREPARED STATEMENT OF REPRESENTATIVE VERNON J. EHLERS

International diplomacy can be crafted through a variety of mediums. Science and technology as a vehicle of diplomacy has been explored by our nation, but I believe it is currently underutilized. This hearing will help us understand both the established foundation of science diplomacy and how we might build upon it.

While I share the concern about the fiscal year 2008 omnibus and its impact on the ITER agreement, this is only one symptom of a greater problem: the perceived worth that scientific collaboration has to our foreign affairs. While it is hard to gauge the return on investment in international science and technology cooperation, it is much easier to realize the cost of *not* investing in these types of endeavors. Furthermore, the U.S. will not remain globally competitive in science and technology unless we are able to work with international partners on large facilities that simply cannot be financed by individual nations. In many fields, U.S. researchers would be crippled by lack of participation in these activities.

I am very pleased that Dr. Fedoroff is testifying today and I believe that the Science and Technology Advisor position at the Department of State has helped build the profile of science and technology diplomacy. Thank you for your attendance, and I look forward to testimony from our panel today.

Mr. NEUGEBAUER. The issue of international science and technology cooperation is one of importance to this nation. This committee spends a significant amount of time talking about American science and technology developments and improvements in terms of global competitiveness. That is as it should be, and is necessary if we are going to remain ahead of the innovation curve.

We do not spend as much time talking or hearing about global cooperation and collaboration when it comes to science and technology, but we are actively involved in these equally important endeavors, and I commend the Chairman for his interest in this topic, and for calling this hearing today. I am pleased to see that we have such a distinguished panel before us this morning to give us an update on what their agencies are doing and any challenges or obsta-

cles that they may be facing when it comes to international cooperation.

I thank you for coming, and I look forward to your testimony, and I yield back the balance of my time.

[The prepared statement of Mr. Neugebauer follows:]

PREPARED STATEMENT OF REPRESENTATIVE RANDY NEUGEBAUER

Thank you, Mr. Chairman, and good morning.

Dr. Ehlers is sorry he cannot be here to greet these esteemed witnesses and hear their testimony, but he is giving his own testimony before another Committee this morning and cannot be here. Hopefully, we will have the benefit of his presence shortly, but in the meantime, I ask unanimous consent that his opening statement be inserted for the record.

The issue of international science and technology cooperation is one of importance to this nation. This committee spends a significant amount of time talking about American science and technology developments and improvements in terms of global competitiveness. That is as it should be and is necessary if we are to remain ahead of the innovation curve.

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I am pleased to see that we have such a distinguished panel before us this morning to give us an update on what their agencies are doing and any challenges or obstacles they may be facing when it comes to international cooperation. I thank you for coming; I look forward to your testimony; and I yield back the balance of my time.

Chairman BAIRD. Thank you, Mr. Neugebauer. If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF REPRESENTATIVE EDDIE BERNICE JOHNSON

Good morning. Thank you, Mr. Chairman, for holding today's hearing on international collaborations in science and technology.

In addition to my service on this committee, I also lead an International Woman's Peace Initiative that is dedicated to improving peace through the empowerment of women.

I will be interested to know how our federal science enterprise is reaching out to other nations and utilizing scientific collaborations to strengthen ties to them. Specifically, S&T outreach to the Middle East is of interest to me.

I have also had the opportunity to travel to Cuba several times. I know that the United States has medical students who are there, trying to earn their medical degrees.

International scientific collaborations with Cuba have decreased dramatically under the current Administration. This stricture has robbed American citizens of important medical breakthroughs, simply because our diplomats don't want to do business with Cuba.

Scientific collaborations, when pursued, can serve as salve in old wounds, to speed their healing. When those bonds are loosened or broken, harm may be done.

I want to thank today's panelists for your presence here today and for the information that you are about to share. Members of this committee want to ensure that international collaborations are sustained and are well-coordinated.

Thank you, Mr. Chairman. I yield back.

[The prepared statement of Mr. Carnahan follows:]

PREPARED STATEMENT OF REPRESENTATIVE RUSS CARNAHAN

Mr. Chairman, thank you for hosting this important hearing on international science and technology.

As a Member of both the Subcommittee on Research and Science Education and the House Committee on Foreign Affairs, I am pointedly interested in the coordination of international science and technology diplomacy. The United States has a cen-

tral role in science diplomacy, building more positive relationships with other countries through science. We also understand that the U.S. can better affect U.S. national security and economic interests by helping to build technological capacity in other countries. I am particularly interested in the role that the Department of State plays in the effort and look forward to hearing more details.

I would like to thank today's witnesses, Dr. Marburger, Dr. Bement, Dr. Fedoroff, Mr. Miotke, and Mr. O'Brien for coming before the Committee. I look forward to hearing their testimony.

Chairman BAIRD.At this time, it is my great privilege to introduce our witnesses. Dr. John Marburger is the Director of the Office of Science and Technology Policy, and in that role, serves as the President's chief science advisor. Dr. Arden Bement is the Director of the National Science Foundation, one of only three research agencies with explicit international programs. Dr. Nina Fedoroff recently became the third Science and Technology Advisor to the Secretary of State, and the first to serve also as S&T Advisor to the Administrator of USAID. Mr. Jeff Miotke is the Deputy Assistant Director of State for Science, Space and Health in the Bureau of Oceans and International Environmental and Science Affairs, and Mr. Michael O'Brien is the Assistant Administrator for External Relations of the National Aeronautics and Space Administration, and responsible for managing NASA's international agreements across its mission directorates.

As our witnesses know, spoken testimony is limited to five minutes, but we are fairly flexible on this committee. And then, we will follow with five minutes of questioning on each side. And at this point, we will hear from our first witness.

Mr. Marburger, Dr. Marburger, please, thank you for being here.

STATEMENT OF DR. JOHN H. MARBURGER, III, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

Dr. MARBURGER. Thank you very much, Mr. Chairman, Ranking Member Neugebauer, Members of the Subcommittee. I am quite glad to be here. Having served on the faculty of University of Southern California for many years, and a Dean there, I think of myself as a Trojan, as well.

In your invitation, you asked two multi-part questions that I have answered somewhat implicitly in my written testimony, and in my oral remarks this morning, I want to address those specific questions very succinctly, and I would be glad to provide more detail in response to your questions.

My written testimony responds mainly to question 1: "What is the role of OSTP in fostering international science and technology cooperation, and in coordinating federal activities?" And also: "What is OSTP's role relative to that of the Department of State?" These are important questions, and we try to be clear about them in my office.

In brief, OSTP provides support to agencies with respect to their international science and technology activities, and to the Department of State, with respect to its overall responsibility for coordinating all international activities. We do not seek to duplicate or replace the State Department in this responsibility, nor does OSTP establish diplomatic priorities or objectives, and we actively discourage other agencies from taking actions that may infringe upon the State Department's responsibility in this regard.

On the other hand, I actively discourage the Department of State from taking actions that imply or entail commitments with international partners that require expenditures within other departments and agencies without prior consultation and arrangement with those departments, and agreements about the source of funds and the responsibility for the programs. The State Department does this, and I think they do it well.

The second question asks how the Administration sets priorities for international science and technology cooperation, and is there any regular forward-looking process by which goals are set by OSTP, or by the National Science and Technology Council, NSTC, that you referred to. And then, finally, what is my response to the National Science Board's recommendation to reconstitute a Committee on International Science, Engineering, and Technology, under NSTC.

Well, as I explained in my written testimony, science is intrinsically internationally, and the Administration expects each agency to include such international components in its programs as are appropriate to their objectives. The current annual priority guidance to departments and agencies from my office and OMB specifically refers to international activity in a bulleted priority, and I am quoting from that document, "to encourage interdisciplinary research efforts on complex scientific frontiers, and strengthen international partnerships to accelerate the progress of science across borders." That is currently an Administration priority to the agencies.

OSTP does not consider the international dimension of science and technology as distinct or separable from specific technical areas, such as nanotechnology or nuclear physics or planetary science. We look to other countries for help in achieving our missions and goals for those kinds of areas. The Administration does not set priorities for international cooperation independently of priorities in the various areas of science, except to achieve diplomatic objectives, and that priority is established by the State Department.

OSTP assists the State Department in identifying agencies and topics appropriate for achieving diplomatic objectives on a case by case basis. Agencies are responsible for determining what international capabilities are appropriate to seek in support of agency goals, and all agencies with significant science capabilities do have international offices.

So, in the view that I have described, the question of goal-setting takes a somewhat different significance than your question implies. The only appropriate top-down goal-setting for international programs is either very broad, as in international collaborations are viewed very positively, or they are related to foreign policy objectives which are promulgated by the State Department, in which case, they do not necessarily refer specifically to science topics.

In my view, more specific top-down goal-setting is counterproductive, and encourages the making of international commitments that are mismatched to agency budgets and programs, and consequently, I do not agree with the recommendation to form a Committee on International Science, Engineering, and Technology under the NSTC. The meetings and products of such a committee

would be duplicative or existing, of existing topic-specific activities that are conducted in connection with the current vigorous program of international collaborations.

I met with the National Science Board Committee that made this recommendation, and advised strongly against it. While I agree with much in that National Science Board, I do not agree with this recommendation.

So, in conclusion, I want to emphasize that science is strongly international almost by definition, and federal departments and agencies do participate broadly and actively in international collaborations. It is appropriate to fund science programs to achieve diplomatic objectives, and those objectives are defined by the Department of State, and the programs are carried out by agencies consistent with their roles and responsibilities.

My office acts as a broker to support State in these objectives, and as a coordinator of the technical component of official activities, such as science and technology agreements and joint commissions. Resources and staffing does exist to perform these functions, and I believe they are being performed well overall.

So, I thank you for the opportunity to make these remarks, and refer you to my written testimony, which I would request be made part of the record.

[The prepared statement of Dr. Marburger follows:]

PREPARED STATEMENT OF JOHN H. MARBURGER, III

Chairman Baird, Ranking Member Ehlers, and Members of the Subcommittee, I appreciate this opportunity to appear before you to discuss *International Science and Technology Cooperation.* Science has always been an international activity, and "strengthening international partnerships to accelerate the progress of science across borders" is an important and explicit priority for Executive Branch departments and agencies.

The *National Science and Technology Policy Organization and Priorities Act of 1976* (Public Law 94–282) requires the OSTP Director "[to] assess and advise on policies for international cooperation in science and technology which will advance the national and international objectives of the United States." OSTP manages this responsibility through an active program coordinated by a full time Assistant to the Director for International Relations. The Assistant to the Director works with the Department of State and all agencies engaged in international science programs, and particularly with the international offices of the National Science Foundation (NSF), Department of Energy (DOE), Department of Health and Human Services (HHS) (including its National Institutes of Health (NIH)), and the National Aeronautics and Space Administration (NASA). She maintains current knowledge of the international issues and activities of these agencies, maintains contact with offices such as the National Security Council within the Executive Office of the President, and meets routinely with the Science Counselors from other countries at the Embassies located in Washington, D.C. Under her coordination, OSTP staff reviews all international Science and Technology agreements.

OSTP is a staff office within the Executive Office of the President, and does not fund domestic or international programs. Such programs are developed and funded by agencies in accordance with the needs and objectives of their missions. Just as science is an intrinsic component of many of those missions, international science cooperation is an intrinsic component of science, and not a separate objective. U.S. diplomatic objectives are established and coordinated by the Department of State. Each agency has its own international affairs officer who maintains contact with the State Department, in most cases with the Bureau of Oceans and International Environmental and Scientific Affairs (OES) currently headed by Assistant Secretary Claudia McMurray and with the Bureau of International Organization Affairs (IO) currently headed by Assistant Secretary Kristen Silverberg. OSTP provides policy guidance and technical support to all departments including the Department of State.

Science policy is necessarily based on input from the science community which comes to Executive Branch policy offices through the agencies that fund their work. The function of the OSTP-staffed National Science and Technology Council (NSTC), among other things, is to ensure that this information is incorporated systematically in agency plans and programs. The OSTP international program balances this "bottom up" practice with "top down" coordination of formal multi-agency interactions with other countries as described in more detail below. Agencies manage their collaborations and fulfill their commitments under umbrella S&T agreements through their individual international offices.

During the past six years, OSTP has experimented with various arrangements for coordinating agency international science and technology programs. The most successful approach has been one that draws together agencies in meetings focused on specific science topics such as nanotechnology or genomics, or on specific countries such as China or Brazil. The former meetings occur naturally in the NSTC context, the latter occur on the schedule of high-level bilateral commission meetings to review progress under the S&T agreements. The agencies are satisfied with this arrangement, which has been very productive. Nanotechnology provides an excellent example of a successful internationally coordinated program. Through the NSTC Subcommittee on Nanoscale Science, Engineering, and Technology (NSET), OSTP collaborated with the Department of State to establish a Working Party on Nanotechnology within the OECD to advise on emerging issues in science, technology and innovation related to nanotechnology. Today 27 countries participate in this working group. The NSET Subcommittee also facilitates U.S. participation in the OECD Working Party on Manufactured Nanomaterials.

As described in more detail below, OSTP is actively involved in international science and technology affairs in all corners of the globe. OSTP senior management participates in numerous bilateral and multilateral meetings that support U.S. priorities and policies. And OSTP staff maintain strong ties with key technical personnel in other countries.

G8 Science Ministers and Advisors: I meet twice per year with Science Ministers and Advisors from the G8 countries plus the European Union in a format originally proposed by the Carnegie Commission (the meetings are referred to as "Carnegie Meetings" of the Ministers). The meetings are small and informal, and we exchange information on our science, technology and education plans and priorities. We provide updates on relevant government activities within our countries, and address international project coordination or provide direction as needed.

Joint Committee Meetings: In cooperation with the Department of State, OSTP leads bilateral meetings with countries that have high priority for United States objectives. In recent years I have led meetings with China (2006), Japan (2006), Brazil (2006), and Russia (2005 and 2008). A Joint Commission Meeting with India is pending. These meetings bring together senior officials from U.S. technical agencies and their counterparts to discuss joint scientific collaboration. They take measure of what has been accomplished, discuss impediments to cooperation, and outline future opportunities for joint collaboration. OSTP arranges coordination meetings prior to these events, and ensures that agency input is relevant to the aims of the collaboration. Bilateral S&T agreements are highly valued in the international S&T government community, but not necessarily because they provide funding to the international partner. Rather, they bring focus to the partner's S&T activities and encourage additional funding by foreign governments to their science agencies.

UNESCO: I am a Member of the U.S. National Commission for the United Nations Educational, Scientific, and Cultural Organization (UNESCO). The U.S. re-joined UNESCO during this Administration. The National Commission is a Federal Advisory Committee administered by the Department of State with 93 members from government, academia, NGOs, and industry. OSTP staff support me and the Commission in its science activities. I have also represented the U.S. on each of our delegations to UNESCO General Conferences since U.S. re-entry, 32nd (2003), 33rd (2005), and 34th (2007). I have served in prominent roles at each of these meetings.

OECD: I am equally active in the Organization of Economic Cooperation and Development (OECD) where I have spoken at forums and meetings most recently in March. OSTP leads the delegations to OECD's Global Science Forum, an organization that deals with international cooperation on major science facility projects, among other things.

United Nations: I served as the U.S. Minister-level representative to both phases of the United Nations World Summit on the Information Society (WSIS). Phase I took place in Geneva (December 2003) and the second phase took place in Tunis,

Tunisia (November 2005). At the WSIS, the U.S. successfully advocated to keep the Internet independent and effective as a tool for democracy, economic development and social progress. By agreeing to a Declaration of Principles and Plan of Action in Geneva and Tunis, the U.S. reaffirmed its commitment to the importance of the use of Information and Communication Technologies to promote peace, security and stability and to enhance democracy, respect for human rights, open and transparent government and the rule of law.

Fulbright Program: In April 2006 I traveled to Israel to celebrate the 50th anniversary of the Fulbright Exchange Program. While there, I met with Israeli academics and Palestinian researchers and supported cooperation between Israeli scientists and independent Palestinian researchers and other scientists throughout the Arab World. At that time I also traveled to Jordan where I discussed the Synchrotron Light for Experimental Science and Applications in the Middle East (SESAME). SESAME is an important scientific endeavor created under the auspices of UNESCO in 2004 that involves Israel, the Palestinian Authority, Jordan, Pakistan, Turkey, Cyprus, Egypt, Iran, and Bahrain. I also received a briefing by the Director at the Alexandria Library (Bibliotheca Alexandrina) in Egypt, which is an outstanding example of a center that provides a cultural focus for regional discussions on topics ranging from medical research, to peace, to ethics and culture. I have advocated support for such centers in presentations to Department of State sponsored meetings.

IPCC: In 2007, OSTP's Associate Director and Deputy Director for Science, Dr. Sharon Hays, led the U.S. delegation to three important plenary sessions of the Intergovernmental Panel on Climate Change (IPCC). In January, Dr. Hays led the U.S. delegation to the 10th Plenary Session of Working Group I, held in Paris, France, during which the *Summary for Policy-makers* was negotiated and approved for the IPCC report *"Climate Change 2007: The Physical Science Basis."* This report was the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. In April, Dr. Hays led the delegation to the 8th Plenary Session of Working Group II, held in Brussels, Belgium, during which the *Summary for Policy-makers* was approved for the Working Group II report *"Climate Change 2007: Impacts, Adaptation and Vulnerability."* And in November, Dr. Hays led the U.S. delegation to the 27th Plenary Session of the IPCC, held in Valencia, Spain, during which the *Summary for Policy-makers* was negotiated and approved for the overall *"Climate Change 2007: Synthesis Report."* These reports are important resources for climate policy formation for all nations, including the U.S.

Earth Observations: The United States plays an international leadership role in Earth Observations, and OSTP supports this activity through the NSTC and the direct involvement of senior officials. Dr. Hays participated at the Group of Earth Observation Ministerial Summit in Cape Town, South Africa in December 2007. I spoke on behalf of the Administration at the inauguration of this program in 2003, and participated in the GEO Summit in Japan in 2004. The U.S. is also a partner in the UNESCO Global Ocean Observing System (GOOS).

WRC: OSTP's Associate Director and Deputy Director for Technology, Richard Russell, was the U.S. Ambassador to the 2007 World Radiocommunication Conference. This UN/International Telecommunications Union meeting brought together all countries of the world plus Nongovernmental Organizations and private industry to review and revise the treaty that governs the use of spectrum globally. The U.S. goals for the conference, all achieved, were to avoid harmful interference to allow systems to work, and to create significant synergies, which reduce the cost of technology and promote the rapid deployment of new technologies and services.

Mr. Chairman, most of the issues OSTP deals with in its role of policy formation, guidance and coordination have an international component. International issues are managed routinely and systematically with substantial interagency communication and coordination, and with the full engagement of the Department of State. I believe the U.S. engagement in international science is intense, productive, and highly successful. I would be pleased to provide more information either now or in greater detail in writing in response to your questions.

BIOGRAPHY FOR JOHN H. MARBURGER, III

John H. Marburger, III, Science Adviser to the President and Director of the Office of Science and Technology Policy, was born on Staten Island, N.Y., grew up in Maryland near Washington D.C. and attended Princeton University (B.A., Physics

1962) and Stanford University (Ph.D., Applied Physics 1967). Before his appointment in the Executive Office of the President, he served as Director of Brookhaven National Laboratory from 1998, and as the third President of the State University of New York at Stony Brook (1980–1994). He came to Long Island in 1980 from the University of Southern California where he had been a Professor of Physics and Electrical Engineering, serving as Physics Department Chairman and Dean of the College of Letters, Arts and Sciences in the 1970's. In the fall of 1994 he returned to the faculty at Stony Brook, teaching and doing research in optical science as a University Professor. Three years later he became President of Brookhaven Science Associates, a partnership between the University and Battelle Memorial Institute that competed for and won the contract to operate Brookhaven National Laboratory.

While at the University of Southern California, Marburger contributed to the rapidly growing field of nonlinear optics, a subject created by the invention of the laser in 1960. He developed theory for various laser phenomena and was a co-founder of the University of Southern California's Center for Laser Studies. His teaching activities included "Frontiers of Electronics," a series of educational programs on CBS television.

Marburger's presidency at Stony Brook coincided with the opening and growth of University Hospital and the development of the biological sciences as a major strength of the university. During the 1980's federally sponsored scientific research at Stony Brook grew to exceed that of any other public university in the northeastern United States.

During his presidency, Marburger served on numerous boards and committees, including chairmanship of the governor's commission on the Shoreham Nuclear Power facility, and chairmanship of the 80 campus "Universities Research Association" which operates Fermi National Accelerator Laboratory near Chicago. He served as a trustee of Princeton University and many other organizations. He also chaired the highly successful 1991/92 Long Island United Way campaign.

As a public spirited scientist-administrator, Marburger has served local, State and Federal governments in a variety of capacities. He is credited with bringing an open, reasoned approach to contentious issues where science intersects with the needs and concerns of society. His strong leadership of Brookhaven National Laboratory following a series of environmental and management crises is widely acknowledged to have won back the confidence and support of the community while preserving the Laboratory's record of outstanding science.

Chairman BAIRD. Thank you, Dr. Marburger. Dr. Bement.

STATEMENT OF DR. ARDEN L. BEMENT, JR., DIRECTOR, NATIONAL SCIENCE FOUNDATION

Dr. BEMENT. Chairman Baird and Ranking Member Neugebauer and distinguished Members of the Subcommittee, thank you for this opportunity to discuss NSF's role in international science and engineering cooperation.

For more than 55 years, NSF has recognized the central role that international partnerships play in achieving America's research and development objectives. The Foundation has a rich history of connecting U.S. scientists and engineers with international collaborators across all sectors and disciplines to leverage intellectual capabilities.

I believe through such international partnerships and leadership with international agencies, NSF fosters trust and understanding essential to advancing diplomatic relations. Today, international leadership roles are prominent in my portfolio as NSF director. I represent the United States at the annual meeting of the heads of Research Councils for the G8 countries, and I serve as a member of the U.S. National Commission for UNESCO. Deputy Director Olsen is also active in UNESCO and OECD's Global Science Forum, and serves as the Vice Chair of the Board of the Human Frontier Science Program. NSF's Assistant Directors and Office Directors also help establish solid working relationships with counterpart agencies and organizations abroad.

For example, as Director of the NSF's Office of Polar Programs, Dr. Karl Erb provides leadership in the International Polar Year, the Arctic Council, and in consultative meetings with the Antarctic Treaty. Through such roles, NSF leadership interacts directly with heads of states, ministers, and other principals, to catalyze intellectual exchange on global issues, develop bilateral and multilateral agreements, and foster international science and engineering capacity.

NSF leadership also provides guidance on international research and related interagency collaborations through its work on the National Science and Technology Council. Moreover, NSF oversees offices in Beijing, Paris, and Tokyo, proactively promote relations between the United States and international science and engineering communities. NSF also fosters international cooperation through the support of the U.S. portion of international research and education projects.

The Foundation effectively partners with almost every country in the world. Our range of international activities presents what I believe is a rich portfolio. Activities range from individual awards to student fellowships for studies, study abroad, to centers and networks, to multinational research programs, and to large, international research facilities.

All of NSF's Directorates and Research Offices fund international science and engineering activities. The Education and Human Resources Directorate also has fostered extraordinary collaborations around STEM education and human resource development. Additionally, NSF's Office of International Science and Engineering, or OISE, supports several programs that specifically fund U.S. scientists and engineers engaged in international work.

One such program, the Partnerships for International Research and Education, or PIRE, enables U.S. institutions to establish partnerships with international groups. PIRE has supported institutional level research collaborations with more than 40 countries. For example, the PIRE Africa Array Project brought together U.S. and African geoscientists as well as students to study seismological and volcanic activity in Africa. This program has now grown to include collaborators from more than 20 U.S., African, and European universities, in addition to large corporations, to advance the understanding of Earth's mantle dynamics.

In recent years, OISE has expanded emphasis on linkages between U.S. scientists and those in developing countries. Specifically, OISE hired a new Program Manager for Developing Countries to expand these collaborations. This Program Manager, along with NSF leadership, has initiated dialogue with 12 domestic and 20 international institutions who can co-fund the developing countries portion of these projects. OISE also works with international counterpart agencies to introduce them to the Foundation's merit review process and organizational structure.

Many organizations, particularly those in developing countries, look to NSF as a model on how to run a competitive merit review research council. The United Arab Emirates, Saudi Arabia, and China will soon send representatives to NSF to study our methods of operation.

Mr. Chairman and members of the Subcommittee, thank you again for this opportunity to testify on a subject of particular importance to NSF.

[The prepared statement of Dr. Bement follows:]

PREPARED STATEMENT OF ARDEN L. BEMENT, JR.

Introduction

Chairman Baird, Ranking Member Ehlers, and distinguished Members of the Subcommittee, thank you for this opportunity to discuss international science and technology (S&T) cooperation and the National Science Foundation's (NSF) current international activities. NSF's combined research and education portfolio provides rich examples of global S&T cooperation. We believe that science collaboration and science diplomacy are essential ingredients for America's future progress and prosperity. I am pleased to testify on this important and timely issue.

Scientists have played an important role on the front-lines of U.S. diplomacy since the end of World War II. They have been the enablers of larger international diplomacy efforts, from the robust scientific exchange with China to renewed and strengthened relations with Egypt, India, and Pakistan-all started with the peaceful beachhead of scientific diplomacy.

For instance, polls indicate that people in the Middle East generally view American S&T more favorably than other aspects of our society. This approving attitude provides for favorable forums to explain other aspects of American policies and actions. Our nation's citizens also benefit directly from S&T cooperation, as it provides our scientists and engineers with greater access to cutting-edge research and allows us to work across geographical boundaries to solve global problems.

In addition, globalization has amplified the worldwide competition for ideas, science and engineering (S&E) talent, and leadership in turning new knowledge into real-world applications. Many nations are accelerating their investments in research and development, education, and infrastructure in order to drive sustained economic growth. To continue being a global leader in S&T, we must ensure that we have access to discoveries being made in every corner of the world.

The National Science Foundation understands the global nature of scientific discovery, and the international character of knowledge creation and research activities are stressed in NSF's FY 2006–2011 Strategic Plan, *Investing in America's Future.* For more than 55 years, NSF has connected S&E researchers and educators in academic organizations, industry and informal science institutions, both nationally and internationally, to leverage intellectual capabilities. NSF has strengthened the Nation's collaborative advantage by leading or participating in key interagency initiatives as well as by developing innovative collaborations across all S&E disciplines.

Three categories of activities illustrate NSF's engagement in international S&T: (1) leadership and diplomacy efforts to foster global S&E connectivity; (2) the coordination and support of research projects, both large and small, that have an international component; and (3) the activities of NSF's Office of International Science and Engineering (OISE). The following selected examples underscore the broad influence of NSF activities.

Leadership and Diplomacy Efforts to Foster Global Science and Engineering

The exchange of scientific information and the cooperation in international scientific research activities were identified by the first NSF Director, Alan Waterman, as two of the major responsibilities that Congress had given the agency. NSF embraced those responsibilities in its first cycle of grants, supporting international travel and the dissemination of scientific information originating overseas. NSF recognized that a two-way flow of information and individuals between nations resulted in both better science and improved international goodwill.

In 1955, NSF took a comprehensive look at the role of the Federal Government in international science, and warned that it was important that "activities of the U.S. Government in the area of science not be tagged internationally as another weapon in our cold war arsenal." NSF concluded that international scientific collaboration, based on considerations of scientific merit and the selflessness of the United States, could help ease international tensions, improve the image of the United States abroad, and help raise the standard of living among less-developed nations.

NSF has long embraced multilateral projects as an essential aspect of its portfolio, beginning with the International Geophysical Year of 1957, and continuing with such activities as the International Biological and Tropical Oceans-Global Atmosphere programs, and, more recently, the International Continental Drilling Pro-

gram, Gemini Observatory, Rice Genome Sequencing Project, and International Polar Year. The agency has also fostered bilateral partnerships in all parts of the world. These overarching partnerships, most of which involve extensive interagency collaboration on the U.S. side, have generated thousands of cooperative research projects on multiple scales.

As you know, the Office of Science and Technology Policy (OSTP) guides and oversees the administration's international science and technology strategies and portfolio. Through OSTP, the National Science and Technology Council (NSTC) has a pivotal role in setting priorities for and coordinating interagency collaborations, including those that are international in nature. International cooperation is integrated throughout the four committees of the NSTC, and NSF participates in this work on many levels. I currently co-chair the Committee on Science and serve as the NSF representative on the Committee on Homeland and National Security. NSF Deputy Director Kathie Olsen serves as the NSF representative on the Committee on Environment & Natural Resources and Committee on Technology. NSF is involved in most of NSTC's subcommittees and working groups, and leads many. For example, Dr. Jim Collins, the Assistant Director of the Directorate of Biological Sciences, chairs the Biotechnology Subcommittee, and Dr. Jeannette Wing, the Assistant Director for Computer and Information Sciences and Engineering, co-chairs the Networking and Information Technology Research and Development.

NSF's senior management team also participates in other important international bodies. As NSF Director, I represent the United States at the annual meeting of the Heads of Research Councils (HORCS) for the G–8 countries (Canada, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States). These meetings provide opportunities for international leaders to meet on a regular basis, to review bilateral issues or problems with individual counterpart agencies, and to propose cooperation on particular topics of common interest. In the last few years, NSF has chaired HORCS working groups on public understanding of science, evaluation of research results, and science and math education in schools.

I also currently serve as a member of the U.S. National Commission for UNESCO and as the vice-chair of the Commission's Natural Sciences and Engineering Committee. As part of the our involvement with U.S. National Committee for UNESCO International Hydrological Programme, NSF is currently working with UNESCO, the U.S. Geological Survey (USGS), the Department of State, and other federal science agencies to organize a high-level Water Science Forum to explore the potential contributions of U.S. science to the challenges of drinking water supply and safety, sanitation, drought, and resource management. The forum, to be held on June 27, 2008, will involve about 80 people, including UNESCO leadership, foreign embassies, and experts from U.S. agencies and academia. A larger meeting, also sponsored by this group and involving hundreds of scientists from around the world, will be held in Irvine, CA, December 1–6, 2008. NSF also actively participates in the OSTP-led Interagency Working Group on Science of UNESCO, which is exploring future collaborative opportunities between the U.S. S&E community and UNESCO.

Additionally, NSF Deputy Director Kathie Olsen serves as Vice-Chair of the Board of Trustees of the Human Frontier Science Program and as co-chair of the U.S.–EC Biotechnology Task Force. NSF leadership also represents the U.S. government on the International Group of Funding Agencies for Global Change Research, and through multiple roles in the activities of OECD's Global Science Forum. For example, NSF has recently been involved in hosting workshops on the science of science policy and biocomplexity, and the agency plays a major role in the coordination of the U.S. role in large facilities. NSF also plays significant roles in the consultative meetings of the Antarctic Treaty, in the scientific activities of other United Nations specialized agencies, such as the World Meteorological Organization, and in the activities of the Arctic Council, where we represent the scientific interest of all the Arctic nations. Through these activities, NSF leadership interacts directly with heads of state, ministers, and other principals to discuss forming new multilateral and bilateral agreements, or to alter or extend already existing agreements. Such leadership roles play a critical role in keeping the Nation proactively involved in the international S&T arena.

NSF's overseas offices in Beijing, Paris, and Tokyo also proactively promote collaboration between the United States and international S&E communities. Staff headquartered in these offices report on in-country and regional S&T developments and policies, serve as resources of information on current and emerging issues in S&E and policy, and work as liaisons between NSF and foreign organizations and researchers. The offices also regularly support NSF's directorates' and research offices' efforts to expand NSF programs internationally and to finalize implementing

agreements. Thus, they play an important role in helping NSF pursue its mission of promoting U.S. research and education excellence in a global context.

Moreover, program officers from NSF's OISE and the heads of its overseas offices have helped establish solid working relationships with counterpart agencies and organizations abroad. Examples are the UK Research Councils, the Japan Society for the Promotion of Science, the National Natural Science Foundation in China, CONACyT in Mexico, the Centre National de la Recherche Scientifique in France, the Deutsche Forschungsgemeinschaft in Germany, the National Research Foundation in South Africa, the Russian Foundation for Basic Research and the Czech Ministry of Education. Over the years, senior officials and program officers from these and other organizations have held numerous discussions, participated in seminars and workshops, and funded cooperative research projects. Since we fund the U.S. portion of international research, these venues provide numerous U.S. S&E researchers, postdoctoral fellows, graduate students, and undergraduates opportunities to gain important international perspectives.

NSF's support of the annual U.S. contribution to the International Institute for Applied Systems Analysis (IIASA) and the International Council for Science (ICSU) via grants to the National Academy of Sciences—the National Member Organization for both IIASA and ICSU—also facilitates involvement of U.S. scientists and engineers in international non-governmental organizations. This support enables U.S. scientists and engineers to participate in global S&E projects. Of particular interest for this hearing, both organizations concentrate on scientific fields of policy importance, including topics focused on the developing world, such as environmental, economic, technological, and social issues in the context of global change.

The Embassy Science Fellows program, administered by the Department of State and coordinated within NSF by OISE, also provides for valuable international experience. Fellows from NSF and certain other U.S. Government agencies spend between one and three months at foreign posts as visiting "scientist/engineer-consultants" to the Embassy, working closely with the Science Counselor and/or other embassy staff involved in S&T issues. The fellows conduct assessments of in-country S&E institutions, fields, and priorities, and meet with leading scientists and science administrators.

Finally, facilitating the flow of S&E talent to the United States is also a major concern of NSF. OISE continues to serve as a resource on visa policies both to the scientific and engineering community at large and to the Department of State. OISE continues to track the visa situation, providing timely information to NSF senior management and program officers as the policies evolve.

NSF's International Research and Education Portfolio

The U.S. portion of international S&E research and education activities is funded by all NSF directorates and research offices. International implications are found throughout all of NSF's activities, from individual research awards and fellowships for students to study abroad, to centers, collaborations, joint projects, and shared networks that demonstrate the value of partnering with the United States.

As a result of its international portfolio encompassing projects in all S&E disciplines, NSF effectively partners with almost every country in the world. The following examples illustrate the international breadth and scope of NSF's international portfolio.

The Research Experiences for Undergraduates program, an NSF-wide activity, gives undergraduate students the opportunity to engage in high-quality research, often at important international sites. One of these sites is CERN, the European Laboratory for Particle Physics in Switzerland, and one of the world's premier international laboratories. Undergraduate students work with faculty mentors and research groups at CERN, where they have access to facilities unavailable anywhere else in the world. NSF also provides support for the Large Hadron Collider housed at CERN.

Collaborations among individual NSF-supported investigators are also common in NSF's portfolio. Recently, scientists at the University of Chicago created a single-molecule diode, a potential building block for nanoelectronics. Theorists at the University of South Florida and the Russian Academy of Sciences then explained the principle of how such a device works. They jointly published their findings.

The Foundation's Division of Materials Research supports the Materials World Network (MWN), a global collaborative aimed at fostering partnerships between materials science and engineering researchers at institutions around the globe, including institutions in Africa, Europe, Asia, and Australia. The MWN was launched in 1995 and further developed via a series of NSF co-sponsored workshops around the world. Through MWN, NSF and international partner agencies jointly solicit proposals for collaborative projects. Since 2001, NSF has participated in funding over

180 awards. Research is targeted at improving medical diagnosis, developing stronger materials for the housing and transportation industries, and more.

At the ends of the world, NSF coordinates nearly all of the U.S. scientific research in the Arctic and Antarctica through its Office of Polar Programs. In fact, NSF was designated as the lead federal agency for the International Polar Year (IPY) 2007–2008. During this campaign, more than 100 countries undertook projects involving scientists, students, teachers, and the public to increase understanding of the polar region.

Research at NSF supported-centers also has significant international implications. For example, the NSF Center for Sustainability of Semi-Arid Hydrology and Riparian Areas recently won the International Great Man-Made River Prize awarded by UNESCO. The prize "rewards remarkable scientific research work on water usage in arid region as well as areas subject to drought and also for the development of agriculture for the benefit of humanity and the environment." More than three dozen scientists and support staff at another NSF-supported center recently won a different prestigious award for their work on climate change. Researchers and staff at National Center for Atmospheric Research (NCAR), as well as many other NSF-supported researchers, were involved in reports by the U.N. Intergovernmental Panel on Climate Change (IPCC). The U.N. Intergovernmental Panel on Climate Change (IPCC) was awarded the 2007 Nobel Peace Prize along with former Vice President Al Gore.

There are also examples where NSF partners with the United States Agency for International Development (USAID) to support international S&T programs to facilitate capacity building. For example, the U.S.-Pakistan Science and Technology Program, led by a coordinating committee chaired by Dr. Arden Bement, NSF Director, and Dr. Atta-ur-Rahman, Pakistan Minister of Education and Science Advisor to the Prime Minister. USAID funds the U.S. contribution of the joint program and supports other programs in Pakistan involving NIH and other agencies. This U.S.–Pakistan S&T program supports a number of joint research projects peer reviewed by the National Academy of Sciences and approved by the joint S&T committee. Over the past year, the Committee has also established sixteen S&T working groups that involve interagency participation in Pakistan and in the United States to carry out joint research projects of mutual interest (with direct benefit to Pakistan).

Through this collaboration, NSF just completed a network connection of *Internet 2* with Pakistan to facilitate research and education collaborations and data exchanges under the program. This project embodies one of NSF's top priorities, the development of the national science and engineering cyberinfrastructure, enabling a prime role for the United States in global research networks. NSF's goals for the national cyberinfrastructure include the ability to integrate data from diverse disciplines and multiple locations, and to make them widely available to researchers, educators, and students. Already, the Grid Physics Network and the international Virtual Data Grid Laboratory are advancing IT-intensive research in physics, cosmology, and astrophysics.

In today's highly sophisticated, technology-driven science, many international partnerships center around major, high-budget research facilities that are made possible only by combining the resources of more than one nation. For example, NSF's facilities budget includes construction funds for the IceCube neutrino detector, antennas for the Atacama Large Millimeter Array (ALMA), and observation technologies for the Arctic Observing Network (AON).

The IceCube Neutrino Observatory—the world's first high-energy neutrino observatory—offers a powerful example of an international, interagency research platform. Agencies in Belgium, Germany, and Sweden have joined NSF and Department of Energy (DOE) in providing support for IceCube, which will search for neutrinos from deep within the ice cap under the South Pole in Antarctica. Neutrinos are hard-to-detect astronomical messengers that carry information from cosmological events.

The Atacama Large Millimeter Array, currently under construction near San Pedro de Atacama, Chile, will be the world's most sensitive, highest resolution, millimeter wavelength telescope. The array will make it possible to search for planets around hundreds of nearby stars and will provide a testing ground for theories of star birth, galaxy formation, and the evolution of the universe. ALMA has been made possible via an international partnership among North America, Europe, and East Asia, in cooperation with the Republic of Chile. NSF is the U.S. lead on this ground-breaking astronomical facility.

As part of the aforementioned IPY activities, NSF serves as lead contributing agency for the Arctic Observing Network (AON)—an effort to significantly advance our observational capability in the Arctic. AON will help us document the state of the present climate system, and the nature and extent of climate changes occurring

in the Arctic regions. The network, organized under the direction of the U.S. Interagency Arctic Research Policy Committee, involves partnerships with the National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, Department of Interior, Department of Defense, Smithsonian Institution, National Institutes of Health, DOE, and USDA. NSF coordinates AON activities across the U.S. government, as well as with international collaborators, including Canada, Norway, Sweden, Germany, and Russia.

Such international infrastructure projects will continue to play a key role in advancing S&E capacity worldwide. NSF leadership and proactive involvement in large international research projects helps ensure that U.S. S&E stays at the frontier.

The Office of International Science and Engineering

The Office of International Science and Engineering—the centerpiece of NSF's international activities—integrates Foundation-wide activities and manages a broad range of programs that support U.S. scientists and engineers engaged in international research and education. OISE is currently leading the agency's effort to develop a goal-oriented strategic plan that will inform the coordination of international activities across the Foundation. In FY 2009, NSF proposes a budget of $47.44 million for OISE.

Organizationally, OISE is comprised of five regional groups and the three aforementioned international offices. OISE has two programmatic priorities: (1) to enhance research excellence through international collaboration; and (2) to serve as a catalyst for partnerships between the U.S. and the international research community.

OISE works closely with the NSF directorates and other research offices to co-fund innovative awards and supplements that promote research excellence through international collaboration and develop the next generation of globally engaged U.S. scientists and engineers. For example, OISE and NSF's Directorate of Mathematics and Physical Sciences co-fund the "East-West Collaboration." The East-West Collaboration supports frontier research in elementary particle physics. This scientific interchange between a 20-university collaboration centered at Cornell University and an 18-university collaboration centered at the Institute for High Energy Physics in Beijing, China has enabled a faster start-up for the first superconducting magnet in China, advances in "new physics," and for the direct partnership of U.S. and Chinese scientists. As China continues to invest heavily in science and engineering research, such collaborations will foster necessary intellectual exchange for U.S. scientists and engineers as well lead to greater connectivity between the United States and China.

OISE also serves as an interface for NSF's directorates, offices, divisions, and programs with multi-national organizations, international science organizations, and national funding agencies and ministries in other countries. OISE often works with international counterpart agencies to educate them on the Foundation's peer review process, organizational structure, and funding process, as many, particularly those in developing countries, look to NSF as a model for how to run their programs.. These efforts help align agency procedures close to those of NSF, which can often make collaboration and science funding more effective in these countries.

For example, the United Arab Emirates' (UAE) Ministry of Higher Education has commissioned their scientists to establish a National Research Foundation by early 2008. These scientists visited NSF in January 2008 to learn about NSF procedures for support of research and evaluation of results. Additionally, the King Abdulaziz City for Science and Technology in Riyadh, NSF's counterpart agency in Saudi Arabia, will send its Director of Research in August 2008 to learn about NSF. China also sends representatives to study the NSF experience, as their research agency, modeled on NSF, operates in a similar fashion. Additionally, Turkey, France, and Ireland, among others, are emulating the NSF model.

NSF's international office has implemented specific programs to stimulate innovative international partnerships. The East Asia and Pacific Summer Graduate Research Institutes (EAPSI), International Research Fellowship, and Partnerships for International Research and Education (PIRE) Programs are examples of three OISE-supported programs that facilitate partnership across institutions and countries.

The *East Asia and Pacific Summer Graduate Research Institutes (EAPSI) Program* enables U.S. graduate students to build collaborations with scientists and engineers working in relevant research facilities in East Asia and the Pacific region. The eight-week institute programs are held at top research institutions in Japan, Korea, Taiwan, China, Australia, New Zealand, and Singapore. Over 1,600 U.S. graduate students have participated in the program since its inception in 1990. The

program fosters a U.S. S&E workforce capable of operating in a global marketplace increasingly impacted by scientific developments in Asia and the Pacific Region.

The research of a behavioral biology student from Texas A&M University offers one example of the resulting increased international connectivity. The student studied the ability of giant pandas to recognize their kin by establishing a live web based "Panda Cam" at China's Wolong Nature Reserve. This student's project not only opened the door for researchers and the broader public to observe the behavior of pandas in their natural habitat, but it helped develop a bridge among China's Forestry Ministry, the Chinese Academy of Sciences, and U.S. researchers.

The *International Research Fellowship Program* supports approximately three dozen U.S. postdoctoral fellows for 9 to 24 months at foreign host institutions annually. The program's objective is to introduce U.S. scientists and engineers to cutting-edge international research opportunities in the early stages of their careers. Fellows' research projects involve international collaboration, the use of overseas instrumentation, and access to unique research environments in a wide range of fields, including biology, physics, engineering, geosciences, computer sciences, and social and behavioral sciences.

In fiscal year 2007, 39 fellowship recipients from 21 states were selected to conduct research in 21 foreign countries. After completion of the fellowship, the researchers return to jobs in academia and industry in the United States. Past fellows attest that their experiences abroad were unparalleled career-enhancers and that the fellowship placed them at the leading-edge of their field of research and positioned them to build new collaborations with colleagues in their host country. These collaborations have also led to foreign hosts of NSF International Research Fellows joining U.S. research teams.

The *Partnerships for International Research and Education (PIRE) Program* is an example of a larger collaborative research activity supported by OISE. PIRE enables U.S. institutions to establish collaborative relationships with international groups or institutions to conduct research dependent upon international collaboration. The program catalyzes a cultural exchange in U.S. institutions by establishing innovative models for international collaborative research and education. PIRE also readies U.S. students to participate in international research collaborations.

To date, the PIRE program has supported the work of 32 institutions in 23 states. Research collaborations with more than 40 countries have resulted. The U.S.–China PIRE project on electron chemistry and catalysis was listed in the Chinese media as one of the top ten S&T developments in China for 2006. The PIRE program supports research projects that nurture U.S. relationships with international counterparts.

Another PIRE project has significantly impacted the developing world. The "AfricaArray" brought together U.S. and African geoscientists, as well as students, to study seismological and volcanic activity in Africa. Collaborators from Penn State University, the University of Witwatersrand (South Africa), the University of Dar Es Salaam (Tanzania), and the National Seismological Network (Uganda) have developed a network of seismic monitoring stations that cross the African continent to study the origins and structure of the African Superplume, an anomalous part of the Earth's mantle that stretches from deep in the mantle to near the surface. To date, the NSF-supported researchers leading AfricaArray have collaborated with more than 20 U.S., African, and European universities, in addition to large cooperations, in order to advance the understanding of Earth's mantle dynamics.

AfricaArray is only one of 15 PIRE projects involving collaboration with scientists in developing countries. Other examples include a project with Indonesia, Malaysia, and the Philippines to transform a biodiversity hot spot into a research and education opportunity as well as a project with Argentina and Mexico to enable cyberinfrastructure applications. In total, the 15 projects represent approximately $36 million in NSF funds, invested in U.S. collaborating institutions.

In recent years, OISE has put greater emphasis on increasing linkages between scientists in the United States and those in developing countries. Specifically, OISE hired a new Program Manager for Developing Countries to expand collaborations with developing countries. Outreach presentations have been given at 12 domestic institutions and 20 international institutions in 10 countries. This OISE program manager and NSF senior leadership are also initiating and continuing dialogue with 12 funding agencies appropriate to co-fund the developing countries' portion of S&E projects, e.g., the International Foundation for Science, the International Rice Research Institute, USAID, and the World Bank.

The progress of humankind will depend increasingly on the new knowledge of science and technology. The collaborative pursuit of new knowledge is a powerful tool for bringing people together, and OISE activities will continue to stimulate global collaboration.

Conclusion

International collaboration in S&E is a necessary foundation for the future. In order for the United States to be competitive in this new global society, we must engage in international research. And, we must proactively develop a workforce that is adept at working on international research teams.

For NSF, this means a continued commitment to foster collaborations of all kinds and to seek new forms of partnership to address today's research challenges and opportunities. The more widely research, data, and new knowledge are shared, the broader the resulting perspectives. As you can see from the numerous examples above, the National Science Foundation is committed to international partnership and collaboration on many levels.

We will continue to leverage our broad mission to catalyze international research endeavors in all disciplines and to train an internationally engaged S&E workforce. We will also continue to leverage science and engineering know-how and the NSF model to catalyze larger diplomatic efforts.

Lastly, we look forward to any new insights that can be garnered from the National Science Board's new report entitled, *"International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise;"* we are currently working with the board on their recommendations.

Thank you again for the opportunity to testify, and I would be happy to respond to any questions.

BIOGRAPHY FOR ARDEN L. BEMENT, JR.

Arden L. Bement, Jr., was sworn in as the 12th Director of NSF on November 24, 2004. He had served as Acting Director since February 22, 2004. Dr. Bement heads the only federal agency that funds research and education in all fields of science and engineering. He directs a budget of more than $6 billion; hundreds of programs that support roughly 200,000 scientists, engineers, educators, and students across the country; and the development of world-class facilities and infrastructure. He oversees a robust international research program in the polar regions and several international partnerships to build sophisticated research and experimental facilities.

Since the White House launch of the American Competitiveness Initiative in 2006, he has overseen numerous initiatives that strengthen the U.S. innovation base and economic position and intensify the training of the U.S. workforce to operate in a high-tech global economy. His top priorities have included increasing the size and duration of NSF funding awards; implementing electronic proposal and grant processing at NSF; developing cyberinfrastructure that advances research and education through expanded capabilities for networking, data processing and storage, modeling, and simulation; and broadening international collaborations to leverage NSF investments. He has expanded NSF's centers of excellence program to encompass dozens of science and engineering disciplines partnering with industries and educators.

He serves as a member of the U.S. National Commission for UNESCO and as the vice-chair of the Commission's Natural Sciences and Engineering Committee. He is a member of the U.S. National Academy of Engineering, a fellow of the American Academy of Arts and Sciences, and a fellow of the American Association for the Advancement of Science. Dr. Bement is an ex officio member of the U.S. National Science Board, which guides NSF activities and serves as a policy advisory body to the President and Congress. He was a member of the NSB from 1989 to 1995.

Prior to his confirmation as NSF Director in November 2004, Dr. Bement served as Director of the National Institute of Standards and Technology of the Department of Commerce, a position he had held since Dec. 7, 2001. At NIST he oversaw an annual budget of about $773 million and an on-site research and administrative staff of 3,000 employees, complemented by a NIST-sponsored network of 2,000 locally managed manufacturing and business specialists serving smaller manufacturers across the United States.

He joined NIST from Purdue University, where he was the David A. Ross Distinguished Professor of Nuclear Engineering and head of the School of Nuclear Engineering. He has held appointments at Purdue University in the schools of Nuclear Engineering, Materials Engineering, and Electrical and Computer Engineering, as well as a courtesy appointment in the Krannert School of Management. He was Director of the Midwest Superconductivity Consortium and the Consortium for the Intelligent Management of the Electrical Power Grid.

Dr. Bement joined the Purdue faculty in 1992 after a 39-year career in industry, government and academia. His positions included: Vice President of Technical Re-

sources and of Science and Technology for TRW Inc. (1980–1992); Deputy Under Secretary of Defense for Research and Engineering (1979–1980); Director, Office of Materials Science, DARPA (1976–1979); Professor of Nuclear Materials, MIT (1970–1976); Manager, Fuels and Materials Department and the Metallurgy Research Department, Battelle Northwest Laboratories (1965–1970); and Senior Research Associate, General Electric Co. (1954–1965). He has also been a Director of Keithley Instruments Inc. and the Lord Corp. and a member of the Science and Technology Advisory Comm. for the Howmet Corp., a division of ALCOA.

He has earned numerous awards and served in diverse government advisory roles, including: head of the NIST Visiting Committee on Advanced Technology; head of the advisory committee for NIST's Advanced Technology Program; member of the Board of Overseers for the Malcolm Baldrige National Quality Award; Chair of the Commission for Engineering and Technical Studies and the National Materials Advisory Board of the National Research Council; and member of the Space Station Utilization Advisory Subcommittee and the Commercialization and Technology Advisory Committee for NASA. He has consulted for the Department of Energy's Argonne National Laboratory and the Idaho National Engineering and Environmental Laboratory.

Dr. Bement holds an engineer of metallurgy degree from the Colorado School of Mines, a Master's degree in metallurgical engineering from the University of Idaho, a doctorate in metallurgical engineering from the University of Michigan, and honorary doctorates from Cleveland State University, Case Western Reserve University, and the Colorado School of Mines, as well as a Chinese Academy of Sciences Graduate School Honorary Professorship. He is a retired Lieutenant Colonel of the U.S. Army Corps of Engineers, and a recipient of the Distinguished Service Medal of the Department of Defense.

Chairman BAIRD. Thank you, Dr. Bement. We have been joined by Mr. Bilbray from California, and Eddie Bernice Johnson from Texas, and I thank them for joining us. Dr. Fedoroff.

STATEMENT OF DR. NINA V. FEDOROFF, SCIENCE AND TECHNOLOGY ADVISOR TO THE SECRETARY OF STATE, U.S. DEPARTMENT OF STATE; ADMINISTRATOR OF USAID

Dr. FEDOROFF. Chairman Baird—thank you—and distinguished Members of the Subcommittee, thank you for the opportunity to discuss science diplomacy at the State Department and USAID.

My written testimony describes what we do, in response to your questions. I take this opportunity to tell you why we do it. *New York Times* columnist Tom Friedman has attracted a great deal of attention with his declaration that the world is flat. By this, he means that the Internet, communications technology, and globalization have put all peoples of the world on an equal economic footing. Yet, despite the extraordinary increase in our ability to communicate and access information, we all know that the world is far from flat, even metaphorically.

Countries that cannot feed their people or provide them with economic opportunities are susceptible to extremist ideologies, autocratic rule, and human rights abuses. The still-growing human population, rising affluence in emerging economies, and many other factors are pushing the global prices of edible oils and grains to unprecedented highs. Global climate change is expected to make matters worse.

Encouraging, and more importantly, assisting countries to use science and technology to build food security, manage land and water resources, and create knowledge-based economic opportunities, are essential goals for U.S. diplomacy and U.S. national security. Indeed, they are a central element of the Secretary's Transformational Diplomacy Initiative.

Let me give you just one small personal example of science diplomacy, from my experience before I came to State. I am a plant molecular biologist and geneticist. In 2004, I published a book on the science behind genetically modified plants, generally known as GM crops, or GMOs. Not long after, I received an e-mail from a junior Foreign Service Officer in the American Embassy in Bangladesh, inviting me to come and speak about GMOs. Bangladesh is a poor country, with a limited amount of arable land, and a still-growing population. It badly needs contemporary science to increase its agricultural output. Caught between U.S. acceptance and Europe's continued rejection of GM crops, Bangladesh had not developed its own GM policy. The conference opened an important dialogue among scientists in our country and theirs, diplomats and government officials, as well as the local press, in the effort to distinguish fact from fiction in this highly charged area and move forward.

There is a growing recognition that science and technology are, and will increasingly be, the drivers of the successful economies of the 21st Century. From countries to companies, today's organizations are shaped by their expertise in science, technology, and engineering. Improving the welfare and stability of the poorest nations will require a concerted effort by the developed world to address the underlying disparities in access to the education, the science, and the technology essential for economic growth.

The world also faces common threats, climate change, energy and water shortages, infectious diseases, and environmental degradation. Such threats are blind to political boundaries. The birds that spread avian flu don't apply for visas or stop at border crossings. Addressing global challenges necessitates international scientific cooperation. Scientists speak a common language, making it possible for members of ideologically divergent societies to cooperatively address the problems confronting all of us.

Finally, some types of science are inherently international in scope and collaborative by necessity. The objective of the International Thermonuclear Experimental Reactor, ITER, as it is generally known, is to harness the power of nuclear fusion as a new and viable energy source. ITER is an international scientific cooperation among key science leaders, Japan, Korea, China, the European Union, India, Russia, and the United States. The recent elimination of funding for the Fiscal Year 2008 U.S. contribution to the ITER Project has made our allies question our commitment and credibility in the international cooperative ventures.

It is perhaps important to remember that in an earlier era, science diplomacy was an important avenue of communication between the Soviet Union and the U.S., credited by many with preventing a flash-over of the Cold War. In a complex, multi-polar world, relations are more challenging, the threats perhaps greater, and the need for engagement even more compelling.

I thank you very much.

[The prepared statement of Dr. Fedoroff follows:]

PREPARED STATEMENT OF NINA V. FEDOROFF

MAKING SCIENCE DIPLOMACY MORE EFFECTIVE

Chairman Baird, Ranking Member Ehlers, and distinguished members of the Subcommittee, thank you for this opportunity to discuss science diplomacy at the U.S. Department of State. The U.S. is recognized globally for its leadership in science

and technology. Our scientific strength is both a tool of "soft power"—part of our strategic diplomatic arsenal—and a basis for creating partnerships with countries as they move beyond basic economic and social development. Science diplomacy is a central element of the Secretary's transformational diplomacy initiative, because science and technology are essential to achieving stability and strengthening failed and fragile states.

S&T advances have immediate and enormous influence on national and global economies, and thus on the international relations between societies. Nation states, nongovernmental organizations, and multinational corporations are largely shaped by their expertise in and access to intellectual and physical capital in science, technology, and engineering. Even as S&T advances of our modern era provide opportunities for economic prosperity, some also challenge the relative position of countries in the world order, and influence our social institutions and principles. America must remain at the forefront of this new world by maintaining its technological edge, and leading the way internationally through science diplomacy and engagement.

The Public Diplomacy Role of Science

Science by its nature facilitates diplomacy because it strengthens political relationships, embodies powerful ideals, and creates opportunities for all. The global scientific community embraces principles Americans cherish: transparency, meritocracy, accountability, the objective evaluation of evidence, and broad and frequently democratic participation. Science is inherently democratic, respecting evidence and truth above all.

Science is also a common global language, able to bridge deep political and religious divides. Scientists share a common language. Scientific interactions serve to keep open lines of communication and cultural understanding. As scientists everywhere have a common evidentiary external reference system, members of ideologically divergent societies can use the common language of science to cooperatively address both domestic and the increasingly trans-national and global problems confronting humanity in the 21st century. There is a growing recognition that science and technology will increasingly drive the successful economies of the 21st century.

Science and technology provide an immeasurable benefit to the U.S. by bringing scientists and students here, especially from developing countries, where they see democracy in action, make friends in the international scientific community, become familiar with American technology, and contribute to the U.S. and global economy. For example, in 2005, over 50 percent of physical science and engineering graduate students and postdoctoral researchers trained in the U.S. have been foreign nationals. Moreover, many foreign-born scientists who were educated and have worked in the U.S. eventually progress in their careers to hold influential positions in ministries and institutions both in this country and in their home countries. They also contribute to U.S. scientific and technologic development: According to the National Science Board's 2008 Science and Engineering Indicators, 47 percent of full-time doctoral science and engineering faculty in U.S. research institutions were foreign-born.

Finally, some types of science—particularly those that address the grand challenges in science and technology—are inherently international in scope and collaborative by necessity. The ITER Project, an international fusion research and development collaboration, is a product of the thaw in superpower relations between Soviet President Mikhail Gorbachev and U.S. President Ronald Reagan. This reactor will harness the power of nuclear fusion as a possible new and viable energy source by bringing a star to Earth. ITER serves as a symbol of international scientific cooperation among key scientific leaders in the developed and developing world—Japan, Korea, China, E.U., India, Russia, and United States—representing 70 percent of the world's current population.

The recent elimination of funding for FY08 U.S. contributions to the ITER project comes at an inopportune time as the Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project had entered into force only on October 2007. The elimination of the promised U.S. contribution drew our allies to question our commitment and credibility in international cooperative ventures. More problematically, it jeopardizes a platform for reaffirming U.S. relations with key states. It should be noted that even at the height of the cold war, the United States used science diplomacy as a means to maintain communications and avoid misunderstanding between the world's two nuclear powers—the Soviet Union and the United States. In a complex multi-polar world, relations are more challenging, the threats perhaps greater, and the need for engagement more paramount.

Using Science Diplomacy to Achieve National Security Objectives

The welfare and stability of countries and regions in many parts of the globe require a concerted effort by the developed world to address the causal factors that render countries fragile and cause states to fail. Countries that are unable to defend their people against starvation, or fail to provide economic opportunity, are susceptible to extremist ideologies, autocratic rule, and abuses of human rights. As well, the world faces common threats, among them climate change, energy and water shortages, public health emergencies, environmental degradation, poverty, food insecurity, and religious extremism. These threats can undermine the national security of the United States, both directly and indirectly. Many are blind to political boundaries, becoming regional or global threats.

The United States has no monopoly on knowledge in a globalizing world and the scientific challenges facing humankind are enormous. Addressing these common challenges demands common solutions and necessitates scientific cooperation, common standards, and common goals. We must increasingly harness the power of American ingenuity in science and technology through strong partnerships with the science community in both academia and the private sector, in the U.S. and abroad among our allies, to advance U.S. interests in foreign policy.

There are also important challenges to the ability of states to supply their populations with sufficient food. The still-growing human population, rising affluence in emerging economies, and other factors have combined to create unprecedented pressures on global prices of staples such as edible oils and grains. Encouraging and promoting the use of contemporary molecular techniques in crop improvement is an essential goal for U.S. science diplomacy.

An essential part of the war on terrorism is a war of ideas. The creation of economic opportunity can do much more to combat the rise of fanaticism than can any weapon. The war of ideas is a war about rationalism as opposed to irrationalism. Science and technology put us firmly on the side of rationalism by providing ideas and opportunities that improve people's lives. We may use the recognition and the goodwill that science still generates for the United States to achieve our diplomatic and developmental goals. Additionally, the Department continues to use science as a means to reduce the proliferation of the weapons of mass destruction and prevent what has been dubbed 'brain drain.' Through cooperative threat reduction activities, former weapons scientists redirect their skills to participate in peaceful, collaborative international research in a large variety of scientific fields. In addition, new global efforts focus on improving biological, chemical, and nuclear security by promoting and implementing best scientific practices as a means to enhance security, increase global partnerships, and create *sustainability*.

The Office of the Science and Technology Adviser (STAS) is actively involved in long-term strategic planning and dialogues about the importance of science, engineering, and technology to the future security our nation. The STAS Global Dialogues on Emerging Science and Technology have focused on emerging technology outside of the U.S. The most recent conference this March focused on the development of geographic information systems for sustainable development in Africa and will promote greater U.S.–African regional cooperation on this issue.

Another broad Department initiative has been the Iraqi Virtual Science Library. The Iraqi Virtual Science Library (IVSL), launched on May 3, 2006, is a digital portal that provides 80 percent of Iraqi universities and research institutes with access to an outstanding collection of millions of full text articles from over 17,000 premier scientific and engineering journals and their archives, in addition to technical content and educational resources through an innovative open-source Internet platform developed with Sun Microsystems. Its goal is to help rebuild the educational and scientific infrastructure in Iraq and reintegrate Iraqi scientists and engineers into the global scientific community.

Recognizing the need to rebuild the science and engineering infrastructure in Iraq, a group of American Association for the Advancement of Science (AAAS) Science & Technology Policy Fellows began the IVSL (*https://ivsl.org*) project in 2004. The IVSL is now an interagency collaboration with members from the U.S. Departments of State and Defense. The project is funded by the Defense Threat Reduction Agency, the U.S. State Department, and the Civilian Research and Development Foundation, the generous donations of publishing companies and professional societies, and partnerships with the U.S. National Academy of Sciences, other departments and agencies of the U.S. Government, Sun Microsystems, the Massachusetts Institute of Technology, Useful Utilities, and Vitalect Technologies.

STAS has been also closely involved in Project Horizon, in partnership with other bureaus at State, as well as the DOD, USAID, the intelligence community, and other U.S. technical agencies. Project Horizon is a strategic, scenario-based planning project to focus on the future of 21st century global affairs and transformational di-

plomacy. The purposes of Project Horizon are threefold. First, it is to develop strategic interagency capabilities in which the U.S. Government should consider investing in to prepare for the threats and opportunities that will face the Nation over the next 20 years, including building and integrating our operational capacity to respond to contingencies and support country transitions effectively. Second, it is to provide participating agencies with a scenario-planning tool set that can be used to support both internal agency planning and planning across agencies. Third, it is to provide a starting point for an institutionalized interagency planning process. Project Horizon anticipates that the Department of State will have a critical need to strengthen the ability of the Department to focus on shaping the environment for our international relations. Science, technology, and engineering are key components of the Horizon blueprint for the future of the Department's statecraft.

Increasing Science Literacy at State

Just as we may use S&T diplomacy outside of State, it is also important to build science literacy within the Department of State and USAID in order to maintain our "intellectual security." Our diplomats will be called upon increasingly to exhibit science, engineering, and technology expertise and presence in fulfillment of their duties.

As the Secretary of State's Advisory Committee on Transformational Diplomacy noted, the Department of State should expand its investment in science, engineering, and technology expertise in order to enhance its presence and global engagement in the formulation of new international laws, standards, and practices in emerging scientific fields such as climate change, genetics, and nanotechnology. We seek to increase the number of scientists in the Department through promotion and coordination of the American Association for the Advancement of Science Diplomacy Fellowships (30 fellows for 2007–2008), professional science society fellowships (two fellows), and Jefferson Science Fellowships (eight for 2007–2008). The Department is also actively promoting the Embassy Science Fellows Program (37 from seven agencies in 33 posts in 2007) to place scientists in posts overseas, and developing science, engineering, and technology student internships at the Department of State. These initiatives provide important technical capacity within the Department, and STAS is actively working, in partnership with the Bureau of Oceans, Environment, and Science (OES), to make scientific, engineering, and technical capacity more widely accessible to the Department and overseas embassies and missions.

The Department should expect all Foreign Service officers and other officials of the Department and Agency for International Development to achieve a minimum level of scientific literacy and awareness in matters relating to foreign policy to perform their duties effectively. This is obvious for issues such as global health, nanotechnology, space and advanced research, environment, and energy, but comes into play in other ways as well. Science literacy is also essential to understanding and dealing with issues such as arms control and nonproliferation, including chemical and nuclear weapons and their delivery systems, and for counter-terrorism. The STAS office is working with the Foreign Service Institute to broaden science literacy within the Foreign Service.

Finally, STAS provides appropriate advice to policy-makers in the Department on emerging scientific issues, and to help reach political consensus on challenging issues. It does so by bringing together scientists within the State Department, other agencies, the private sector, and the academic communities.

THE ROLE OF SCIENCE AND TECHNOLOGY AT USAID

Development can directly support diplomacy and science is an integral part of development. The foci of our foreign assistance are building self-sustaining economies and poverty alleviation, transforming agriculture and resolving food insecurity, solving global health problems, climate and environment, as well as building democracy and supporting the rule of law. Science and technology have a role to play in all of these.

Science, engineering, and technology are eagerly desired by developing countries and remain among the most admired aspects of American society. Access to S&T is a key component of innovation, which in turn, is a key component of economic competitiveness in all countries, at every stage of development. Investments in science and technology have long been recognized as a key element of development strategies to lift people out of poverty and onto a path of self-sufficiency and sustainable growth.

Enhancing Science at USAID

Nearly all aspects of development require science and technology or would benefit from them, and this will only grow in the future. Yet USAID has suffered steep de-

clines in S&T capacity, staffing, and funding, particularly in overseas missions, where such knowledge is crucial to the development of foreign assistance programs that fully respond to local needs. In parallel, so too has the Agency's support for research to develop a new generation of technologies and practices to address these emerging or deepening problems of development. These shortfalls have hurt the Agency's ability to achieve its mission.

The State Department's Science Adviser's recent additional appointment as the Science Adviser to the USAID Administrator highlights the Agency's recognition of the importance of S&T to development, and emphasizes the need to ensure that that U.S. Government is using the best scientific and technological information to solve the world's development challenges. Solving such challenges pays important dividends to the American people.

To address the science and technology issues at the Department of State and USAID and to link policy initiatives with foreign assistance programs, the STAS office is transforming into a joint State Department–USAID Science Diplomacy unit to more effectively engage scientists, engineers, and a variety of technical experts in meeting our diplomatic and development goals and unite STAS' dual roles to the Secretary and the USAID Administrator.

The mission of this office will be to deliver the kind of scientific and technical expertise required by a country to address the critical challenges that threaten it. It will focus on emerging, as well as fragile and failing states in need of technical and scientific expertise. The office will call on the U.S. academic, industrial and USG S&T sector, constituting working groups of scientists, engineers and other technical personnel to address development problems. Its purpose is to ensure that the use of science and technology achieves our goals in public diplomacy, increases the efficacy of our foreign assistance programs, and meets our foreign policy objectives of transformational diplomacy and stabilization of the international system.

THE ROLE OF STAS RELATIVE TO OES

The State Department's Science and Technology Adviser to the Secretary is one of the Department's principal interlocutors with the national and international scientific community. The Adviser seeks counsel and assistance from the community on foreign policy based science and technology initiatives at the Department of State, but also serves to inform the community of such initiatives, and provide a venue for collaboration.

STAS helps ensure that scientific issues receive attention at senior levels of the Department, including the Secretary. The Adviser provides accurate advice to the Department to help officials understand emerging scientific issues and inform U.S. positions on issues, such as biotechnology and climate change. The Adviser also ensures access for the Department to the expertise and resources of the scientific community.

The Science Adviser works closely with OES and with other bureaus and offices within the State Department on a variety of issues, from promoting international cooperation on science, engineering, and technology, to meeting with delegations, and crafting policy for international meetings. STAS is both a resource and a collaborator for OES and other and functional and regional State Department bureaus.

Most importantly, the Adviser is a conduit for scientific information to the leadership of the Department. STAS advises and receives policy advice from the Secretary of State, the Deputy Secretary, the Under Secretary for Democracy and Global Affairs (G) and OES Assistant Secretary, on all science, environment, health, technology, engineering, and related research and development activities, and issues that have foreign policy implications. STAS also provides scientific and technical advice and counsel to other Under Secretaries, regional and functional Assistant Secretaries, and other senior staff throughout the Department on issues that involve a scientific, engineering, or technology component, in partnership with OES.

STAS' ROLE IN AGENCY, NGO, & PRIVATE SECTOR COORDINATION

STAS plays a key coordination role for State in its relationship with the NGO community on scientific, engineering, and technology topics. STAS works actively with professional and scientific organizations, such as the American Association for the Advancement of Science, and the National Academies of Science, Medicine, and Engineering. These relationships provide the Department of State and the Agency for International Development access to the best intellects in the field, and to the frontiers of science.

STAS also maintains close working relationships with the other USG agencies that deal with science- and technology-based issues, particularly, with the White House Office of Science and Technology Policy (OSTP), the National Science and Technology Council within the White House, the National Science Foundation, and

the National Institutes of Health, and speaks for the Department in its dealings with those agencies. The Adviser has met with many of her direct counterparts at the Departments of Agriculture, Energy, and Defense, for example, to share ideas about areas of common interest and concern, and to pursue collaborative opportunities.

Finally, STAS is an important link to the private sector, both companies and foundations. Such partnerships leverage State Department and USAID resources to achieve common goals.

Thank you again for allowing me to testify on this important topic.

BIOGRAPHY FOR NINA V. FEDOROFF

U.S. Secretary of State Condoleezza Rice has named Dr. Nina V. Fedoroff to be her new Science and Technology Adviser. Dr. Fedoroff is the Willaman Professor of Life Sciences and Evan Pugh Professor in the Biology Department and the Huck Institutes of the Life Sciences, Pennsylvania State University.

Dr. Fedoroff is a leading geneticist and molecular biologist who has contributed to the development of modern techniques used to study and modify plants. She received her Ph.D. in molecular biology from the Rockefeller University in 1972. In 1978, she became a staff member at the Carnegie Institution of Washington and a faculty member in the Biology Department at Johns Hopkins University. In 1995 Dr. Fedoroff joined the faculty of the Pennsylvania State University, where she served as the founding Director of the *Huck Institutes of the Life Sciences.*

Dr. Fedoroff has done fundamental research in the molecular biology of plant genes and transposons, as well on the mechanisms plants use to adapt to stressful environments. Her book, *Mendel in the Kitchen: A Scientist's View of Genetically Modified Foods,* published in 2004 by the Joseph Henry Press of the National Academy of Science, examines the scientific and societal issues surrounding the introduction of genetically modified crops.

Dr. Fedoroff is a member of the National Academy of Sciences, the American Academy of Arts and Sciences, and the European Academy of Sciences. She has served on the National Science Board of the National Science Foundation. Dr. Fedoroff is a 2006 National Medal of Science laureate.

Nina V. Fedoroff did her undergraduate work at Syracuse University, graduating summa cum laude with a dual major in biology and chemistry. She attended the Rockefeller University, where she earned her Ph.D. in molecular biology in 1972. Both her undergraduate research at Syracuse University and her graduate research on RNA bacteriophage at The Rockefeller University were supported by grants and fellowships from the National Science Foundation. Following graduation from The Rockefeller University, she joined the faculty at the University of California, Los Angeles (UCLA), and carried out research on nuclear RNA.

In 1974 Fedoroff received fellowships from the Damon Runyan-Walter Winchell Cancer Research Fund and the National Institutes of Health (NIH) for postdoctoral work, first at UCLA and then in the Department of Embryology of the Carnegie Institution of Washington in Baltimore. Working in the laboratory of Donald Brown, Fedoroff pioneered in DNA sequencing, determining the nucleotide sequence of the first complete gene. In 1978, Fedoroff became a staff member at the Carnegie Institution of Washington and a faculty member in the Biology Department at Johns Hopkins University. Her research focus changed to the isolation and molecular characterization of maize transposable elements. The isolation of the maize transposons, discovered genetically by Barbara McClintock in the 1940s, was achieved in the early 1980s. In subsequent years, Fedoroffs lab showed that the maize transposons were active in a variety of other plants, developed transposon tagging systems, and studied the eipgenetic regulation of transposon activity.

In 1995 Fedoroff joined the faculty of the Pennsylvania State University as Willaman Professor of Life Sciences. From 1995 to 2002, she served as the Director of the Biotechnology Institute and she organized and served as the first Director of the Life Sciences Consortium (now the Huck Institutes of the Life Sciences), a seven-college organization devoted to the promotion of multi-disciplinary research and teaching in the life sciences. In 2002, Fedoroff was named an Evan Pugh Professor of the Pennsylvania State University and in 2003, she became a member of the External Faculty of the Santa Fe Institute. Fedoroff's current work is directed at understanding the genetic organization and molecular dynamics of plant stress and hormone responses and makes use of DNA microarray expression profiling, reverse genetics, and theoretical approaches to the analysis of large data sets. Fedoroff has published two books and numerous papers in scientific journals.

Fedoroff has served on the editorial boards of the *Proceedings of the National Academy of Sciences, Science, Gene, Plant Journal* and *Perspectives in Biology and*

Medicine and currently chairs the NAS Council's Publications Committee. She served on the board of the International Science Foundation and the International Scientific Advisory Board of the Englehardt Institute of Molecular Biology in Moscow. She has been a member of the Council of the National Academy of Sciences, the Board of Directors of the Genetics Society of America, the American Association for the Advancement of Science, the Board of Trustees of BIOSIS and the National Science Board, which oversees the National Science Foundation. She is currently a member of the Science Steering Committee of the Santa Fe Institute and the Board of Directors of the Sigma-Aldrich Chemical Company.

Fedoroff has received several awards and honors, including an NIH Merit Award, a 10-year research grant that supported her work from 1989 to 1999. She also received the University of Chicago's Howard Taylor Ricketts Award in 1990, the New York Academy of Sciences' Outstanding Contemporary Woman Scientist award in 1992, and the Sigma Xi's McGovern Science and Society Medal in 1997, and Syracuse University's Arents Pioneer Medal in 2003. She is a member the American Academy of Arts and Sciences, the European Academy of Sciences, the American Academy of Microbiology and the National Academy of Sciences.

Chairman BAIRD. Thank you, Dr. Fedoroff. Mr. Miotke.

STATEMENT OF MR. JEFF MIOTKE, DEPUTY ASSISTANT SECRETARY FOR SCIENCE, SPACE, AND HEALTH, BUREAU OF OCEANS, ENVIRONMENT, AND SCIENCE, U.S. DEPARTMENT OF STATE

Mr. MIOTKE. Thank you, Mr. Chairman, and Ranking Member Neugebauer, and distinguished Members of this subcommittee. I welcome the opportunity to talk a little bit about how important S&T is to diplomacy, although I have to say I am now a little at a loss for words, since your own comments and Dr. Fedoroff's have pretty much stolen my thunder.

And Dr. Marburger, as usual, has described the role of the State Department better than I can. I am going to be asking him to write my work requirement statement. So, I got myself in trouble. Nonetheless, I am a diplomat. I get paid by the word, so I am going to read my statement in any case.

My last overseas tour in Hungary was a great example of the power of S&T to build bridges. My Ambassador there, Nancy Brinker, who many of you may know from the Komen Foundation, orchestrated an impressive breast cancer awareness campaign. GE was generous in its support of the initiative, making medical equipment and experts available. And so, at the very time that we were working with Hungary in preparation for the coalition forces to move into Iraq, Ambassador Brinker engineered a massive outpouring of support for the Embassy, and I believe that had very real implications for the level of support that we enjoyed from Hungary.

As Dr. Fedoroff has noted also, S&T is also a fundamental pillar of development. Most, if not all countries have realized that to create jobs and be competitive, they must accelerate the development of their knowledge and technology sectors. Our cooperation with them supports the establishment of science-based industries, encourages investments, highlights the importance of education, and promotes international dialogue on issues of global import. By hearing our expertise in an area of comparative strength, the United States demonstrates to other nations that we are interested in seeing them develop and flourish. This helps alleviate some of the misconceptions about U.S. motives.

Science also drives diplomacy as well. This is certainly the case in the full range of my Bureau's issues, be it avian influenza, persistent organic pollutants, climate change, or nanotechnology. In each case, the scientific community alerted us to potential problems or concerns. That awareness then spawned an international process. As the international dialogue proceeds, the scientific community redefines and updates the parameters of the problem. Ideally, this ongoing scientific process helps achieve a consensus on an issue, or at least helps to narrow the political divide.

In the best known example, growing concern about climate change resulted not just in the negotiations under the U.N. Framework Convention on Climate Change, but also, in the periodic assessment process of the Intergovernmental Panel on Climate Change.

The Department is applying S&T diplomacy in a strategic manner. In July 2005, Secretary Rice approved an initiative to increase S&T outreach to the countries in the Middle East, North Africa, and South Asia. The goal of this strategy is to enhance our relationships, to foster development in those countries by engaging more fully with their science and technology communities, and by reaching out, in particular, to women and youth.

In approving this strategy, the Secretary recognized the promise of S&T to both advance American national interests and promote the freedom and dignity of others. Science and science education can play an important role in fostering dialogue, increasing innovation, and addressing poverty. S&T empowers people to raise themselves up by developing their own human and intellectual capacity. This empowerment gives hope, a natural enemy of extremism.

I am pleased to say that S&T diplomacy has been an all-hands effort at State. In addition to launching the Muslim Outreach Strategy, the Secretary has signed several S&T agreements, including Bulgaria and India, just to name a couple. Under Secretary of State for Democracy and Global Affairs, Paula Dobriansky, was the architect of our Muslim S&T Outreach strategy, and she has led a number of S&T delegations, including the first to Libya since that country renounced nuclear weapons. OES Assistant Secretary Claudia McMurray has led S&T delegations to Morocco and Libya as well. Ambassador Reno Harnish, the OES Principal Deputy Assistant Secretary, has been extremely active speaking on S&T issues in the United States and abroad. And Dr. Fedoroff, of course, has been an invaluable addition to the S&T team at State.

I thank you again for this opportunity, and I look forward to any questions you might have.

[The prepared statement of Mr. Miotke follows:]

PREPARED STATEMENT OF JEFF MIOTKE

Mr. Chairman and Members of this committee, thank you for giving me the opportunity to address the important topic of international science and technology cooperation.

Scope

The Department of State (DOS) engages governments, business, universities, nongovernmental and international organizations, and individuals from every region in the world to promote scientific cooperation and education. To accomplish this, DOS applies a suite of diplomatic tools including: formal bilateral science and technology (S&T) cooperation agreements that facilitate international collaboration by USG

technical agencies, promotion and support of S&T entrepreneurs and innovators, scientist and student exchanges, workshops, conferences, meetings, public-private partnerships, seed funding for scientific programs and innovation activities, and production of educational materials, including films, websites, posters, and cards.

Our own activities and cooperation with other USG agencies cover a wide range of scientific topics, including alternative energies, health and medicine, environment and marine research, nanotechnology, space exploration, weather, seismology, and geology among many others. In carrying out its science diplomacy, DOS makes a special effort to include women, youth, and emerging leaders as beneficiaries, and in recent years, has supported programs focused on capacity building, entrepreneurship, outreach to scientific communities in Muslim-majority countries, and the developing world.

Bilateral S&T Cooperation Agreements

Science and science-based approaches make tangible improvements in people's lives. Strategically applied, S&T outreach serves as a powerful tool to reach important segments of civil society. Sound science is a critical foundation for sound policy-making and ensures that the international community develops reliable international benchmarks. Science is global in nature—international cooperation is essential if we are to find solutions to global issues like climate change and combating emerging infectious diseases. International scientific cooperation promotes good will, strengthens political relationships, helps foster democracy and civil society, and advances the frontiers of knowledge for the benefit of all.

The Bureau of Oceans, Environment, and Science (OES) in DOS pursues such efforts through the establishment of bilateral and multilateral S&T cooperation agreements. There are now over forty of these framework agreements in place, or in various stages of negotiation, in every region of the world—from Asia and Africa, to Europe, the Middle East, and Latin America. These agreements:

- Strengthen bilateral, regional, and global cooperation
- Advance broader U.S. foreign policy goals
- Provide for protection and allocation of intellectual property rights and benefit sharing
- Encourage public and private engagement
- Foster science-based decision-making
- Facilitate the exchange of scientific results and access for researchers
- Address taxation issues
- And respond to the complex set of issues associated with economic development, security, and regional stability

These bilateral agreements have significant indirect benefits including contributing to solutions and initiatives that encourage sustainable economic growth, promoting good will, strengthening political relationships, helping foster democracy and civil society, supporting the role of women in science and society, promoting science education for youth, and advancing the frontiers of knowledge for the benefit of all.

The agreements are instrumental in advancing our diplomatic relationships with key countries. They bring leading U.S. Government scientists together with foreign counterparts and policy-makers to discuss the important role of cooperative scientific endeavors in advancing, for example, our understanding of key elements of the climate system. Through our bilateral relationship with Russia, to cite one such project, we have advanced the state of research on the impacts of climate change in the Arctic—a key system in which we are working to address important gaps in knowledge. In bringing senior officials together to discuss areas of common concern, the bilateral partnerships have helped to demonstrate how much we have in common and have thereby advanced our diplomatic relationships and helped us achieve our objectives.

Promotion of International Cooperation

The International Space Station Agreement and the International Thermonuclear Experimental Reactor (ITER) projects are multilateral projects the Department supports that have the promise of broadening knowledge, strengthening capabilities, and extending benefits to the United States and our international partners. Disseminating knowledge on the use of remote sensing capabilities in developing countries and negotiation of nanotechnology standards for emerging products and services in member nations of the Organization for Economic Cooperation and Development (OECD) are included in the wide range of subjects supported by DOS.

The Global Positioning System (GPS) is one of the greatest gifts of the American people to the world. OES works with the USG interagency community and foreign

space-based satellite navigation providers to promote compatibility and inter-operability of other provider's signals and services with GPS for the benefit of users worldwide. A GPS–Galileo Cooperation Agreement with the European Union and Joint Statements on GPS Cooperation with Japan, India, Australia, and Russia are producing tangible results such as common signal design and protecting United States national security interests.

OES works closely with the United Nations (UN) Office on Outer Space Affairs and other interested nations to form a voluntary International Committee on Global Navigation Satellite Systems (ICG) and related Providers Forum. This multilateral venue provides an opportunity for discussing and resolving spectrum compatibility and inter-operability issues, considering guidelines for the broadcast of natural disaster alarms via Global Navigation Satellite Systems (GNSS), seeking ways to enhance performance of GNSS services, promoting GNSS use among developing countries, and coordinating work among international scientific organizations for GNSS applications worldwide.

OES also protects U.S. security and global economic growth by promoting global health. Global health policy is firmly grounded in a scientific understanding of the infectious, environmental and potential terrorist threats to public health worldwide. OES works with agencies throughout the U.S. Government to facilitate policy-making regarding environmental health, infectious disease, health in post-conflict situations, and surveillance and response, bioterrorism, defense of the food supply and health security. OES works on global health with other U.S. Government agencies, including the National Security Council, Homeland Security Council, Departments of Health and Human Services, Homeland Security, Agriculture, Defense, USAID, and intelligence agencies. OES also works with the United Nations (especially the World Health Organization) and other international organizations, the private sector, non-governmental organizations, and foreign governments.

DOS performs an important role in coordinating United States engagement in the scientific and technical organizations of the UN and other multilateral fora including the Arctic Council, the International Council for the Exploration of the Seas, and more. Often, the scope of scientific endeavors and research interests requires DOS, due to limited financial resources, to leverage its resources with other governments. For example, with National Oceanic and Atmospheric Administration (NOAA) leadership and DOS cooperation, the United States hosted the First Earth Observation Summit in 2003, with 34 participating nations, to generate international support for creating a comprehensive Global Earth Observation System of Systems (GEOSS). This ambitious undertaking involves coordinating disparate Earth observation systems across the world in order to improve our collective ability to address critical environmental, economic, and societal concerns. The now 72-member governments, including the European Commission, and 46 participating organizations of the Group on Earth Observations (GEO) met in Cape Town in November 2007 to assess progress.

Other parts of the Department of State are similarly engaged in S&T related cooperation. For example, the bureaus under the leadership of Acting Under Secretary for Arms Control and International Security John Rood has, in cooperation with the Bureau for Near Eastern Affairs, have been focused on redirecting scientists through engagement in new programs, whether in the Middle East, North Africa or Central Asia. In Central Asia, cooperation is focused on post Soviet demilitarization of science infrastructure following the model of the Civilian Research and Development Foundation (CRDF) and the International Science and Technology Center (ISTC). Cooperation in Eurasia involves the Department of Energy, which since 1994 has funded over 650 projects at over 200 research institutes in Russia, Kazakhstan, Georgia, Armenia, and Uzbekistan under its Global Initiatives for Proliferation Prevention (GIPP) program to provide meaningful, sustainable, non-weapons-related work for former Soviet weapons of mass destruction scientists, engineers, and technicians through commercially viable market opportunities.

The GIPP program provides seed funds for the identification and maturation of technology and facilities interactions between U.S. industry and former Soviet institutes for developing industrial partnerships, joint ventures, and other mutually beneficial peaceful arrangements. The program involves the active participation of ten DOE national laboratories and the DOE Kansas City Plant. The national laboratories provide technical direction, project managements, and intellectual property management assistance. U.S. industry partners bring the resources and know-how to bring project results to market. Industry partners are engaged in specific projects through Cooperative Research and Development Agreements (CRADAs) with the participating DOE national laboratories. Cooperation also is underway with and USDA in the process of moving weapons scientists to civilian science roles. Coopera-

tion is also conducted with DOD in nonproliferation as well as the destruction of nuclear missile silos.

The State Department's Public Diplomacy/Public Affairs section supports many activities related to S&T diplomacy, especially in its Education and Cultural Affairs bureau. Most effective have been visitors' programs and other exchanges, the Fulbright S&T scholarships, and more recently grant competitions for science and technology education and women's scientists mentoring programs. They have also provided seed money for a number of bilateral and multilateral efforts, most notably the 2007 Kuwait Conference of Women Leaders in Science, Technology, and Engineering.

To address trans-boundary environmental issues, and to support officers at U.S. embassies working on OES issues, the Department established 12 regional environmental Hubs, located in embassies around the world. The Hub concept is based on the idea that trans-boundary environmental problems can best be addressed through regional cooperation. The regional environmental officer's role complements the traditional bilateral Environment, Science, Technology and Health (ESTH) officers stationed in U.S. embassies in many countries of the world. Rather than dealing with a single country, Hub officers engage with several countries of a region on a particular issue, with the aim of promoting regional environmental cooperation, sharing of environmental data, and adoption of environmentally sound policies that will benefit all countries in that area. The Hubs work closely with other USG agencies and support their efforts by raising key issues at the diplomatic level. They also cooperate with non-governmental organizations on environmental activities within their region. In addition, there are ESTH officers working with the U.S. Mission to the UN and the U.S. Mission to the EU.

OES works closely with a number of USG technical agencies on the international aspects of climate change policy. Under OSTP leadership, OES has played a key role in the Intergovernmental Panel on Climate Change (IPCC) since its inception, through official contributions and key leadership positions in IPCC report development, as well as through the contributions of many U.S. scientists and experts. Other examples of DOS cooperation on climate issues include:

- Bilateral climate partnerships with 15 countries and regional organizations that, together with the United States, account for almost 80 percent of global greenhouse gas emissions. These partnerships now encompass over 400 individual activities with Australia, Brazil, Canada, China, Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama), the European Union, Germany, India, Italy, Japan, Mexico, New Zealand, South Korea, Russia, and South Africa. These partnerships now encompass over 400 individual activities.
- The Asia-Pacific Partnership on Clean Development and Climate, which focuses on acceleration and deployment of clean energy technologies, and includes Australia, Canada, China, India, Japan, the Republic of Korea and the United States.

Oceanographic exploration in the 20th century has completely transformed our view of the deep ocean. Today, scientists know that the deep sea is teeming with life and that its bio-diversity is comparable to the world's richest tropical rain forests. The advent of new exploratory technologies is leading to the discovery of ecosystems which are extraordinary in nature, often hosting species found nowhere else on the planet.

For the fishing industry also, the unreachable is now within reach. Advances in bottom fishing technology mean that it is now possible to fish the deep sea's rugged floors and canyons. This has led to an urgent call for action within the international community to ensure that deep-sea bottom fishing on the high seas is monitored and regulated to protect these unique and fragile areas. The Department of State, in collaboration with NOAA, has facilitated science and technology partnerships enabling more effective fishery regulation to achieve sustainability.

Outreach to the Muslim S&T Community

OES is finalizing S&T cooperation agreements with Kazakhstan and Azerbaijan that will enable an increase in the scope of S&T cooperation in the region. Funding, and how we successfully leverage the ability of those countries to finance science exchange, will largely determine the pace of activities in terms of new programs.

U.S. S&T capability remains one of the most admired aspects of American society around the world, and this is particularly true in predominantly Muslim countries. Public opinion polling indicates that people view American science and technology more favorably than American products, our education system, or even our freedom

and democracy. Young people under thirty find American S&T particularly appealing.

Secretary Rice recognizes the promise S&T offers both to advance American national interests and to promote the freedom and dignity of others. S&T empowers everyone to raise themselves up by developing their own human and intellectual capacity. This empowerment gives hope—a natural enemy of extremism.

In July 2005, Secretary Rice approved a strategic initiative, put forward by Under Secretary of State for Democracy and Global Affairs Paula Dobriansky, to increase U.S. outreach to countries in the Middle East, North Africa, and South Asia. The goal of this strategy is to enhance our relationships and to foster development in those countries by engaging more fully with their science and technology communities, reaching out to women and youth, and increasing collaborative S&T activities and exchanges. In approving this strategy, the Secretary recognized the promise of science and technology to both advance American national interests and promote the freedom and dignity of others. Science and science education can play an important role in fostering dialogue, increasing innovation, and addressing poverty.

A wide variety of outcomes have resulted from the implementation of this strategy.

1. We have recently concluded S&T agreements with Algeria, Morocco, Libya, and Jordan. We are now finalizing agreements with Kazakhstan, Saudi Arabia, and Azerbaijan. We've raised our S&T relationship with Pakistan to a higher level. With Pakistan and Egypt we have the only two government-to-government S&T funds still in existence.

2. Under Secretary Dobriansky hosted a "Conference of Women Leaders in Science, Technology, Engineering, and Mathematics" in Kuwait in January 2007. The Conference brought together 270 women scientists and leaders from 18 Arab countries and Turkey, including a 31-member U.S. delegation that included university presidents, CEO's and an astronaut, to build the capacity of Muslim majority and developing countries by focusing on women scientists as a key human resource.

3. Following the Kuwait Conference of Women Leaders in Science, Technology, Engineering, and Mathematics, Under Secretary Dobriansky approved a body of robust new science partnerships in a wider array of Muslim-majority countries. We have leveraged resources with others to begin dozens of new engagements which focus on the transformative aspects of science diplomacy, including conferences, workshops, training, educational materials, e-education, science films, technology accelerators, sustainable laboratory design, and a host of other engagements.

4. The S&T cooperation agreement with Libya was the culmination of a multi-year, multi-faceted effort to acknowledge Libya's historic decision to renounce nuclear weapons. By forging a new, positive relationship through science engagement, we hope to enhance our bilateral relationship and to advance peace and stability.

The suite of agreements which now exist between the United States and the North African countries of the Maghreb enables the United States Government and the non-governmental science community to pursue a vigorous science dialogue with these countries, and permits their science establishments to reciprocate, both bilaterally and regionally, as a group. The United States Government will use these instruments to forge new relationships at the government-to-government level. But the true vibrancy of a more normalized relationship with Libya comes from the academic and private sector. We already have significant new programs to illustrate how this effort is paying off:

- Two U.S. universities have teamed up with the University of Tunis to conduct a North Africa—wide workshop on nano-structured materials and nanotechnology.
- Scientists from the United States and across North Africa, and around the world, came together in Libya for a conference which that country hosted on solar and other alternative energy technologies.
- Some 3,000 delegates attended the Washington International Renewable Energy Conference (WIREC 2008). Morocco, Algeria, and Tunisia were present along with many government, civil society, and private business leaders from around the world.
- This month mayors and other municipal leaders from American cities came together in Chicago for the U.S.–Arab Cities Forum. They will share their insights on attracting global investment, poverty eradication, clean energy technologies, and new approaches to providing clean water to their people.

- Later this spring, Stanford University and NASA's Goddard Space Flight Center will install monitoring devices at Libyan universities in Tripoli and Benghazi that will enable graduate students to join in an international assessment of high atmospheric disturbances.
- The Fulbright Academy of Science and Technology brought together Fulbright Scholars and alumni for an annual meeting in Boston in late February 2008 that included a number of students from the Middle East and North Africa. A few of these individuals received Fulbright Grants. OES will be working with institutions here in the United States and in the Middle East to increase the number of Arab students studying the sciences in the United States.

5. OES supports a variety of science-based educational programs in the Islamic World. One, a Boston-based, educational non-profit NGO, translated its website, *www.greenscreen.org* with OES support into Arabic and French. Teacher guides and other educational materials focus on developing student skills in multiple subject areas, including science, mathematics, and environment themes. These materials provide step-by-step, how-to instructions on carrying out student projects and scientific experiments to be undertaken in the classroom. The Greenscreen web portal allows students to share their science-writing and create linkages with peers domestically and overseas. Thus far, top countries accessing the site have been the United Arab Emirates, Libya, Tunisia, and Kuwait.

Stimulating Growth of the S&T Private Sector in the Middle East

The public and private sectors in the United States are respected for sharing S&T advances and best business practices with the world. The American way of doing business and our earnest efforts to apply honest, best practices in business and institutional partnerships reinforces our attraction to the Islamic World. Our public and private sector S&T communities are perceived as reliable, non-controversial, and beneficial to Islamic society.

Technology business accelerators provide entrepreneurs with reliable partners, provide financial means to create market-ready products from prototypes, assist in developing business plans, and attract venture capital interest. The guiding principles of technology business accelerators make them especially attractive to countries that want a sense of ownership of the program rather than just being beneficiaries of traditional foreign assistance programs. OES is advocating introduction of business technology accelerators that can provide the United States and cooperating countries with opportunities to create partnerships that build S&T-based private sectors and strengthen public institutional ties.

OES is currently working with Jordan, Egypt, Morocco, Algeria, Tunisia, and Libya on the development of technology business accelerators and hopes to expand this program to partner countries in other parts of the world. Elsewhere, OES has on-going dialogues with South Africa and Vietnam regarding accelerators and has raised the subject in meetings with the OECD and APEC. Since the promotion of technological entrepreneurship is of great interest to many partner countries, discussions on accelerators are frequently associated with recently signed bilateral agreements on S&T cooperation.

Business focuses aggressively on market drivers for selecting technologies that can be developed into business opportunities. It applies proven processes and practices to speed up growth of technology-based enterprises that are regionally focused and globally competitive from the outset. Business strives to overcome traditional barriers to success including lack of access to capital and to markets firstly by attracting investment and secondly by using innovative proactive marketing and business development processes in key markets. Finally, U.S. and local business partners assertively infuse the appropriate know-how to ensure their success by transferring their knowledge and advocating its adoption.

U.S. and host country business partnerships are desirable as a means of sustaining S&T programs because they are guided by the following principles:

- They are host country-owned and backed by U.S. public and private partners.
- They are business initiatives.
- They involve stakeholders from both the governmental and private sectors.
- They are guided by both technology policy and business development components, frequently have links to bilateral S&T agreements, and have goals that aim to strengthen the underlying legal, regulatory and policy framework supporting S&T business sector development.
- They offer opportunities for stakeholders to commercialize research undertaken at local universities and government agencies.

- They create long-term independence through extensive knowledge transfer and local capacity building and infrastructure for S&T business creation and growth.

One case in point that illustrates how S&T cooperation is integrated into our diplomatic activities in the Middle East is in the case of Egypt. A wide array of joint United States-Egyptian S&T research activities that have occurred have been funded under our bilateral S&T agreement. In addition to the more tangible and pragmatic S&T benefits observed, both countries have benefited from the cultural understanding and goodwill these relationships foster. The agreement continues to play a significant role in a very important bilateral relationship for the United States. Egypt plays a key role in helping to ensure a stable Middle East.

Establishing Priorities for S&T International Cooperation

The role of the DOS in international S&T collaboration is to advance the objectives of the USG, the academic community, and U.S. commercial interests. The State Department's power rests in its ability to lay the appropriate ground rules for engagement at the government-to-government and international level, to serve as a catalyst, and to use its convening authority effectively. In its role as "chair" for USG international science engagement, OES convenes USG interagency working groups on S&T cooperation with specific countries. These groups are composed of representatives from over 20 USG agencies that have on-going, past or planned activities in those countries. Most interagency meetings are discretionary and called when S&T policy coordination is necessary. There are several every week over the course of the year.

Our outreach program to the Muslim world is indicative of the Department's broad interest in seeing S&T being used as a way to build bridges, promote development, and enhance U.S. scientific progress and capacity. Each year the DOS reviews its priority objectives with each of the regional bureaus to ensure that science and technology is advancing American national and foreign policy interests and promoting the freedom and dignity of others. This is followed up with detailed discussions at the bureau leadership level. Input from our missions abroad is factored into these deliberations, through the review of mission-specific strategic planning documents.

DOS also participates on various joint subcommittees of the National Science and Technology Council including the Joint Subcommittee on Ocean Science and Technology, and attends meetings of the National Academy of Sciences and National Research Council's Studies Boards. DOS finds such mechanisms useful conduits to gather and disseminate information on international S&T policies and collaborative programs.

Interagency S&T coordination is achieved on both a country-by-country and regional basis. For example, the scientific response to the need for a tsunami early warning system in the Indian Ocean and Caribbean basins, the implementation of a U.S. strategy on GPS, or the mobilization of "big science" programs, such as the International Thermonuclear Experimental Reactor or the International Space Station, require coordination along thematic lines and on a regional basis. Building science collaboration that addresses individual national concerns and aspirations requires a more intensive effort toward coordination of agency programs on a bilateral basis, while concomitantly implementing the strategic vision put forward by the Secretary of State.

Working with USG Technical Agencies

We enjoy close collaboration with the technical science agencies, including the Office of Science and Technology Policy (OSTP), the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), the United States Agency for International Development (USAID), the National Institutes of Health (NIH) within the Department of Health and Human Services (HHS), the National Institute for Science and Technology (NIST), the Department of Energy (DOE), and the Environmental Protection Agency (EPA).

OSTP

The Office of Science and Technology Policy (OSTP) plays an instrumental role in defining interagency programmatic priorities and broad budget guidelines for the many global science challenges we face. OSTP Director Dr. Marburger also serves as our "Science Minister" on some bilateral S&T cooperation committees, and in some meetings with S&T Ministers from the international community. His team leads the U.S. delegations to the IPCC as well. The State Department promotes OSTP's R&D Priorities for 2009 through its international partnerships. The 2009 R&D priorities "encourage interdisciplinary research efforts on complex scientific

frontiers and strengthen international partnerships to accelerate the process of science across borders."

NSF

NSF works with DOS to promote S&T cooperation with a number of countries or regions. These include:

- The U.S.–Egypt Joint Fund Program, where NSF manages nearly half of the entire portfolio of proposals for research and workshops.
- The U.S.–Pakistan Commission on Science and Technology, where the Director of NSF is the U.S. Co-Chair. NSF recently funded a linkage from the Global Research and Education Network node in Singapore to Karachi, Pakistan, where it connects with the large and developing Research and Education network in that country.
- NSF participated in an assessment trip in the fall of 2003 followed by a number of workshops, notably one on digital libraries in Rabat, Morocco in January 2007, and one on nanotechnology in Tunisia in March 2008. The workshops are scheduled to be broadcast via Digital Video Conferencing (DVC) to other countries in the region.
- NSF staff worked with OES on developing collaboration with Jordan, with a visit of a staff member in January 2006 and a two-month science fellowship by another NSF staff member at the Embassy in Amman. A new NSF funded workshop on nanotechnology is scheduled for the fall of 2008 in collaboration with the Government of Jordan. That workshop is also scheduled to be broadcast via DVC to other countries in the region.

NOAA

In fulfilling their mission to understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our nation's economic, social, and environmental needs, NOAA undertakes science and technology collaborations globally. NOAA's science and technology cooperative efforts range across their capabilities, and in many cases link to their contributions to the Global Earth Observing System of Systems. Activities include collection of data on the Earths' atmosphere and oceans, weather forecasts, severe storm warnings and climate monitoring, fisheries management, coastal restoration and supporting marine commerce.

Examples of NOAA's recent cooperation through bilateral science and technology agreements include:

- NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) participated in a bilateral meeting with Brazil that has led to enhanced cooperation and data exchange for Earth observations. Key areas of cooperation include regional cooperation on Earth observations, data dissemination (especially via GEO–NETCast), continuity of moderate-resolution space-based land observation, satellite navigation signals and Global Positioning System (GPS) applications, weather and climate forecasting, the Pilot Research Moored Array in the Tropical Atlantic (PIRATA) network, research on the ionosphere and magnetic anomalies, Earth Observation space projects, satellite reception and dissemination, and training on the use and application of Earth Observation data.
- NOAA, along with the Deputy Secretary of Commerce, participated in a visit to Libya in 2007, setting the stage for cooperation on integrated watershed management to prevent impacts on coastal ecosystems from land based sources of pollution.
- Several NOAA offices recently participated in a bilateral meeting with South Africa, and are discussing opportunities for further collaboration to improve climate change models and fill gaps in oceanic and atmospheric data collection in the South African region.

USAID

USAID plays a significant role in integrating the products of S&T to meet the challenges of economic, environmental, and social development. USAID supports research primarily in the areas of agriculture and health and is directed towards applied problems. The technologies and results from research and development supported by other federal agencies and the private sector is, however, integrated across the Agency's work in areas such as information technology, infrastructure, climate change, energy, clean water, environmental management, social safety nets

and education. Among federal agencies, USAID has the unique mandate for applied work on the ground in more than seventy developing countries.

USAID leverages the expertise of U.S. universities, private companies, and other federal agencies in partnerships with governments, research institutions, and the private sector in developing countries. In recent years, USAID funding cuts have greatly scaled back the Agency's support for training in science and technology compared to the 1980s. The Agency still supports modest programs of capacity building as integral to its agricultural research and higher education development programs.

USAID is seen as an international leader in areas such as agricultural biotechnology, contraceptives research, nutrition, vaccines, and the application of geospatial information to climate analysis and response. USAID is one of the only donors to support the development of improved crops using modern biotechnology, providing broader access to this technology by scientists, and eventually small farmers in Africa and Asia. USAID is also a major donor to the Consultative Group on International Agricultural Research (CGIAR), a network of research centers in developing countries which formed the basis of the Green Revolution.

Rising international food prices due to rising food demands threatens the welfare of the world's poor. USAID's leadership in the CGIAR will be a critical component of an international effort to raise productivity and meet this growing food demand. USAID's program to apply geospatial information technology to improve disaster response, weather forecasting, and monitoring of fires, ocean tides, and air quality in Central America was highlighted as an early accomplishment under GEOSS and is now expanding with USAID support to Africa.

USAID invests in bilateral scientific cooperation between the U.S. and Pakistani research and engineering communities. A series of some 40 cooperative R&D efforts, involving several hundred researchers and students on both sides, focus on areas that contribute to broader USAID development objectives in public health, agriculture, water and the environment, education and other sectors. The program, implemented by the National Academy of Sciences, is a true bilateral partnership, with USAID funding U.S. research partners and the Government of Pakistan funding the Pakistani scientists and engineers. All of this activity is implemented under the auspices of an S&T cooperation agreement negotiated by OES.

NIH/HHS

Over the past several decades, the NIH has supported research and research training programs that have resulted in the growth of a worldwide community of global health scientists. Many of these NIH-trained and/or NIH-funded scientists are making remarkable scientific advances and discoveries, becoming worldwide leaders in the medical research enterprise. Life expectancy and prosperity are generally increasing across the developing world, in part due to the success of biomedical advances directly or indirectly supported by the NIH.

NIH's Fogarty International Center is specifically dedicated to advancing global health by supporting and facilitating medical research conducted by U.S. and foreign investigators, building partnerships between U.S. and health research institutions worldwide, and training the next generation of scientists to address global health needs. Although significant advances have been made through the efforts of the NIH, there are still many unknown global health research questions that need to be answered, before we can adequately address the immense challenges from infectious diseases, and the growing global burden of non-communicable diseases. These questions are particularly relevant given the increasing incidence of infectious and non-communicable diseases in low and middle-income countries, where science diplomacy could be most helpful for the United States.

Because the United States is a melting pot of immigrants from every continent, we can make substantive gains in our own nation's health only through a better understanding of the predilection for diseases from ancestral populations abroad. Moreover, as life expectancy and the prevalence of life-style related chronic diseases increase in most foreign countries, the research questions that are most relevant in the United States are those that are also relevant in foreign countries, often with large populations such as India or China, wherein research findings conducted through collaborative work with U.S. and foreign investigators can more quickly lead to biomedical breakthroughs. For many reasons, the future health and well-being in the United States will be increasingly dependent on strengthening existing, and developing new international research collaborations.

NIH's extramural support for health research conducted by foreign investigators is estimated at more than $500 million per year. Additionally, the NIH Visiting Program provides intramural research opportunities for non-citizen scientists to train and conduct collaborative research at the NIH. Annually, more than 3,000 foreign scientists from over 100 countries worldwide conduct research in the basic and clin-

ical science laboratories on the NIH campus in Bethesda, Maryland, and in several field units around the country.

Likewise, we work closely with the Departments of Agriculture, Energy, Interior, and Health and Human Services on related research, and climate change, that permeates all of our S&T relationships, from the ITER fusion energy large-scale collaborative project to a widespread interest in biofuels and other renewable energy sources. Clean coal R&D is a major interest in China and India. In all these areas, we work closely with these agencies to promote S&T cooperation with our foreign partners. All of these agencies and others are important members of our technical working group that convenes frequently to assess new S&T agreements and programmatic activities.

Additionally, we encourage initiatives such as the National Nuclear Security Administration's unique partnership arrangement between its Cooperative Border Security Program (CBSP) and Jordan's Royal Scientific Society (RSS) and Cooperative Monitoring Center in Amman, Jordan (CMC–A). CBSP partnered with RSS in 2002 to establish the CMC–A. The CMC–A is a forum in the Middle East for regional experts and officials to explore and adapt technology-based methodologies and solutions for enhancing regional cooperation on security and security-related issues. It assists official and technical experts in the Middle East to acquire cooperative monitoring concepts and technology-based skills and tools necessary to assess, design, analyze, and implement projects related to Nonproliferation, Border Control, Strategic Trade Control, Public Health, and Environmental Security. CBSP is working directly with the CMC–A to help establish cadres of technical specialists and experts in the focus areas of Nonproliferation, Border Control and Strategic Trade Control.

EPA

EPA's Office of International Affairs supports several major international partnerships and initiatives that build the capacity of other countries to address key environmental threats and that help to reduce the risk of trans-boundary transport of pollutants to the United States. EPA works closely with DOS, USAID, and other USG partner agencies to advance work under these partnerships. EPA's efforts include:

- The Partnership for Clean Fuels and Vehicles (PCFV), which EPA launched during the 2002 World Summit on Sustainable Development. This multilateral partnership seeks to eliminate the use of leaded gasoline worldwide, reduce the level of sulfur in fuels, and promote the use of cleaner vehicle technologies. Technical and policy cooperation under PCFV helped move countries in sub-Saharan Africa to phase out the refining or importing leaded gasoline as of 2006, thus significantly reducing the exposure of 767 million people (42 percent of whom are children) to this toxic substance. As of March 2008, only 16 countries in the world still used leaded gasoline. The Partnership has also designed and implemented diesel retrofit technology projects in some of the world's largest and most polluted cities. These projects are designed to build support for introducing low-sulfur diesel fuel and demonstrate the emissions reductions that can be achieved in older vehicles with retrofit technologies combined with low-sulfur fuel.
- EPA has played a key role in developing and implementing the UNEP (United Nations Environment Program) Global Mercury Partnership. This Partnership, which began in February 2005, promotes the protection of human health and the global environment by reducing or eliminating mercury releases to air, water, and land from the use of mercury in products and processes as well as by reducing unintentional releases from combustion and processing of fuel and ores. Under the Partnership, EPA leads global work on mercury in chlor-alkali production and in products, and is also active in work on small-scale gold mining and cooperates with scientists in other nations on mercury fate and transport research and analysis. Under EPA's chairmanship, the multilateral Arctic Contaminants Action Program (ACAP) Working Group of the Arctic Council has helped Russian chlor-alkali production facilities reduce consumption and release of over two tons of mercury. In the small-scale gold mining sector, EPA helped West African miners who use mercury to amalgamate gold learn adopt inexpensive (less than $5.00), locally constructed hand-held retorts which can reduce mercury releases. By the end of 2007, miners using these retorts had captured more than 24.5kg of mercury. EPA also helped develop a low-cost, locally manufactured technology to capture mercury emissions from vent hoods during small-scale gold processing in gold refining shops; this technology is capable of keeping 80–90 percent of the mercury emissions from this process out of the atmosphere, thereby re-

ducing demand for new stocks of mercury. This technology, piloted in Brazil, can be adapted for use in shops in over 55 countries which further refine gold from artisanal miners in the field.

- EPA's technology transfer and training efforts under the ACAP Working Group of the Arctic Council have substantially reduced the trans-boundary transfer of Persistent Organic Pollutants (POPs) to the Arctic. EPA has led efforts to inventory, analyze, and safely store of over 3000 metric tons of obsolete and prohibited pesticides from the Arctic and sub-Arctic regions of Russia, thereby preventing the potential transport of these chemicals to the U.S. Arctic. It has also implemented a model cleaner production program at one of the world's largest emitters of air pollutants, Norilsk Nickel Company, located in the Russian Arctic. This technology cooperation project has resulted in annual reductions in fresh water consumption by 7.9 million cubic meters; reduction of waste discharge by 3.4 million cubic meters; reduction in electrical energy use by 14.9 million kWh; and reduction in discharge of heavy metals and their oxides into the atmosphere by 850 tons. EPA also led the creation of the Indigenous Peoples Community Action Initiative within ACAP, a model environmental justice and indigenous community empowerment program. This ACAP initiative has enabled indigenous communities in the Arctic Rim countries to manage their local sources of hazardous contaminants, and has already resulted in removal and safe storage of over 1.1 tons of PCBs and POPs pesticides from five indigenous villages in Alaska and northern Russia. The State Department provided funding to this initiative.
- EPA Partnered with Norway and the Russian Federation in building Russian capacity to treat low-level liquid radioactive waste from decommissioned naval submarines, which ultimately facilitated Moscow's decision (May 2005) to formally accede to London Convention ban on ocean disposal of all radioactive waste (October 2005). Through this technical cooperation effort, Russia completed design, construction and testing of the first cask conditioning system for long-term safe storage of highly radioactive spent nuclear fuel from decommissioned Russian submarines. This project allows safe transport of spent nuclear fuel away from the Arctic and Far Eastern coasts and helps meet the joint U.S. and Russian objectives under the Strategic Arms Reduction Treaty.

Non-governmental Partners

We are fortunate to have very constructive relationships with the American Association for the Advancement of Science (AAAS), as well as the National Academies of Science (NAS). The Academies of course, play a vital role in informing us of the state of the science in key international issues, as well as in identifying emerging science issues. NAS has also been extremely generous helping to host bilateral S&T discussions, most recently with Viet Nam. Similarly NAS has been helpful in choosing the scientists that participate in the Jefferson Fellows program, managed by Dr. Nina Federoff. NAS is also able to access some communities that DOS cannot reach. NAS is actively working to build ties to the Iranian scientific community. In some case, NAS has been able to convey key messages to overseas audiences.

A NAS delegation, for instance, was able to speak for the American scientific community to the government of Libya on the issue of the Bulgarian nurses who were accused of intentionally infecting children with HIV. NAS made the compelling argument that American scientists and health professionals would be reluctant to work in a country where science was misused to imprison foreign collaborators. Along the same lines, NAS has been very active in strengthening counterpart Academies aboard. It was instrumental, for instance, in helping its South African colleagues in the production of an objective assessment of the causes and appropriate treatments of AIDS. NAS has also provided valuable information tools to U.S. embassies, such as the multi-language website (*www.drinking-water.org*) and a CD on providing safe drinking water, and free access to all NAS reports and publications to all users in developing countries.

The AAAS has been no less helpful. We are working together to organize an APEC workshop on linking research to innovation. AAAS has also worked with some of the posts in Africa to distribute our science on a stick to science institutes in Africa. This program puts content from *Science* magazine on USB drives for countries with limited Internet broadband access. State has participated in the AAAS annual meeting at senior levels. Dr. Federoff gave the keynote speech this year. The AAAS also co-sponsored the 2007 "Conference of Women Leaders in Science, Technology, Engineering, and Mathematics" in Kuwait and has been a valuable advocate in the importance of S&T in diplomacy. Finally, the AAAS Diplomacy Fellowship,

also managed by Dr. Federoff, is a crucial contributor to the Department's science literacy.

We have been the beneficiaries of the work being done by others as well. Ambassador Harnish and I have participated, for example, in several events organized by the science and technology program of the Saban Center at the Brookings Institute. While we are collaborating with AAAS and NAS fairly closely, we could interact more with the private sector, academia, and a variety of other non-governmental organizations.

Conclusion

S&T is universally perceived as apolitical. This inherent characteristic makes S&T an excellent means for engaging societies, such as those in the Middle East, where the United States has become progressively more unpopular. While there has been no definitive study on the topic of what makes science diplomacy effective, we have learned through years of engagement that some of the key elements are:

- finding areas that break new ground, sometimes in a neglected area of science or development
- finding areas that are educationally and developmentally transformative, that are highly motivational for the participants
- finding areas that address core developmental issues of poverty and human development
- finding areas that promote sustainable uses of natural resources
- finding programs that stimulate job creation and private sector investment
- finding collaborative projects that bear tangible results

The appeal of American science and technology creates a more favorable atmosphere in which to explain other American policies and interests. S&T allows the United States to engage in mutually beneficial dialogue with foreign nations, and creates a foundation for international exchange of ideas, scientists, data, and students. Science education provides opportunities for upward mobility for youth worldwide. S&T empowers individuals, in America and around the world, to find dignified, independent solutions to pressing social, economic, and environmental problems.

We are proud of the work we are doing to strengthen our S&T ties with other nations. Nonetheless, there is a lot more that could be done to further harness the soft power of S&T. Last month, the Secretary of State's Advisory Committee on Transformational Diplomacy recommended that the DOS "expand its investment in Science, Engineering, and Technology expertise, presence, and global engagement. This includes expanding the Department's engagement in global science, engineering, and technology networks through exchanges, assistance, and joint research activities addressing key issues." I look forward to hearing from the Committee how we might work together to broaden our international cooperation on science and technology.

Thank you for this opportunity to testify and I would be pleased to respond to any questions you may have.

BIOGRAPHY FOR JEFF MIOTKE

Jeff Miotke is a Foreign Service Officer currently serving as the Deputy Assistant Secretary of State for Science, Space and Health. Previously, Mr. Miotke was the Chief of Staff for the Under Secretary for Democracy and Global Affairs, Paula J. Dobriansky. As the Director of the Office of Global Change, he was a senior negotiator on climate change. He has also been the Deputy Director of the Office for Development Finance in the State Department. Overseas, he served as the Deputy Chief of Mission in Lesotho, Economic Counselor in Hungary, Economics Officer in Guatemala and Consular Officer in the Dominican Republic. He has received eleven Honor Awards as well as the Frank Loy Award for Environmental Diplomacy.

Prior to joining the Foreign Service in 1986, Mr. Miotke managed the overseas users' groups for Hewlett-Packard, edited biostatistical reports for Syntex Labs, served as a management consultant for SRI International, and taught math and science as a Peace Corps Volunteer in Swaziland.

He has a Bachelor's degree in Biology from Dartmouth College, a Master's in Public Policy from the Goldman School at the University of California in Berkeley, and a Master's in International Policy Studies from Stanford University.

He speaks Spanish and Hungarian.

Chairman BAIRD. Thank you, Mr. Miotke. Mr. O'Brien.

STATEMENT OF MR. MICHAEL F. O'BRIEN, ASSISTANT ADMINISTRATOR FOR EXTERNAL RELATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. O'BRIEN. Mr. Chairman, Ranking Member Neugebauer, and Members of the Subcommittee, thank you for the opportunity to appear today—there we go. Sorry.

For 50 years, NASA has enjoyed the benefits of international cooperation, the direction for which is found in legislation that created NASA in 1958, and more recently, in the U.S. Space Exploration Policy signed by the President in 2004.

NASA's international cooperation has involved thousands of agreements, not only with space-faring nations, but also, with an increasing number of other countries that rely on the unique vantage point of space for their day to day activities, such as resource management and disaster warning.

International cooperation, for NASA, is mission-driven, and pursued in accordance with guidelines that we have developed over the years. For example, such activities must have technical merit and demonstrated programmatic benefit to NASA, provide access to unique capabilities, or improve mission redundancy, and certainly, in all cases, they must be consistent with U.S. foreign policy objectives.

Now, international cooperation in our four Mission Directorates covers a broad spectrum of activities. Currently, two thirds of our roughly 300 active international agreements support the Science Mission Directorate, with more than half of nearly 50 current missions on orbit including some level of international participation. In earth science particularly, international cooperation is absolutely essential as we strive to understand the planet as an integrated system of land, sea, and atmospheric processes.

In space operations, the premiere example of international cooperation is obviously the International Space Station. This 15-nation partnership has worked for two decades on what may be the most complex international science and engineering project in history. Regarding future robotic and human exploration, NASA welcomes participation by other countries, and in fact, we expect it. We have already partnered with 13 space agencies to develop a global exploration strategy that expresses a shared vision among those participating in the agencies, of the importance of space exploration to individual and national objectives.

I think it is safe to say that NASA's international activities also promote foreign policy interests. For example, the invitation to Russia, to join the existing Space Station Partnership in 1993 had an important U.S. foreign policy component. Over the years, the Partnership has overcome a number of significant challenges, including the tragic loss of Space Shuttle Columbia, and now plays an ongoing positive role, in my view, in the relationship between the United States and its Space Station partners, one benefit of which certainly is their willingness to cooperate with the United States on future space exploration endeavors.

Less dramatic international cooperation, and I guess that includes everything other than the International Space Station, can

also have foreign policy benefits. In the area of remote sensing applications, for example, in collaboration with USAID and several other organizations, NASA supported the establishment of the SERVIR operations facility in Panama. SERVIR is a regional system used to monitor ecological changes and forecast severe events, such as forest fires, tropical storms. Eight countries participate, and discussions are underway now for potential use of this particular model in East Africa.

NASA carefully coordinates with other government agencies during the conceptual development and negotiation of international agreements. We believe we have an excellent basis for this coordination, due to our longstanding, effective relationships with OSTP, the Department of State, other agencies within the Executive Branch. And in the vast majority of cases, such as bilateral agreements with our traditional partners, the consultation and approval process is straightforward and relatively streamlined, in my view. In cases or potential cooperation with nontraditional partners, such as India, Korea, Ukraine, perhaps in the future, even China, NASA clearly recognizes a requirement for detailed interagency and Congressional coordination to ensure that overall U.S. Government interests and any potential legal restrictions are fully addressed.

In summary, international cooperation will continue to be fundamentally important to NASA, as we seek opportunities for mutually beneficial cooperation around the world. Let me add that we are extremely proud at NASA of our international cooperation. It benefits NASA programs. It benefits the programs of our partners, has a positive impact around the world, on the relations between the United States and those governments with whom we participate and cooperate in space.

I would be pleased to respond to any questions that you might have. Thank you very much, Mr. Chairman.

[The prepared statement of Mr. O'Brien follows:]

PREPARED STATEMENT OF MICHAEL F. O'BRIEN

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear today to discuss NASA's international science and technology (S&T) cooperation.

The *National Aeronautics and Space Act of 1958,* as amended (42 U.S.C. 2451, et seq.) directs NASA to conduct its activities so as to "contribute materially to. . .cooperation by the United States with other nations" and effect "the widest practicable and appropriate dissemination of information concerning its activities and the results thereof." As a result, since the Agency's inception, NASA has enjoyed significant benefits to almost all of its major programs through some level of international cooperation. Since 1958, NASA's international cooperative activities have involved more than 3,000 agreements with over 100 nations or international organizations. While the majority of NASA's cooperation is accomplished with spacefaring nations, an increasing number of other nations are now relying on the unique vantage point of space for day-to-day activities such as urban planning, resource management, communications, weather forecasting, and navigation. As a consequence, NASA's international partnerships have continued to grow in diversity and importance, as the Agency engages both developed and developing nations in a wide range of mutually beneficial activities.

Throughout NASA's extensive history of international cooperation, the Agency has developed a series of guidelines to govern its international activities. First, cooperative activities must have scientific and technical merit and demonstrate a specific programmatic benefit to NASA. These benefits are often achieved through the pooling of resources, access to foreign capabilities or geographic advantage, addition of a unique capability to a mission, increased mission flight opportunities, or enhanced scientific return. In almost all instances, each Partner funds its respective contribu-

tion and the cooperation is conducted on a "no exchange of funds" basis. These cooperative activities are always structured to protect against unwarranted technology transfer, take into account U.S. industrial competitiveness, and establish clearly defined managerial and technical interfaces to minimize complexity.

Currently, international cooperative activities are underway in each of NASA's four Mission Directorates (Science, Space Operations, Exploration Systems, and to a limited extent, Aeronautics Research) involving hundreds of active agreements. This cooperation includes joint mission planning and development of human space flight systems such as the International Space Station (ISS); flight of foreign astronauts on NASA's Space Shuttle; flight of NASA instruments on foreign spacecraft (and vice-versa); close coordination of independent space activities with similar mission objectives; suborbital campaigns and field research (e.g., measurements from sounding rockets, balloons, aircraft and ground-based measurements); cooperative tracking and space communications inter-operability support; and scientist-to-scientist data exchanges with joint analysis, interpretation and publication of results.

International Cooperation Related to the Science Mission Directorate

As might be expected, international cooperation in a wide range of science and technology initiatives is most evident in NASA's Science Mission Directorate whose activities fall broadly under the categories of Earth science and space science. The Agency has established a robust program of scientific research, informed by input from the global science community, from National Academy of Sciences' studies and decadal surveys, and from NASA external advisory committees. International involvement in the implementation of this science-driven program has historically been welcomed at all levels, which has ranged from multi-million dollar contributions of instruments and spacecraft to data analysis by individual researchers from around the world. At the present time, two thirds of NASA's three hundred active international agreements are for missions led by the Science Mission Directorate. It should also be noted that more than half of NASA's 46 currently-operating science missions include international participation. It is anticipated that this involvement will continue to grow as NASA and international institutions with similar research objectives seek to maximize scientific return with limited domestic resources for mission development and operations. On an almost daily basis, the benefits for the broader scientific community are realized as NASA and its international partners readily make their research data available to the global research community.

NASA's Earth science activities are inherently global as we strive to understand the Earth as a system, from a variety of U.S. and international platforms. In fact, some ground-based research programs involve dozens of countries, such as the Aerosol Robotic Network (AERONET), an optical, ground-based aerosol-monitoring network and data archive system in which over 40 countries/regions participate. NASA is a major U.S. contributor to the International Polar Year (IPY) 2007–2008. IPY will involve a wide range of research disciplines, but the emphasis will be interdisciplinary in its approach and truly international in participation. NASA is also a leader in international mechanisms such as the Committee on Earth Observation Satellites (CEOS), which coordinates the civil space-borne missions of nearly 50 space agencies and associated national and international organizations that observe and study the Earth. Global participation in these activities is a necessity.

Certain examples of space science missions with international involvement are well known, such as the Hubble Space Telescope, which includes cooperation between NASA and the European Space Agency, and its follow on mission-in-development, the James Webb Space Telescope, in which NASA, ESA and the Canadian Space Agency are partners. For robotic planetary missions, bilateral cooperation with multiple international partners is generally the norm. For example, seventeen nations contributed to building Cassini-Huygens, a cooperative mission led by NASA, ESA and the Italian Space Agency to explore Saturn, Titan and the other moons of Saturn. Hundreds of scientists worldwide participate in the Cassini-Huygens science teams. Looking to the future, NASA's Science Mission Directorate recently initiated discussions on potential international participation in a new NASA-led lunar network initiative. While details of the concept are still being developed, the overall concept is to work with the international community to place a network of landers on the lunar surface in the 2012–2015 timeframe.

International Cooperation Related to the Space Operations Mission Directorate

NASA's premier example of international space cooperation is the ongoing assembly of the ISS. With participation from 15 nations, NASA and its space agency counterparts have worked together to design, develop, assemble on-orbit and operate one of the most complex science and engineering projects in history. With the last two

Space Shuttle missions, NASA delivered to the ISS several key international elements: the European *Columbus* laboratory, a portion of the Japanese *Kibo* laboratory and the Canadian *Dextre* robotic manipulator system. As a result, NASA continues to honor the Nation's commitment to our international partners on the Space Station, while meeting the most prominent milestones of the program. As NASA Administrator Michael Griffin testified before the Committee on Science and Technology on February 13, 2008, ". . .its development is the largest task ever performed by the civilian agencies of the United States or our international partners. Such international partnerships will be an integral part of our next steps out beyond low Earth orbit, toward what President John Kennedy called 'this new ocean'."

The success of the ISS is all the more remarkable due to the necessary harmonization of complex engineering and technology development activities among the United States, Russia, Japan, Canada and many nations of Europe. The ISS International Partners represent over a dozen different political systems, budgetary mechanisms, and cultural, management and industrial approaches, that rely on the multilingual skills of engineers, astronauts and mission controllers around the world.

The history of Space Shuttle crew assignments clearly demonstrates the global nature of NASA's human space flight program. Fifty-nine international astronauts from 15 countries have flown on the Space Shuttle a total of 89 times, representing one-fifth of the total Shuttle Mission Specialists. As we move forward, each ISS Partner has an allocation of future Space Station crew opportunities for the lifetime of the program, based on its contributions to the ISS as articulated in the Space Station international agreements.

Further, NASA enjoys significant international cooperation in support of space communication. NASA and the international community routinely provide back up communication services for each other. NASA leads the development of international data standards and protocols for such space communications, as well as participating, in coordination with the Department of State, in International Telecommunication Union forums to ensure that sufficient radio frequency spectrum is allocated appropriately to all international partners. International inter-operability is an important keystone of our joint missions. NASA also provides communications between the U.S. and the U.S. South Pole Station and, through this service, is supporting a number of international science projects that were launched under the banner of the IPY.

International Cooperation Related to Future Exploration Activities

In future exploration by humans beyond low Earth orbit, NASA expects significant international cooperation. On January 14, 2004, the President directed NASA to pursue opportunities for international participation to support U.S. space exploration goals in the implementation of its new vision. Since that direction was issued, NASA has made steady progress with its international counterparts. Most significantly, NASA and 13 space agencies from around the world developed "The Global Exploration Strategy: The Framework for Coordination." This document, which the participating agencies released in May 2007, expresses the shared vision of these agencies, both large and small, on the importance of space exploration to national objectives. The process in which 14 international space agencies agreed on common goals for space exploration was as important as the product itself.

For NASA, the focus on international cooperation for future exploration can be described by two parallel paths: maintaining our multilateral approach to information sharing and coordination while expanding our bilateral cooperation with international counterparts to identify new areas of space exploration. Some specific examples of bilateral cooperation that have resulted from this process include: NASA's ongoing cooperation with the Japanese Aerospace Exploration Agency on its Kaguya spacecraft currently orbiting the Moon; cooperation with the Indian Space Research Organization on its Chandrayaan lunar mission later this year, in which NASA is providing a Miniature Synthetic Aperture Radar to map ice deposits in the Moon's polar regions and a Moon Mineralogy Mapper to assess mineral resources of the Moon; and cooperation with the Russian Federal Space Agency on Russian provision of neutron detectors for NASA's Lunar Reconnaissance Orbiter and NASA's Mars Science Laboratory missions.

NASA International Cooperation and Foreign Policy Interests

While NASA's international cooperation is driven by its mission objectives, such activities also promote U.S. foreign policy interests. Two highly visible examples at different extremes of complexity and cost include the ISS and frequent U.S. astronaut visits around the world. The ISS partnership resulted in a robust program among 15 nations with scientific and technological benefits for all of the partners

involved. Along the way, the partnership itself survived significant challenges such as initial delays in delivery of major components and the tragic loss of Space Shuttle *Columbia.* The success of this program has played a significant positive role in the governmental relationship between the United States and its ISS partners. In the case of U.S. astronauts, by virtue of their unique human space flight experiences and genuine admiration by international audiences, they have long been able to transcend government-to-government issues and help to enable constructive discussion on the peaceful uses of outer space for the benefit of all.

In addition, small, low-cost activities in partnership with other U.S. Government Agencies and international organizations can also have significant U.S. foreign policy benefits. Working closely with the U.S. Agency for International Development and international organizations, NASA has initiated a number of very successful pilot projects, particularly in the area of remote sensing applications. An important example of this type of cooperation is NASA's involvement in the establishment of the SERVIR operations facility in Panama. SERVIR (both a Spanish acronym and also a Spanish verb meaning "to serve") is a regional visualization and monitoring system for Mesoamerica that integrates NASA-provided satellite and other geospatial data for improved scientific knowledge and decision-making. Among other things, SERVIR is used to monitor and forecast ecological changes and severe events such as forest fires, red tides, and tropical storms. Eight countries in the region are members of this network and there is international interest in using this network as a model for other parts of the world. Discussions are already underway for potential use of this model in the eastern part of Africa.

NASA's international activities have been a key component of the Agency's overall mission from the beginning. While those activities are pursued for scientific, programmatic and mission-related purposes, they also provide significant benefits to the United States more broadly, requiring close coordination with other government agencies during the negotiation of the related international agreements. NASA's authority to enter into international agreements, combined with effective, long-standing relationships with the Office of Science and Technology Policy, the Department of State and other organizations in the Executive Branch, provides an effective basis for the development and implementation of NASA's international cooperation. In the vast majority of cases, such as bilateral agreements with long standing traditional partners from Europe, the consultation and approval process is straight forward and relatively streamlined. In other cases, NASA clearly recognizes that as we explore opportunities for cooperation with non-traditional partners such as India, Korea, Ukraine, China and others, enhanced interagency and Congressional coordination will be required to ensure that broader U.S. Government interests and any potential legal restrictions are carefully addressed.

Summary

International cooperation will continue to be fundamentally important to NASA. By direction of the President and Congress, NASA is pursuing a bold agenda that commits the United States to complete assembly of the ISS and retire the Space Shuttle in 2010, and also develop the next generation of launch systems, vehicles, and other capabilities that will carry humans and robots beyond low Earth orbit as an integral part of a balanced program of human and robotic exploration, science and aeronautics research. As we continue to implement this exciting new chapter in space exploration, NASA will seek opportunities for mutually beneficial cooperation around the world.

Again, thank you for the opportunity to appear before you today. I would be pleased to respond to any questions that you or other Members of the Subcommittee may have.

BIOGRAPHY FOR MICHAEL F. O'BRIEN

As Assistant Administrator for External Relations, Mr. O'Brien is responsible for NASA's interaction with Executive Branch offices and agencies; international relations for each NASA Mission Directorate; administration of export control and international technology transfer programs; the NASA History Office; NASA advisory councils and commissions. Prior to this appointment Mr. O'Brien served as Deputy Assistant Administrator for External Relations (Space Flight), in which capacity he led the team that negotiated the agreements for the International Space Station with the space agencies of Europe, Japan, Canada, and Russia.

Mr. O'Brien came to NASA from the United States Navy. He served as a naval aviator in command positions and in Washington on the staffs of the Chief of Naval Operations and the Chairman of the Joint Chiefs of Staff. As an advisor to the Chairman concerning political-military policy in the Middle East, Africa, and South-

west Asia, he traveled widely in the Persian Gulf area for bilateral discussions with the defense forces of Saudi Arabia, Kuwait, Bahrain and other nations in the region.

He also served as the Deputy Director for Research at the Institute for National Strategic Studies in Washington. O'Brien was Commanding Officer of U.S. Naval Station Roosevelt Roads, Puerto Rico where he designed and executed the $350 million repair and reconstruction program after the station was nearly destroyed by Hurricane Hugo. As a Navy combat pilot, he commanded a Navy carrier-based attack squadron, and has made over 900 aircraft carrier landings in high performance jet aircraft.

O'Brien graduated with high distinction from the University of Virginia. He holds a Master of Science in Physics from Cornell University and a Master of Science in Aeronautical Systems from the University of West Florida. As an Olmsted Scholar, he performed research in International Relations and Strategic Studies at the Graduate Institute of International Relations in Geneva, Switzerland. O'Brien is also a graduate of the French Ecole Militaire in Paris, France.

O'Brien's awards include the Presidential Rank of Meritorious Executive, the NASA Exceptional Service Medal, the Defense Superior Service Medal, two Legions of Merit and two Air Medals. He is a member of Phi Beta Kappa.

DISCUSSION

Chairman BAIRD. Thank you, Mr. O'Brien. We can tell we have a distinguished and experienced panel of witnesses. I think everybody came in within 15 seconds of the five minute mark, which is very rare here. We thank you for that, but we will——

Mr. O'BRIEN. That is what stopwatches are for.

Chairman BAIRD. We will enjoy a good round of questions. And because Dr. McNerney has informed me he has to go to another meeting at 11:00, I want to make sure we let all Members have an opportunity to ask questions. I will yield my time to Dr. McNerney, and then reclaim it after the Minority goes.

Dr. McNerney.

Mr. MCNERNEY. Thank you, Mr. Chair. I am not a Trojan, but you let me take cuts in line, so I appreciate that.

Historically, the United States has been recognized as an international scientific leader, and one of the focuses of this committee is, then, to make sure that we retain that leadership position, even as countries like China and India produce more and more engineers and scientists.

Dr. Fedoroff, do you think that the United States continues to be viewed as a scientific leader, or is our role diminishing in some way that we should be aware of, and take strong action about?

Dr. FEDOROFF. I think we continue to be recognized as leaders and indeed, other countries are very much seeking partnerships with us, while their own scientific establishments are increasing. There is no question that the primacy of the U.S. is not what it was. This is not a negative, but in fact a positive. What I am experiencing as I travel is that scientists of other countries want to be seen as partners, as collaborators, not as recipients of our wisdom.

So, I think that is a very important point. The second important point is that we have, for half a century, been the prime attractor of graduate students, talented people from around the world. We have to become aware of the fact that that situation is changing. Countries around the world are recognizing the importance of intellectual talent and are competing with us. Our visa policies haven't helped us. That aside, the value of the best and the brightest for economic development is recognized the world around.

So, today, the challenge is more building capacity, educational capacity, everywhere. It is not that the world is short of people. The shortage is of highly trained people. Thank you.

Mr. MCNERNEY. Thank you for that answer. Dr. Miotke. Am I pronouncing that correctly?

Mr. MIOTKE. It is most commonly pronounced Jeff, but that——

Mr. MCNERNEY. Jeff.

Mr. MIOTKE. The last name is Miotke. Jeff works for me.

Mr. MCNERNEY. All right, Jeff. Compared to other—thank you—compared to other industrialized nations, the United States is dragging its feet with regard to eliminating greenhouse gas emissions, and both yourself and Dr. Fedoroff did mention global warming as a concern. Do you think that is hurting our international reputation as a premiere science country, and what should we do about that, if that is the case?

Mr. MIOTKE. Well, I am not going to venture into Dr. Marburger's area of expertise, but let me just say that I have been a climate negotiator off and on since the '80s, and I don't see that our policies on climate change have an impact on the prestige that others assign to American scientists. On the contrary, most of the IPCC process, and Dr. Marburger, please correct me if I am incorrect here, is driven by American scientists and American science.

So, I think we are on the cutting edge of pushing—we are not the only ones who are doing this research, but certainly, I think, we are doing more than others. And countries realize this—across the board, I think.

Mr. MCNERNEY. So, there is a disconnect, then, between what the Administration is doing and what the American scientist community is recommending. And you don't have to answer that if you don't want, but that is implied in what you said.

Mr. MIOTKE. Yeah. I don't see the disconnect. I believe the President when he says that we will learn and act, and then, learn and act again. One of the first acts of the Bush Administration in their first term was to turn to the National Academies of Science, and ask for an assessment of the science of climate change at that point. And to my mind, they have acted accordingly, based on the information they are getting from the scientific community. And you can see, the MEM process that is underway, as well as a multitude of partnerships that are based on developing new technologies, new clean technologies, with countries that represent 80 percent of the total greenhouse gas emissions around the world. The administration is pretty active, and that it has been informed by the science.

Mr. MCNERNEY. Thank you, Mr. Chairman. I have one more question, but I think I had better yield back at this point.

Chairman BAIRD. Thank you, Dr. McNerney. Mr. Neugebauer.

Mr. NEUGEBAUER. Thank you, Mr. Chairman.

I have two different questions, but I am going to roll it into one question. You know, a lot of folks would ask what is the value of our international participation in science diplomacy? In other words, we are, are we exporting American tax dollars? What is the value of doing that? And the reciprocal of that, they would say, well, why shouldn't we reserve American research dollars for American scientists?

So, how would—and that is a question that I hear a lot about when we talk about diplomacy, and that everybody wants to be our friend, as long as we are sending American dollars over there. So, if we could just go down the panel here, and tell me, in your own words, what you think the value of that is, and what you would say to someone at Texas Tech University that is out there competing for these research funds, and they hear these funds are going to other parts of the world, and I will just—Dr. Marburger, I will start with you.

Dr. MARBURGER. I believe that American objectives are served, and should be served, by investments that we make in science in other countries. Certainly, after I came to Washington, I prepared a list of 10 reasons why we should fund international science that I would be happy to share with the Committee, the Subcommittee, and make part of my testimony.

To be brief, first of all, I think I had better just submit this for the record. The important thing is——

Chairman BAIRD. Go ahead and expand on it a little bit. If we need to give you more time, we will do that.

Dr. MARBURGER. We do have—one of the reasons is to provide access to the frontiers of science, wherever they may be. The U.S. doesn't have tropical forests. We don't have the South Pole. We don't have access to the Southern Hemisphere for astronomy, so there are good reasons for providing access to the rest of the world.

Another is to augment our own human capital, as we have done historically, to go out and reach out to the best talent in the world, to find out what they can do to help us, sometimes invite them to our countries, but we have to be out there. To strengthen U.S. science through visits and exchanges, and by bringing in outstanding scientists from other countries. To increase U.S. national security, as Dr. Fedoroff pointed out so eloquently, national security and economic prosperity, by fostering the improvement of conditions in other countries, is a direct benefit.

To accelerate the progress of science across a broader front than we may wish to fund. There are some areas of science that are very expensive, and we would like to know, but if other countries are willing to join us in an adventure, whether it is particle physics or nuclear physics, or space exploration, then we should reach out to them to broaden our own frontiers. To address U.S. interests of a global nature, which the U.S. alone cannot afford to address. Climate change is a good one, and the various enterprises, huge enterprises, like the International Polar Year that we are now involved.

We can, we have a stake in these investigations, but they are so large that we enjoy having other countries involved. To discharge obligations in connection with treaties. And certainly, to increase U.S. prestige and influence with our nations. So, these are some of the things that we really do get out of science.

And in my testimony, I emphasized the fact that my office, OSTP, is primarily concerned with the science, and the ability of the agencies, like the National Science Foundation, or NASA, to do that science as well as it can be done on an absolute global standard. So, we look to see if the agencies are taking advantage of international assets.

When it comes to diplomatic objectives, the primary agency would be USAID, and we are very encouraged by the fact that USAID now has Dr. Fedoroff as a science advisor, and I hope that practice continues in future administrations.

So, these are, this is a somewhat long answer, perhaps, and there is more in my statement.

Chairman BAIRD. Dr. Marburger, we will make that available. And I think this is such a central question that I am going to take some discretion here, and ask other members to, of the panel to address it if they wish.

Dr. BEMENT. It has already been mentioned that countries around the world are investing more in higher education and research and development, because they now recognize this drives the economy in a knowledge society. It is not preordained that scientists in the U.S. are always going to know where the frontier is at any given time. It may be somewhere else, in another part of the world. So, having broad-ranging networks, where they have collaborations with scientists around the world, is critically important.

Also, we don't have all the best research facilities in the United States. CERN is an example, the Large Hadron Collider at CERN. So, having access to special facilities is also critically important. But it is also important for our workforce for the 21st Century that we have people in leadership positions in science and engineering to have a broad international connection. And that is true even for our graduate students, because those who go into industry, for example, who have language skills, who have some interconnection with other scientific groups around the world, are considered to be very valuable, because most global companies now are trying to seek where the best technology may be that they can capture and add it to their internal innovation system. They can add their own know how, their own patents, and gain an advance in the marketplace.

So, just for self-serving interests, and being able to develop our workforce for the 21st Century, having a very strong international program is critically important.

I might add just one other thing. One of the greatest things we contribute to developing countries in the world is building their human resource capacity through exchanges, and working with scientists, and getting technical assistance, and learning how to use sophisticated instrumentation, and also, in jointly conducting field studies, where they can share information and knowledge, in how their natural environment is changing.

There are many areas where we are really making a major impact on developing countries. I might add that NSF currently, even in sub-Saharan Africa, there are, well, in Africa altogether, there are 57 nations. We have active collaborations in projects with 40 out of those 57, which is just an example.

Dr. FEDOROFF. We live in a single, very interconnected world. In some measure, the violence that we see against us is rooted in the disparities in our way of life and those of the poorest countries. They are immediately obvious to everyone through contemporary telecommunications. We ignore that at our peril.

It is in our best interest to raise the educational levels around the world, to help other countries create the kinds of opportunities

that are, in fact, the purview primarily of the most developed countries today. We cannot afford that. We are increasingly realizing how interconnected the entire world is.

The question of infectious diseases is a critical one today. We can't wall ourselves off. Our best strategy is to help others interconnect the entire world for a surveillance system for infectious diseases and help build the requisite capacity on the ground.

Let me just give you one example. Extremely drug-resistant TB is a problem. It came to our attention because we had an American citizen who took off to get married, and have his honeymoon in Europe. But a few days ago, last week, in the New York Times, there was an article about South Africa, which has had a huge outbreak of XDR–TB. There are hundreds of patients in isolation, because this is an extremely infectious disease, and frankly, they have so little in the way of support and personnel and drugs, that those patients know that they will only leave that hospital dead.

They broke out at Christmas time, they broke out at Easter time, just to be with their families. That is a problem that can come to us. It is time to think globally in this area, as well as many others. That is just one of them.

Thank you.

Mr. MIOTKE. Yeah. I mentioned the outreach effort in Hungary, and I think that is a good example of how S&T cooperation can have broader foreign policy benefits for the United States. I won't belabor that point.

I want to add a little bit to what Dr. Fedoroff said, as well. Pandemic flu is another example that we benefit from international cooperation because, no pun intended, avian flu could come home to roost. And also, I have been consistently surprised at where we have found some cutting edge work being done. There is an African country in particular that is doing interesting work producing solar panels on plain copying paper. And they are also using nanotechnology for novel ways to purify water in mines. This is something that my people tell me is not being done elsewhere. So, there is almost inevitably some benefit to the United States in cooperating and in fact, mutual benefit is one of the underlying principles of our S&T agreements across the board.

And then finally, let me also, again, highlight something that Dr. Fedoroff said, and that is, S&T is a fundamental pillar of development. Without it, we are only assisting people over the short-term, but if we are building S&T capability, we are helping them to develop, to truly develop over the long-term.

And if we want to close the gaps, or if we want to prevent the gaps between the United States and other countries from growing larger, we have to invest in S&T with our international S&T partners.

Mr. O'BRIEN. Mr. Chairman, I would just respond to one part of the question, which I think asks why are we sending money overseas. Wouldn't it be better to keep it here in the United States?

NASA, the way we cooperate, is generally almost uniquely on a no exchange of funds basis, so in those 300 agreements that we have, all but a couple of them involve NASA funding its own contribution, our partners funding their contributions, and then reaping the collective benefits. There are only a couple of occasions

where we actually are sending money overseas, and that is for services that we need and can't get elsewhere.

Chairman BAIRD. Thanks for the question. I think it is central. I am inclined to share an analogy offered by former Governor of Colorado, Roy Romer, and I am a little bit hesitant with Dr. Fedoroff here, because it may not be scientifically apt, but former Governor Romer used to describe a fellow who, every year, his corn won the prize at the State Fair. Dr. Bartlett may have some insights on this as well. He won the prize at the State Fair, blue ribbon, and the very first thing he would do is distribute the corn seed to all the farmers around him. People said why are you doing that, because these guys are your competition? And the reply was, you understand that the way the wind carries pollen from corn, pollen from the fields around my field are going to blow some of that pollen into my cornfield, and if the guys around me don't have good corn, I am going to have bad corn down the road. And that is part of what you are describing.

I think the other side of it, though, that is lacking from Governor Romer's analogy, is that sometimes, the other guy has better corn. And if we don't collaborate in that way, and the corn is obviously the metaphor, whether that is any aspect of scientific research, we tend, parochially, to assume that we are always at the cutting edge. We can gain a great deal from other countries, and one of the fun, but also challenging realizations, as one travels and studies international science, is sometimes, folks are well ahead of us, and it is to our benefit. If we don't collaborate now, when the time to collaborate comes back the other direction, people may say hey, you weren't there with us, and so, there is this mutual benefit.

I think it is a central question, and we all need to be able to answer that for our taxpayers, who have every reason to ask the question.

Dr. Fedoroff.

Dr. FEDOROFF. I would like to add one thing, and that is probably 20, 25 years ago, USAID was educating something close to 20,000 students a year. Those individuals are now back, often as ministers, as people in high places around the world. Today, I think that number is less than 1,000. China is educating 10,000 Africans. We go around the world, and we speak English. If we do not maintain our educational support, the next generation will not be speaking English.

Chairman BAIRD. I think that is very eloquently said. I don't think most Americans are aware of those numbers, and it is absolutely true when you travel the world.

Let me, if I may, ask a question to follow up on this. So, if we agree that there is merit in this, what do we need to do to further enhance this issue? How do we—what are the obstacles remaining, what takes us to the next level and improves this?

Dr. BEMENT. There is a change in many countries in the world. Until fairly recently, most of the research was done at federally supported institutions in most nations. There is a movement to put much more capability in universities, and to build higher education to integrate education with research, as we have been doing in this country traditionally for many, many years.

As a result, what we are finding is that many countries are modeling the National Science Foundation, and setting up a National Research Council that mimics the National Science Foundation. For example, I can mention Turkey, France, Japan, Ireland, Russia, and more recently, the United Arab Emirates, and the King Abdul Aziz City for Science and Technology in Saudi Arabia, and many more. They come to the National Science Foundation. They—and we invite them. We have an open door for them, to show them how we do merit review, how we operate, what our policies are, and then, they take that back, and build it into their programs.

Now, why do I use that as an example? The more Research Councils around the world that are normed, if you will, according to the National Science Foundation, the easier our relationships are, the lower the barriers, and the more opportunities we have for cooperative research. That is happening at a very rapid rate.

Dr. MARBURGER. Sir, I would like to generalize that very articulate answer from Dr. Bement. The idea is to have receptor sites in the other countries. There are many countries that would like to be our partners that don't have the capability of doing so. I believe that one of the most valuable aspects of the Secretary's Initiative for Transformational Diplomacy, is that it can build receptor sites that make it possible for these other countries to participate with us.

So, there is sort of, there is somewhat of a chicken and egg problem here. It isn't a question of our just coming in and dumping money in. It is necessary to have a level of sophistication within those other countries, and a base capacity. And this is a function of USAID, I think. It is important, and it is one of the reasons that I am glad to see the direction of increased science advice into USAID. I think it will help.

Chairman BAIRD. I am going to actually yield, at this point, and recognize Dr. Bartlett.

Mr. BARTLETT. Thank you very much, and thank you for your testimony. I am caught in the horns of a dilemma.

For a long number of years, the United States has been preeminent in science, math, and engineering. The best and brightest of the world have flocked to our universities, as scientists and students. I think it is no accident that during those same years, we were the world's undisputed military and economic superpower.

I remember a few years ago, I sat with a number of the top scientists in the little country of Georgia, desperately poor, and I thought, "Gee, with the limited money that we have in this country, wouldn't it go a whole lot further if we were collaborating and working with these scientists, and putting some money there?"

As you know, during the last several years, every year, we have committed less and less of our resources to basic science and R&D. I am a farmer. I represent farmers, and that is exactly the equivalent of eating your seed corn. I have a lot of farmers. None of them are dumb enough to eat their seed corn, but that is precisely what we have been doing.

The dilemma that I face is that we are 1 person out of 22 in the world, and we have a fourth of all the good things in the world. We use a fourth of the world's energy. Now, what do I do? China today will graduate 6 times as many engineers as we graduate.

India will graduate 3 times as many engineers as we graduate, and about half of our engineers are Chinese and Indian students, aren't they?

How are we going to maintain this preeminence in the world, where this 1 person in 22 has a fourth of all the good things in the world? Particularly challenging, since I believe that the world now is at the point of the maximum production of fossil fuel energy. By the way, for everybody in the world to live as well as you and I live, they would have to have the equivalent of 300 people turning the cranks and running the industry that provides the amenities that represent our quality of life. Now, that is the amount of fossil fuel energy that each of us consumes today, the work output of 300 people. That energy just won't be there.

If I want to maintain, for my kids and my grandkids. . .I have 10 kids and 16 grandkids and two great-grandkids. I would like them to live as well as I am living. If we are going to maintain this superiority in this country, how do we do that, with the diminishing supply of energy, with the challenge of science, math, and engineering in the rest of the world? How do we do that?

Dr. BEMENT. We are now in a knowledge-driven economy, much less a resource-driven. Knowledge is the sort of thing that when you change it, it doesn't exchange, your share doesn't deplete. It actually enhances, so that there is a tremendous leveraging power in the exchange of knowledge.

The critical factor is what you do with that knowledge, and how successful you are in reducing that knowledge into products and services that are useful to society at large. And the key to that is to have a very strong entrepreneurial and innovation-driven system, and to have very creative people doing the research, and finding ways to apply the research.

I think at present, we do that better than any other country in the world. We are the teachers, but other countries in the world are learning, and learning very rapidly, so we have to be more agile in the future. We have to, I think, pay particular attention to whether or not we are getting to be a complacent society, instead of really recognizing the trends, and doing something about it.

Dr. FEDOROFF. Well, could I answer your question directly, and that is, imagine a world in which you could live as well as you do, using energy much more efficiently, and simultaneously, through the kinds of knowledge building that Dr. Bement has described, help the rest of the world live better?

Mr. BARTLETT. When I drove to work this morning, more than half the cars that shared the road with me were SUVs and pickup trucks with one person in them.

Dr. FEDOROFF. They sure are.

Mr. BARTLETT. It would be really nice if we can move to a more efficient world.

Dr. FEDOROFF. We could do something about that, yes. I think it will take cultural changes. I think it will take technological changes, but I think we ignore learning those lessons at our own peril.

Mr. BARTLETT. We have faced some huge challenges. This is exhilarating for me, Mr. Chairman, because there is no exhilaration

like the exhilaration of meeting and overcoming a big challenge, and boy, do we have one. Thank you very much.

Chairman BAIRD. Well said, Dr. Bartlett. Eddie Bernice Johnson.

Ms. JOHNSON. Thank you very much, Mr. Chairman. I am sorry I was a little late, and I would like to ask unanimous consent to put my statement in the record.

Chairman BAIRD. Without objection.

Ms. JOHNSON. As a follow-up to the line of questioning, my concern goes back, I guess, a little bit further. We are not preparing an adequate number of young people for our future, and I would like each of you to comment on what you are doing, or what you have done to address this issue.

Dr. MARBURGER. So, I will go first. The—this Administration is very concerned about the quality of education, from preschool up throughout the lives of our citizens, and worked very hard early in the Bush Administration, to pass laws, such as No Child Left Behind, and augment that initiative with further initiatives, some of which were captured in the President's American Competitiveness Initiative, which had a strong education component, and of course, the President signed the *America COMPETES Act,* which this committee had something, important input on, which also had strong educational components.

I believe it is important for us to pay attention to the quality of the education that we deliver to American young men and women, and my office has participated strongly in interagency programs to understand exactly which steps have to be taken to improve the quality of the educational experience, particularly in math and science.

We support the Department of Education in their efforts to form panels, and study the situation, and try to identify the best avenues for research on how children learn, and we support agencies like the National Science Foundation, that have systematic programs for studying the, how people learn science and mathematics, and they sponsor pilot programs in schools to try to learn best practices.

So, I believe that, I certainly agree that education is a primary pillar of strength for our future national security, as well as our economic competitiveness, and it is important for us to continue to support these important initiatives.

Ms. JOHNSON. Thank you. Does the President know that No Child Left Behind is not working?

Dr. MARBURGER. The President understands that we have got a difficult problem, that will only yield to persistence. We can't back away from the commitments that we have made to our children. We have got to keep pushing at this until we get it right.

Ms. JOHNSON. Thank you.

Dr. BEMENT. Let me bring this to a more international orientation. I think you are pretty well aware of what we are doing in the Math and Science Partnership, in our informal education programs, in our public education programs, involving the Internet, the media, as well as science museums. What we are discovering is that as we provide undergraduate students an international experience, it generates a lot more enthusiasm for science, and it

helps in retaining them through not only their undergraduate degree, but it encourages them to go on to a graduate degree.

For that reason, we are also primarily concerned about the number of students of color who participate in international programs. And we discover that the percentage is lower than the number that are in higher education overall. So, to simulate that, and to help address this challenge, we have provided, or embedded in our Louis Stokes Alliances for Minority Participation, international activities, and—of course, is aimed at undergraduate students.

Likewise, in our Alliances for Graduate Education, and in our Professoriate Program, we have also embedded international research experiences in that program, for graduates and post-doc students as well.

Ms. JOHNSON. Thank you.

Dr. FEDOROFF. I spent most of my life as an educator. I am very familiar with this problem.

Before coming to the State Department, I was at Penn State University, and one of the things that I did there, as a director of a multi-disciplinary organization, was to support an outreach program that went out into the schools into the primary and secondary schools in hands-on science and technology education, just to give people experiences.

But to come back to my present role, one of the things that has been considerably neglected is our international investment in tertiary education, that is, college education. And one of the things that is happening this month is that Secretary of State Rice, Secretary of Education Spellings, and USAID Administrator Fore are convening a global conference of university presidents to address precisely how we can build the capacity in all countries for higher education.

Ms. JOHNSON. Thank you.

Mr. MIOTKE. If I can just add to that real briefly, too. We do make a special effort to reach out to young people in our S&T programs overseas. We are bringing a group of 16 Middle Eastern kids to NASA Space Camp in Alabama later this summer.

We are teaching teachers in the Philippines to use GPS and other space-based technologies to teach geography to kids. We look for ways to reach out to youth during our S&T delegation trips overseas. My boss, Assistant Secretary McMurray, for instance, spoke to a group of kids in Morocco, and tried to excite them about science. We are bringing a group of kids in from TJ to participate in the Earth Day in the State Department, where the focus this year is going to be on science and technology working for the environment.

Ms. JOHNSON. And Mr. O'Brien, in addition to your comments, I would also like to know what you are doing to be sure that NASA has prepared persons in the future. NASA in particular.

Mr. O'BRIEN. Thank you. As far as education is concerned, NASA does have an education component that is largely domestically focused, and be glad to give you a much more detailed response to that for the record.

On the international aspect of that, we do partner with international counterparts on occasion. An example of that would be that over at, the Dutch, in cooperation with NASA and the Euro-

pean Space Agency, have replicated a NASA program that we call the Explorer School Program. There are a series of schools around the United States for which NASA, for a three-year period, provides scientific education materials, trains the teachers through a three-year period, that they can focus on space science types of disciplines.

Now, your second question, I am sorry.

Ms. JOHNSON. I am wondering what type of investment or leadership does NASA engage in, to be sure that you have the adequately prepared persons for the program?

Mr. O'BRIEN. For NASA?

Ms. JOHNSON. Yes.

Mr. O'BRIEN. Well, we—I have to say that I can't really answer that directly. I can tell you that we at NASA have no problem getting educated people in NASA, and I will give you an example. In our organization, which manages international cooperation, occasionally, we are allowed to hire somebody, and we have a very bright group of about 50 people managing a lot of things at NASA. The last time that we were able to hire more than one person, we hired two, we had 450 applications. So, we don't have a problem, in my view, at least in my area, attracting highly qualified, educated people to populate the NASA workforce.

Ms. JOHNSON. Well, thank you. I know a couple of years ago, there was real concern, because most of the people there were nearing retirement age, and they didn't feel that was a——

Mr. O'BRIEN. Well, that is another issue. There are a lot of old people, like me, in NASA, too, but——

Ms. JOHNSON. Thank you. Thank you, Mr. Baird.

Chairman BAIRD. Thank you, Ms. Johnson. Mr. Bilbray.

Mr. BILBRAY. Thank you, Mr. Chairman. I guess, Mr. Chairman, first of all, to sort of answer Dr. Bartlett's question about how do we do this, I think we start off by saying what we don't do. We don't burn the world's food, consuming more energy than it produces, and call it green.

We don't abandon international, long-term strategies for energy, clean energy independence, like ITER, which has been abandoned over the last two Administrations, since '92, while the entire crisis of climate change has been talked about, on one hand, by an Administration, while at the same time they were abandoning the long-term answer to addressing the problem.

And the other issue we don't do, is we don't continue to pay math and science teachers the same as a history teacher or a coach, just because union rules preempt the wellbeing of this Nation's future in science. In D.C., and now, let us just face this, in D.C., we talk about education across this country. Washington, D.C. is our responsibility, like it or not. We may delegate authority, but not responsibility. Still, in D.C., a science teacher does not get a bonus, does not get an incentive to stay in the educational institutions. And we sit here and talk like we are concerned about it, but we are not willing to cross that political boundary of saying we are going to implement the responsibility here in D.C., and lead through example, rather than cry about how bad the world is in the future.

So, now that I have gotten that off my chest, I have just got to say, Doctor, your comment about ITER, I appreciate it. I do have to say one thing to you. I think it is an illusion by science to think that the language of the world is based on what science talks about. There was a period in the 19th Century the Germans would be dominating, and if anybody who spends any time in Third World countries, like I do, let us all agree that our media impact in this world is extraordinary, and Americans don't understand it. You go to villages, they don't have electricity, but they have satellite dishes, and they are watching I Love Lucy, and having it under subtitles. That impact, the language, the American language will dominate until the Chinese start producing the movies. Okay. So, let us just start off with that.

But the ITER program, can we bring, Doctor, would you articulate about how that is going to affect our relationship, not just in science, but in climate change and everything else, but the entire concept that this long-term strategy, that the rest of the world is still recognizing, because of our internal political structure, the lack of a special interest group lobbying for it, it has now been basically put on a back shelf? Can you articulate at all your feelings about that?

Dr. FEDOROFF. I am going to defer that to Dr. Marburger. He has been centrally involved in it.

Dr. MARBURGER. ITER is an important project for the future, because it does capture a source of energy that doesn't produce large quantities of radioactive waste or CO_2, and—but it does require demonstration. There is still a further science step that has to be taken, that is now underway, in France, and the U.S. rejoined the partnership that is trying to make this work in 2003, and we continue to be a partner, despite the fact that funds, in fact, were eliminated for our share of this in the '08 Omnibus Bill.

I don't believe that that represents the true will of the U.S. Certainly, it is an embarrassment to us. It does jeopardize our partnership status. It has detracted from the confidence that other countries have in us as an international partner. So, there is no question that this was an event that has hurt.

However, President Bush has requested funds, increased funds for this program, in his '09 budget request to Congress. I hope that Congress will respond with an appropriations bill soon enough so that other countries can see that we do mean to carry forward our obligation to see this thing through.

So, it is important. This Administration is trying to make it work, and I know that many Members of Congress want to see it work as well. So, let us keep our fingers crossed for the future of this important project.

Mr. BILBRAY. Another issue that is sort of near and dear to me is the fact that we talk about Africa, we talk about Asia, when we talk about scientific exposure, outside of Brazil, you know, Latin America is an orphan, culturally and economically to us, so much, and it is our own backyard. I just get frustrated when I see major emphasis on things like biofuels in Indonesia, but not in Nicaragua. Is there a cultural or institutional barrier for us not doing more outreach into Latin America, especially Central America, which has been the orphan?

Dr. MARBURGER. Let me say one thing about Central America. There are some important assets. The U.S., as a matter of fact, the Smithsonian Institution has an important Tropical Studies Program in Panama. We do look to countries that have unique ecological and archaeological assets for cooperation and partnerships. There are very important archaeological sites, as you know, spread throughout South America and Central America, and U.S. archaeologists work with local archaeologists and scholars in those countries, to preserve and study those sites.

We also have important programs in astronomy, because the Southern Hemisphere is blocked to our telescopes here in the U.S., and there are some excellent sites in Chile, perhaps Dr. Bement can talk to this, that—where we have important scientific stations. So, we are looking for what I referred to earlier as receptor sites in those countries, and trying to develop further relationships with those countries.

Dr. BEMENT. We have strong partnerships with most of the countries in Central America, as well as in South America. Dr. Marburger mentioned Chile, you mentioned Brazil, but we have strong partnerships with Argentina, with Colombia, with many other countries in South America.

In Central America, there are many important research activities going on that have to do with biodiversity and natural medicines. There is a World Materials Network, that is interconnected with most of the countries now in South America. The Foundation has worked with the Inter-American Development Bank, and with the Organization of American States, to develop programs that will build capacity, not only in Central America, but also, in South America.

So, I would say that South America and Central America are about on par with almost anything we are doing elsewhere in the world. I think we are paying attention to it.

Mr. MIOTKE. We have four or five S&T agreements with countries in Central and South America. One of them, the Brazilian S&T relationship, has been raised to a higher political level, and we are quite engaged in all these, and I should say also that Dr. Marburger plays, and Dr. Bement have played huge roles in those relationships under the S&T agreements.

Chairman BAIRD. Go ahead, Mr. Bilbray, go ahead, briefly. We have got—those buzzers mean we have a vote shortly, so we will wrap up.

Dr. FEDOROFF. I would just like to say that we are still not doing enough, and I would like to put Mexico on the table as well.

Mr. MIOTKE. That is my concern, is Central America and Southern Mexico has basically been a black hole, and we talk about Colombia, and we talk about Brazil, but it is almost as if we are looking right over our neighbors. But go ahead, Doctor. I am doctor.

Dr. FEDOROFF. I think we need to do more. One of the things that is really important is bringing together scientists to begin collaborations it is an enormously important diplomatic tool, and it does take a little bit of money.

Chairman BAIRD. I want to commend our witnesses, and Mr. Bilbray, good question. To wrap up on that, and maybe tie that into something Dr. Bartlett said, Mr. Miotke talked about the science

and technology partnerships. One of the challenges is we don't fund that, and one of the questions I think this committee needs to do, one of our tasks, as Members of Congress, we have heard from our witnesses, we have read their testimony, is advocate vigorously with our colleagues to set aside some of this money.

Because within an agency budget, be it USAID, or one of the various directorate agencies, other directorate agencies, you—the task of international scientific collaboration can too easily be the easy cut. It is not the urgent thing, like getting food to somebody's door, but again, Dr. Bartlett's seed corn analogy, so instead of building capacity among their scientists to solve their own problems, and maybe some of ours, that may easily be the first thing to be cut.

And when we sign science and technology agreements with these countries, there is almost never funding that goes with it. It is sort of we want to work together, but our funding to even fund our own side of that is limited, and then there are statutory restraints on what we can give to the other country that participates. So the handshake is important, but we need to back that up with more substance, and I think that is our committee's task, is to educate our colleagues in the Congress, and frankly, to vote that way when these appropriations and other measures come forward.

There is a great article by Norm Neureiter, which I will introduce into the record, but also, share with my colleagues, about the whole broad role of science at the Department, but one of the issues he makes is making sure there are dedicated funds for this purpose.

[The statement follows:]

STATEMENT OF NORMAN P. NEUREITER

Abstract

This article is a first-person account of the strategy and experiences, over the past three years, of the first Science and Technology Advisor to the U.S. Secretary of State—a position created based on a study by the NAS/NRC on the role of science, technology, and health issues in current foreign policy. It stresses the importance of having more scientists either as Fellows or career officers in the Department of State. It also presents a strong case for the value of science and technology cooperation as an instrument of soft-power diplomacy in strengthening ties among nations and building technical capacity in the developing world. ©2004 Elsevier Ltd. All rights reserved.

1. Introduction

Rather than the critical, sometimes retrospective, analysis for which this publication is noted, this article represents a highly personalized account of a forty-year career spent more or less continually in efforts to develop scientific and technical cooperation on an international basis—in governmental, industrial and, indirectly, academic circles. The principal piece here is a discussion of my three years as the first Science and Technology Advisor (STAS) to the U.S. Secretary of State. I first briefly consider the uneven history of science at the Department of State, and then lay out the approach we[1] took to try to fulfill the promise of this new position. One can then ask to what extent did we succeed in assuring that scientific and techno-

[1] "We" refers to the three of us who were the initial complement in the S&T Advisor's office (STAS). Of enormous help was my Deputy, Andrew W. Reynolds, a highly effective and knowledgeable government science official with experience at the Department of Energy (DOE), in State's Bureau of Oceans, International Environmental and Scientific Affairs (OES), at OECD in Paris, and as Scientific Counselor in the U.S. Embassy in Rome. One AAAS Fellow was also assigned to STAS. The first was Michael Landolfa (biologist), who is now at the Max Planck Gesellschaft in Dresden, Germany. In the second year we had two Fellows, Ranjan Gupta (microbiologist) and Melissa Flagg (chemist). I am particularly grateful to Dr. Flagg, for helping to assemble this article.

logical (S&T) considerations were effectively integrated into the formulation of U.S. foreign policy, and what should be the future of science at State?

2. Increasing importance of S&T

Throughout the 1960s and 1970s, the State Department developed an increasingly important office for handling scientific issues, SCI, while also managing a corps of some 20–25 professional scientists who were designated "science attachés" or "scientific counselors" and who served in major embassies abroad. In Washington, the SCI office had solid S&T competence in its staff that backed up the attachés, and the office handled issues such as the peaceful uses of atomic energy, space, and the growing number of issues involving high technology. From 1967–1969, I was the first science attaché in Eastern Europe. I lived in Warsaw,[2] and I was responsible for S&T affairs in Poland, Czechoslovakia, and Hungary. While no doubt mistakenly suspected by hostile Polish government officials of being a spy, I nonetheless had considerable access to the Polish scientific community and some success in developing cooperative projects with U.S. institutions. In 1974, as a result of legislation, SCI became the Bureau of Oceans, International Environmental and Scientific Affairs (OES).

Upon leaving Warsaw, I returned to Washington to the Office of Science and Technology (OST) as Assistant for International Affairs to the President's Science Advisor, initially Lee DuBridge and then Ed David. This was a time when—cynics said for lack of money to give away, but I think because they really believed in it—both President Nixon and his National Security Advisor, Henry Kissinger, were traveling the world and, in lieu of other "goodies," often left behind the prospect of a better S&T relationship with the U.S. In fact, I recently found this relevant quote by Dr. Kissinger: "No human activity is less national in character than the field of science. . .no development efforts offer more hope than joint scientific and technical cooperation. The symbolism of nations working together in an area as strategic as science is important" [1].

The truth was, we were quite busy following up on their trips, and it was an exciting time to have an international science portfolio in OST, especially if one was an inveterate "engager" like myself. We are all prisoners of our own experiences, and my years in Eastern Europe had convinced me of the value of keeping open channels of communication to the science communities of other nations—even those where political relations were very strained. We knew that many of the scientists in those countries agreed with us and were not in sympathy with their own governments. I also had seen how the Pugwash Conferences involving Russian physicists and the informal contacts and growing trust between the U.S. and Russian science communities had contributed to the eventual signing of the treaty banning nuclear tests, and later to other arms control agreements.

"Engagement" is often maligned as a strategy by those who favor a policy of isolating unfriendly nations, but I found that it was always the communist governments that wanted to keep their scientists away from us; it was the governments that feared scientific contact with the West. There is a belief in some quarters that we can punish hostile governments by not allowing their people to contact Americans, but my view is that we should make every effort to develop these people-to-people relationships, which emerge naturally from visits, exchanges, and cooperation in appropriate areas.

The Nixon Administration brought two dramatic developments in foreign policy: the Nixon-Brezhnev period of détente with the USSR, and the breakthrough in relations with China. S&T played a role in each initiative. Indeed, one of the seven science-related agreements, which was eventually signed during the 1972 summit in Moscow, underwent its final negotiations with the Soviets at the dining room table in my home in Bethesda, Maryland, after almost a year of back-and-forth discussions in both countries. While the resulting relationship almost ended after the Soviets invaded Afghanistan, the core agreement was drawn on again for a new agreement on S&T cooperation which was signed in 1993 and is still in effect today. It was in 1972 that Ed David coined a new phrase, one that still resonates today: "Science and technology have become the new international currency."

Less well-known is the science element in President Nixon's unprecedented visit to China. Henry Kissinger had requested OST to prepare a series of illustrative proposals for S&T cooperation that could be laid before the Chinese as evidence of U.S. willingness to enter into meaningful cooperation as part of the proposed change in

[2] I was not the first U.S. science attaché to serve in the Eastern Bloc. Glenn Schweitzer, who is still active in S&T relations with Russia on the National Research Council (NRC) staff, was science attaché in Moscow from 1963–1966 and he impressively demonstrated the value of such a position for interacting with the Soviet S&T community.

the political relationship. In great secrecy and haste, under Ed David's guidance, and with help from the Committee on Scholarly Communication at the National Academy of Sciences (NAS), we cobbled together forty possible projects as examples of what might be done. Those proposals later served as models for actual exchanges and joint projects that began after President Nixon's visit—slowly at first, but then with increasing momentum. They were administered on the U.S. side by the NAS. Ultimately, an intergovernmental S&T Agreement was put together by Frank Press during the Carter Administration. Today the S&T relationship with China is truly incredible in its range of activities, including some 60,000 Chinese students who annually attend U.S. universities, the majority of them in S&T fields. As one U.S. university professor said to me, "Where would our physics research be today without these Chinese graduate students? Not enough Americans want to study physics any more." He was not joking, although I assume the Russian physicist was joking who recently described an American university today as the place where Russian professors teach Chinese students.

Not all Americans welcome these developments, arguing that we are helping China to become stronger and that the science can be applied to military uses, thus becoming a threat to U.S. interests. At a recent, quite remarkable conference on U.S.–China relations held at the Bush Library at Texas A&M University, the keynote speakers—President George W. Bush, Secretary of State Colin Powell, former Secretary of State Henry Kissinger, and former Chinese Vice Premier Qian Qichen—each stressed the importance of the U.S. bilateral relationship with China and the need to work through the occasional strains that will doubtless appear in that relationship. In a later session co-keynoted by Deng Xiao Ping's daughter, Vice Minister of Science and Technology Mme. Deng Nan, and myself, both of us emphasized the role of S&T cooperation in strengthening the ties between our nations. Indeed, the relationship has already weathered several storms: the Tienanmen incident, the accidental NATO bombing of the Chinese Embassy in Belgrade, and the downing of a U.S. reconnaissance plane on Hainan Island, among others. So far, statesmanship on both sides, plus a recognition of the importance to both countries of what could be lost, have prevailed. I believe that S&T cooperation is one significant element contributing to the overall stability of the U.S.–China relationship.

The great foreign policy achievements of the Nixon Administration were sullied, though not obliterated, by the Watergate scandal and the President's resignation. But even before that, at the end of 1972, the OST staff had been informed that the entire White House science advisory structure would be abolished. It was then that I decided to leave government. I had been concerned for some time that when we in the government discussed S&T cooperation with other countries, we were talking about exchanges of students and cooperation on issues of environment, health, housing, basic science, etc. However, the other side wanted computer technology, aerospace technology, and other high-tech elements that were largely in private hands in the U.S.

3. Moving on

In mid-1973, I joined Texas Instruments (TI), a high-technology, multinational company where I could experience the global movement of technology in the private sector. TI was at the time the world's leading semiconductor company, with plants in the U.S., Europe, Asia, and Latin America. My assignments in Europe, Japan, and at corporate headquarters provided an excellent vantage point from which to observe and participate in the enormous economic, educational, and infrastructure-stimulating impact of high-tech investment in another country. TI has been part of the explosive technical development of Japan, Taiwan, Singapore, and Korea since the 1960s, and it had a role in the 10-year semiconductor market-opening battle with Japan in the late 1980s and 1990s. My final major assignment at TI was as Vice President of TI–Asia, with residence in Japan for five years, prior to retirement at the end of 1996.

While this essay is intended to focus on the role that governments play at the policy level in our S&T relations abroad, it is useful to note that a single corporate project can involve hundreds of millions of dollars, the training of thousands of operators, technicians, and managers, and exchanges of hundreds of individuals, often dwarfing single government-to-government programs. I also learned from working on the semiconductor problems with Japan, that a government/industry team, working together in a coordinated way, can achieve results that neither industry nor government could negotiate alone.

4. The decline of science at State

At roughly the same time, in the Washington science community, the distinct impression was arising that science had come on hard times at the Department of State. Some symptoms of decline were:

- the position of Deputy Assistant Secretary for Science in the OES Bureau was eliminated;
- the staff of the once-strong OES office for international cooperation, which managed the 35+ S&T agreements between the U.S. and other countries, had been sharply cut back;
- all the professional scientists in U.S. embassies abroad were gone, replaced by foreign service officers—some actually quite good, but most with little or no technical background;
- the "science cone" as a professional category of career choice in the foreign service was eliminated;
- nuclear affairs had been transferred from OES to the Nonproliferation Bureau, and protection of technology replaced sharing of technology as a principal element of U.S. policy; and
- environmental issues, and fisheries and ocean negotiations dominated the OES agenda at the expense of S&T.

Concern in the science community, particularly from the National Academies and the American Association for the Advancement of Science (AAAS), reached the point that in 1998 Secretary of State Madeline Albright formally requested a study of this issue by the National Research Council (NRC). The resulting eighteen-month effort produced an excellent report on the relationship of S&T to foreign policy, and a series of recommendations to the State Department for strengthening its capacity to deal with those issues.[3] In one salient phrase, the report conveys the pervasiveness of the challenge for the foreign affairs community, when it observes that of the sixteen specific objectives set forth in the U.S. Strategic Plan for International Affairs, thirteen of them encompass considerations of science, technology, or health.

5. Reinvigorating science in the Department of State

Secretary Albright's response to this report was to establish a task force which developed an action plan called "Science at State" and included a number of actions to increase State's overall capacity to deal more effectively with issues involving S&T. One recommendation, taken from the NRC report, was to appoint an S&T Advisor to the Secretary (STAS).[4] The Advisor would drive this action plan while reporting through the Under Secretary for Global Affairs.

I was hired in late 2000, but with the presidential election only two months away, I was cautioned not to sell our home in Dallas—the implication being that the survival of STAS was not guaranteed in a new administration. However, from our very first meeting after the election, the new Under Secretary for Global Affairs, Paula Dobriansky, strongly affirmed her support of the office and the work to be done on the action plan. Her support remained steadfast throughout my three-year term and in the important decision of appointing my successor. Secretary Powell, in his first week on the job, revealed his own "techie" biases in a department-wide town meeting in which he committed to seek funds for a major upgrade of State's global computer system, including the goal of Internet access at every desk. Later, in addressing an annual meeting of the NAS, his ringing endorsement of the importance of S&T to inform and support foreign policy-making, and the role of scientists at State, brought the packed auditorium to its feet in a standing ovation [3].

Secretary Powell did much more, but one key factor was a new focus on the management of the department and on relating mission to financial needs in ways that brought a positive response from the White House and Congress. This reversed a negative trend in State Department budgets that had gone on for many years, despite ever-increasing demands for embassy security, for adding new missions, for in-

[3] "The pervasive role of science, technology, and health in foreign policy: imperatives for the Department of State" [2] is certainly among the best pieces written on the practical aspects of the relationship of S&T to foreign policy. It also contains an extensive bibliography of previous studies on S&T and foreign affairs, including work done by the Carnegie Commission on Science, Technology, and Government in the early 1990s. It is a must for any serious student of this subject.

[4] While the study was still in progress, supporters in Congress inserted language in the FY 2000–2001 authorization bill for State calling for establishment of the S&T Advisor's position. This legislation has certainly helped to sustain this independent office within State's complex bureaucracy.

creased hiring to staff unfilled positions in the Foreign Service, and for upgraded communications, not to mention the new challenges that arose in response to the terrorist attacks of September 11, 2001.

It was immediately clear to me that the Department of State must be seen by the American people not as tea-sipping diplomats attending lavish diplomatic affairs but as a critical agency of national security—and it must be budgeted for and funded in that context. Early on, we coined a simple mantra for STAS: the three pillars of national security—intelligence, diplomacy, and military preparedness. A common thread through those pillars is science and technology, with diplomacy the last stop before war-when the talking stops, the shooting starts. Secretary Powell speaks about people in the U.S. embassies and consulates abroad as the "front line of national security." Sadly, the growing number of foreign service names on State's bronze memorial plaques to those killed in the line of duty gives a special poignancy to this front-line metaphor.

6. A new paradigm

For me this renewed focus on diplomacy as a special instrument for national security is the new paradigm in this post-Cold War era. We no longer live in what was once called a "New World Order," but now live in a world of inordinate disorder, in which diplomacy carries a particularly heavy burden for building peaceful, constructive relationships among nations. And S&T are essential components of that diplomacy, whether combating terrorism, striving for sustainable development, understanding and addressing global climate change, attacking the HIV/AIDS pandemic, developing new energy technologies, preventing the proliferation of weapons of mass destruction, assuring food safety and security for a growing world population, protecting the global environment, or conservation of diminishing marine resources, among a list of many.

In a non-classified report released three years ago called "Global Trends 2015: A Dialog about the Future with Non-government Experts," the National Intelligence Council identified S&T as one of the seven key drivers that will shape the world in 2015. Specifically cited were information technology, biotechnology, materials science, and nanotechnology. The report also foresees the dangers of side-wise development or proliferation of older technologies for ballistic missiles and weapons of mass destruction.

There is no shortage of S&T-related topics for America's foreign policy agenda in the 21st century. But the real question is whether we can make progress toward strengthening State's capacity to deal with S&T issues in a foreign policy context. How can the STAS office, with only three people, affect the culture of the oldest department of government, which a former Science Advisor to the President called the most technophobic culture he had ever experienced?

6.1. Outreach to the scientific and engineering communities

We began with a three-point program, the first element of which was a major outreach effort to the scientific and engineering communities, both inside and outside of government. We wanted the closest possible relationship in order to draw on the best S&T advice and counsel available in the country. Key participating institutions were the National Academies (of Sciences, Engineering, and the Institute of Medicine), the AAAS, the American Association of Universities (AAU), a host of professional science and engineering societies, and a number of individual universities. The responses were quite fantastic. All were eager to help find ways to make effective inputs into the policy process. We expected less enthusiasm from the government technical agencies, which we thought might see State as interfering with, rather than assisting, their international activities. But we were surprised and pleased at their enthusiastic response to having a stronger S&T focus at State.

Also of great importance to the STAS office is the President's Science Advisor, who is also Director of the Office of Science and Technology Policy (OSTP). For international representational purposes, the OSTP Director is the de facto S&T Minister for the U.S., with a highly visible and important international role. We were fortunate to enjoy strong support and close working relations with Neal Lane at the start and the present incumbent, John Marburger.

So there was no doubt that the transmission side of the advisory process was in fine shape. But how about the receptor mechanisms inside State? Certainly, we could draw on the best available S&T advice and convene roundtables, workshops, or briefings with State officials. Such sessions were useful, especially to brief a delegation leaving on a specific mission, but to me they seemed insufficient for the challenge of institutionalizing a greater awareness of S&T issues throughout the policy process. One might be tempted to think that foreign policy is made by whispering in the Secretary's ear, but nothing could be further from the truth.

Policy development at State is a complex process that derives from the structure of the institution—a structure that should be understood if any attempt to advise or inform the system is to succeed (see Fig. 1). State has over 25,000 employees located in Washington and in more than 250 embassies, consulates, missions to international organizations, and other overseas posts that formulate and carry out U.S. policy toward some 191 nations.

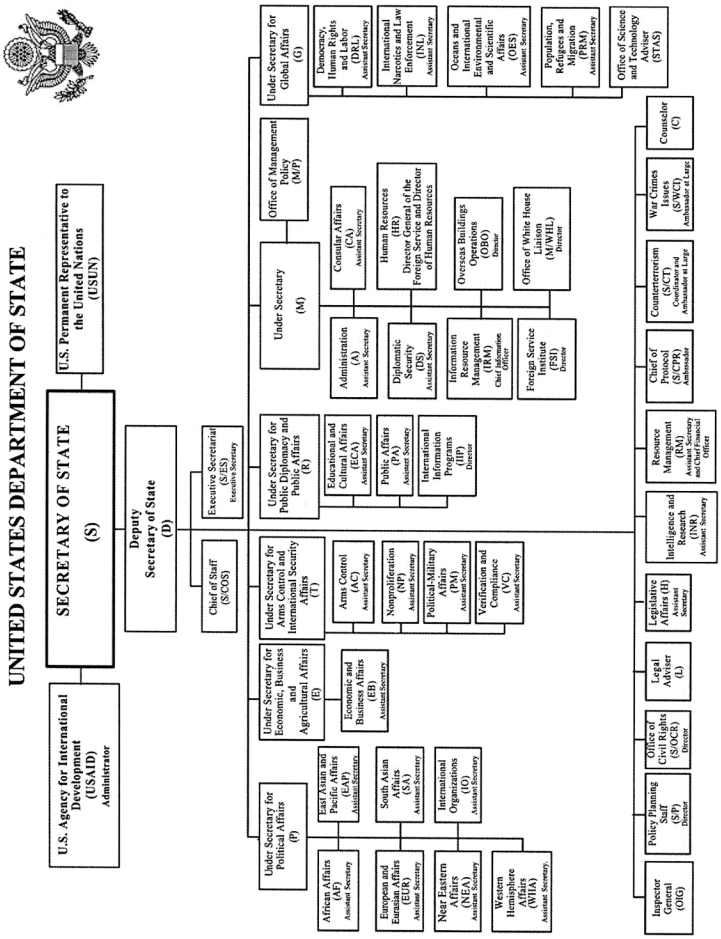

Fig. 1. Organization of the Department of State.

Reporting to Secretary Powell through his Deputy, Richard Armitage, are six undersecretaries who oversee the work of some 23 bureaus of two different types: regional bureaus and functional bureaus. The six regional bureaus (which divide the world into six geographic regions), each headed by an assistant secretary, are responsible for all posts abroad and the focus of all policies toward individual regions and countries. Early in my assignment, one senior foreign service officer said that to have any real impact at State, I had to penetrate the "baronies"—the realms of the regional assistant secretaries, the six "barons," who represent the traditional diplomatic heart of the Department.

The functional bureaus outnumber the regional bureaus and serve specific missions, such as arms control; verification and compliance of arms agreements; nonproliferation; oceans, environment, and science; consular affairs; educational and cultural affairs; economic and business affairs; democracy, human rights and labor; international narcotics and law enforcement; population, refugees, and migration; political/military affairs; intelligence and research; international organizations; administration; etc. The functional bureaus are extremely important but, to oversimplify, they are essentially single-viewpoint organizations that wish to have their issues prevail in the formation of policy toward any given country or region—among a tide of often competing interests.

Take country X as an example. The desk responsible for X would like good relations; the human rights office wants to punish it for rights abuses; OES wants a bilateral science agreement to work with X's science community; a third bureau insists that X's space program is for military purposes and there must be no cooperation; the narcotics people want to spray the poppy fields just discovered there; the economics people want to promote business opportunities in X for U.S. industry; the trade controls office wants to deny export licenses for certain products for security reasons; the education people want to start a Fulbright program with X's main university; another bureau wants to deny a U.S. visa for one of X's prominent professors because he is a nuclear scientist; the agricultural affairs office wants to take retaliatory action because X has just banned imports of U.S. genetically modified corn; the aviation people want to deny U.S. landing rights to X's airline, because X will not permit a second U.S. carrier to serve its capital city; and the health office says that X has a surge of HIV/AIDS incidents that threaten an entire region because the president of X denies there is a problem.

As these multiple, often-conflicting views move up through the system and the regional people try to blend them into a coherent policy position toward country X, if the S&T inputs are not made early in the process but wait until the final papers reach the assistant secretary or higher, the chances of having any influence on that policy are very slim indeed. This is even more true with the big political issues that occupy much of the Secretary's time, such as North Korean weapons, the Mideast conflict, Iran's nuclear program, Iraq reconstruction, the Global AIDS Fund, etc. If relevant S&T inputs are not made at the bureau or office level on such issues, the chances of them influencing the final policy are next to nil.

Therefore, it seemed obvious that we had to try to get more scientists into the system, and to distribute them among many different bureaus. In the functional bureaus they could work in their scientific fields. In the regional bureaus, their creative and adaptive skills could deliver large dividends in bringing new perspectives and approaches to offices where science is (usually) at best only an afterthought. They could begin to influence the baronies.

6.2. The Fellows program

The second element of our STAS strategy was to greatly expand the Fellows programs. For years there had been a handful of Ph.D. scientist Fellows, selected on a highly competitive basis by AAAS, and made available to the State Department at State's expense for one year, renewable by mutual agreement for a second year. These had generally been limited to the OES bureau. With help from Human Resources, we were able to secure a small number of these two-year positions and then distribute them across several bureaus. We also found some offices with unfilled positions that were able to take Fellows with the right qualifications and interests.

In addition, the American Institute of Physics (AIP) became the first professional society to create and fund a competitive Scientist Fellow program for State. The quality of the candidates from AIP has been so high and the demand so strong that we have been able to place not only the winner but also the runner-up for three years running. The first AIP Fellow at State, George Atkinson, a professor of chemistry and optical physics on leave from the University of Arizona, was so successful that he was selected as my successor when my three-year appointment ended in September 2003. The Institute of Electrical and Electronics Engineers quickly followed AIP and is now in its second year with a total of three Fellows. The American

Chemical Society (ACS) recently approved a program and we expect an ACS Fellow in 2004. On the industry side, the Industrial Research Institute has also signed a Fellows agreement.

The unprecedented result is that as of September 2003, we had some 40 Ph.D. scientists and engineers working or committed to work in State as Fellows, distributed among 18 offices in 12 bureaus, including five of the six regional bureaus. This rich mixture of talent brings distributed S&T wisdom to State at affordable costs and easy accommodation in the personnel system. I would like to see this number stabilize at about 50 Fellows per year. Furthermore, George Atkinson is now putting the final touches on a new Jefferson Science Fellows pilot program with funding from private foundations and U.S. universities. Administered through the NRC, this program should add five new Fellows per year on leave from their faculty positions, hopefully presaging a new relationship between State and the university research community.

We have also put a new focus on getting science students into State's summer intern program, have increased the number of scientist detailees into State from other U.S. Government agencies, and have strongly promoted an OES program that is now placing some 30 staff scientists from six participating government agencies into tailored, one- to three-month assignments at U.S. embassies throughout the world. These varied programs all aim at bringing technical talent into State on a non-career basis. But we also worked with the recruiting people to hire more people with S&T backgrounds into the career foreign service. It is now possible for Fellows interested in a foreign service career to be exempted from the written examination and move directly into the competitive selection process.

There is also one long-term detailee from NASA who has been assigned as the first S&T advisor to an embassy. That person is in Australia and has demonstrated brilliantly the benefits to an embassy of having a professional scientist to complement the foreign service officer who holds the science portfolio as part of his economic job. It is a model I would like to see realized in 20–25 embassies around the world because I do not see any possibility of rebuilding the professional science attaché corps that existed 30 to 40 years ago. A professional scientist will always enjoy a level of access and interaction with the local scientific community that is simply not possible to a layman.

6.3. Selecting specific science initiatives

The third element of the STAS program was the selection of specific science initiatives that could demonstrate the direct value of S&T for achieving political objectives with other countries. With the ability to interact with the programs of all government technical agencies and to interface with any of the 191 countries in the world, there was a rich smorgasbord of opportunities on which to draw. We were selective in choosing actions that we believed would raise awareness in the regional bureaus to the value of S&T initiatives as part of an active foreign policy. In citing a few examples, I must also note the inadvisability of a small office taking on long-term operational responsibilities. Such responsibilities are simply too time-consuming and should be transferred, after the catalytic stage, to a bureau equipped to manage the operation.

I spent nearly 30 years in two large companies—one in oil, the other in electronics. It is clear to me that the greater corporate world has heartily embraced globalization. Mergers and alliances, especially in high-tech industries, are de riguer. Exxon and Mobil were not big enough alone to address the global marketplace, so now my $83 per month retirement check comes from ExxonMobil Corp. HP and Compaq were either too big to compete with each other or not big enough to compete in the global market, so they merged.

But the political world has not yet bought into this. There, centrifugal forces are rife. Ethnic tensions, nationalist ambitions, and religious extremism continue to divide the world's peoples at a remarkable rate. The instruments of division or separation can be democratic, but increasingly they are violent—fueled by passionate convictions that emerge as terrorism or suicidal attacks. The point is that the political world is very different and global business solutions and market forces alone do not provide the answers. All nations struggle to find answers to these questions and, in doing so, to protect their borders and their citizens and to move forward with economic development. In considering projects, we worked on both strategic bilateral science relationships as well one of the multilateral "big science" opportunities emerging globally.

6.4. The Indo–U.S. S&T forum

The first project was the formation and implementation of the Indo–U.S. S&T forum. It grew out of two high-level dialogues between U.S. and Indian science leaders. It then became a major objective of the U.S. Ambassador to India, but although a modest rupee endowment was provided and an agreed framework established, nothing happened, and the money was about to be lost.

With strong support from State's South Asia Bureau and our embassy, we set up a U.S. board and arranged a first meeting with the Indian counterparts. For three years now, I have served as the U.S. Co-Chairman of the Forum, with strong support from the National Academy, and in this way we have sustained a formal, funded mechanism for promoting bilateral S&T cooperation with India. This fits well with present U.S. policy toward India, which stresses cooperation, encourages the economic and scientific development of India, and has relaxed the sanctions imposed after India's nuclear tests. The Indians particularly want more cooperation in nuclear power, civil space activity, and the easing of export controls on high-technology items—the so-called "trinity of issues." Progress continues in these areas, but proliferation issues and intellectual property protection concerns still limit these interactions. At the same time, the forum is working, and is considered a meaningful part of the new and much warmer relationship between the U.S. and India.

6.4.1. Vietnam

A second project involved Vietnam. A previously signed bilateral S&T agreement had not yet been ratified in Vietnam and there was no activity. The East Asia Bureau was eager to see this program proceed as part of warming relations with this most populous and energetic country in the region. On a trip to India, I also stopped in Hanoi to try nudging things forward. Subsequently I put together an interagency delegation and convened the first meeting of a committee to define some joint activities. The result is that there is now a modest, functioning, bilateral program with operational responsibility shifted to the OES Bureau. Furthermore, Congress has also created the Vietnam Education Fund, which will provide $5 million per year for 17 years from Vietnamese debt payments to the U.S. to support exchanges of students and professors in science, technology, and mathematics. Over time, this program will develop a cohort of U.S.-trained Vietnamse scientists, who will maintain links with their U.S. colleagues and build the cooperative programs of the future.

6.4.2. Pakistan

Pakistan is crucial in the war against terrorism, and President Musharraf, in the face of considerable domestic opposition, has pledged his support to the U.S. in this effort. During a U.S. visit with President Bush, in addition to discussions on fighting terrorism, the two leaders noted the desirability of S&T cooperation and assistance in education and economic development. This was of considerable interest to the embassy and to the South Asia Bureau, so when no one else picked up the issue, STAS did.

Working with Pakistan's indefatiguable Science Minister, Atta-ur-Rahman, and the U.S. technical agencies, we laid out the framework for a jointly funded cooperative program, and OES developed a bilateral science agreement to formalize the relationship. In a subsequent meeting with the U.S. Ambassador to Pakistan, President Musharraf emphasized the importance of this S&T relationship for Pakistan's future economic development.

While U.S. funding was delayed due to complexities in the appropriations process, funds were included in the FY 2004 for State and implementation plans are now underway, also including partial funding from the Pakistan side.

6.4.3. Multilateral cooperation on big projects

Another important issue is multilateral cooperation on big science or big technology projects that are so large, expensive, or risky that no one country will undertake them alone. A current example is the International Thermonuclear Experimental Reactor project (ITER), a key next step on the still long and uncertain road from nuclear fusion to another source of energy.

Since our office began, we strongly supported the ultimately successful effort of DOE and OSTP to have the U.S. rejoin the ITER consortium, which now includes the EU, Russia, China, Japan, and South Korea. This is an extremely important test case for the viability of a prototypical big science or technology project. Can five nations and one region really come together at a fixed location in one nation and work for ten years to build a reactor and then work cooperatively for an additional 10 to 20 years of operation? Will each entity compromise its own domestic fusion

program, its domestic industry involvement, and agree to sustain funding for work at a site perhaps thousands of miles from home? Can issues of export control, intellectual property, and legal structures all be resolved on a timely basis?

While the parties have now agreed on a basis for sharing the $5 billion cost of the project, there is as yet no agreement on the site for construction. ITER has been in process for 18 somewhat bumpy years. It must move forward soon or it will founder, with very unfortunate implications for other big programs, such as the next large accelerator for the high-energy physics community. Success, however, will provide valuable lessons and inspiration to future programs by demonstrating that such complex cooperative activities are indeed possible.

7. Building S&T cooperation

The above examples all involve international S&T cooperation, which I see in a political context. I strongly believe that S&T cooperation can help build a solid, long-term relationship between participating countries. Each individual program represents a separate strand in the fabric of an overall relationship. The more of these strands that exist and the stronger they are, the more resilient and durable the relationship, whatever the slings and arrows that may impinge on it.

Such cooperation is particularly valuable in today's complex world. But let me say it in slightly different terms. The military strength of the U.S. is our hard power. No other nation today can challenge that hard power on the open battlefield. But there is another side to America—our soft power—also called by Joseph Nye our "co-opting power" [4]. It is the siren song of the values of an open, democratic society, one that cherishes human rights, freedoms of speech, religion, and inquiry, etc. Science and technology, coupled with our universities and the relationships we build around the world, are all instruments of that soft power. It is highly appropriate that both OES and STAS are housed at State in Paula Dobriansky's Under-secretariat for Global Affairs, together with several other bureaus and offices that are major actors in the conduct of America's soft power diplomacy (refer back to Fig. 1).

S&T cooperation can also be one of our most effective instruments for helping the developing world to build an indigenous technical capacity for linking to the global economy that is essentially driven by technology. That is why the S&T forum with India was a priority for their rapidly developing S&T community, and why the President of Pakistan so strongly favors S&T cooperation with the U.S. That is also why a major study, just beginning in the NAS/NRC, on the role of S&T in the U.S. Agency for International Development (USAID), is of such potential import. Despite a number of sporadic attempts over the years to make S&T an identifiable and pervasive element in USAID's activities, that has not happened, even though many of their projects are technical in nature. USAID's approval and partial funding of this study is highly significant.

7.1. Challenges facing S&T cooperation

I should also note some of the challenges that we currently face in taking full advantage of our cooperative S&T opportunities. The U.S. response to the terrorist attacks of September 11 profoundly changed the Nation, as well as its scientific and diplomatic priorities. The top issues today are the war against terrorism, homeland security, and nonproliferation of weapons of mass destruction (WMD), and they are impacting all of our international activities. On the positive side, there are opportunities to cooperate with other countries on R&D aspects of cyber security, combating terrorism, detecting hidden weapons, protecting container shipments, etc. The newly formed Department of Homeland Security (DHS) has offices for international activities and has begun discussions with some potential international cooperative partners. Our STAS office has also discussed cyber security issues with the EU, led a negotiation on an R&D agreement with Canada, and scheduled a first meeting with Japan on R&D for peace and security.

7.1.1. New visa procedures

However, one issue has emerged, which I believe has the potential to seriously affect research and development activities in the U.S., and which, over time, will negatively impact U.S. national security. That is the issue of new visa procedures contained in Congressional legislation passed in response to 9/11. Under this legislation, visa policy was moved from State to DHS, and procedures were tightened considerably in order to prevent terrorists or potential WMD proliferators from entering the country as students or scientists. This article is not the venue for reviewing these procedures in detail, nor is it easy to acquire accurate data on the impact of visa delays and denials on attendance at scientific meetings and research in indus-

trial and university laboratories; both the AAU and NAS/NRC are trying to develop accurate numbers. However, extensive anecdotal information indicates a serious problem, particularly for applicants from China, Russia, Vietnam, the Balkans, India, and Muslim countries. Graduate students and post-doctoral researchers, who are not being granted visas or who simply find the procedures too onerous or the decisions too capricious, are turning toward Europe, Australia, and Japan. One large midwestern university president told me that enrollments fell by about 1000 students in Fall 2003 because of visa problems. While the processing is faster than a year or more ago when serious backlogs arose, many people will not or cannot apply two or three months ahead of their trip as recommended. Scientific meeting planners are increasingly looking at alternate overseas venues.

I believe we must find a better balance between security and openness. We are muffling one of the most effective soft-power instruments of this great country-a nation whose very essence rests on the principle of openness. In 1966, Hollywood produced a comedy film about the cold war called "The Russians are Coming." The present Russian Ambassador to the U.S. had an op-ed piece in the *Washington Post* last year titled, "The Russians Are Not Coming." It was about the visa problem.

Good science is not limited to the U.S., and diminished contact with excellent work abroad will only constrain U.S. research. Last year nearly 70 percent of the pages of *Physical Review,* the world's leading physics journal, came from foreign authors. With something like 50 percent of our graduate students in the physical sciences and engineering coming from overseas, a severe decline will also limit U.S. university research, with long-term adverse effects on the economy as well as the cutting-edge basic research important for national security.

7.1.2. Absence of funding mechanisms

A second issue, which I never thought was a problem until seeing it firsthand during the past three years, is the absence of effective government-wide funding mechanisms for international S&T cooperation. In most agencies there are no dedicated funds for this purpose. Furthermore, legislation often limits cooperation to programs that can be justified purely in terms of their domestic missions or the benefits to U.S. science.

One possibility would be to appropriate funds expressly for soft-power S&T cooperation, perhaps to the Department of State. To some extent there are precedents. One was when the Soviet empire imploded and funds were made available by Congress, through the *SEED Act* and the *Freedom Support Act,* to aid the transition in those countries. Some of that money did go for science programs, although with more emphasis on assistance than on cooperation. The difference may be subtle, but it can be important to the receiving nation.

It might also be possible—and legislatively easier—to specifically designate for S&T cooperation a portion of the so-called Economic Support Funds (ESF), which State now receives for various uses overseas including some regional environmental initiatives. This may require more program development capacity than State can presently muster, but such an approach deserves serious consideration.

Easier funding for S&T cooperation could also be achieved via changes in the spending authorities for each of the technical agencies—not a simple process. It would require some sort of resounding policy authorization stating that international S&T cooperation is an active element of U.S. foreign policy. Then each agency would have to interpret that policy in terms of its own mission, with guidance from State to ensure overall compatibility with U.S. foreign policy.

I recently learned of a past effort in the Carter Administration to create a new government agency to directly support international S&T cooperation. The proposal actually made it through three of the four Congressional hurdles—two authorization bills and one appropriations bill in the House—but, regrettably, it died in the Senate for lack of a champion and in the face of opposition by USAID.

But in truth I am not sure a new agency is the best answer to the problem. Our S&T cooperation needs to be broad and to encompass the full range of mission-oriented research within our federal technical agencies. However, that would require a clear indication from Congress that international S&T cooperation is, in fact, encouraged and fundable. I was pleased to see this year, in the OSTP/OMB budget guidance to the agencies, that one of the seven criteria for project funding that would be seen favorably was to include an element of international cooperation. That is a welcome statement, but it does not solve the larger issue, and I hope that a brave future S&T Advisor at State will try to find such a resolution. It could have a great impact on the challenge of effective capacity building in the developing world and on U.S. relations in some problematic, but important, countries.

7.1.3. Export controls

When I was in government 30 years ago, export controls were a problem of constant contention among the agencies. That situation has not changed. One particularly difficult area has been controls on satellite technology, which has caused problems at universities where non-U.S. graduate students have worked on scientific satellite experiments. Of more direct economic significance, in the last few years the struggling U.S. satellite industry claims that these controls have caused a drastic drop in their global market share of civilian satellites and components and virtually guaranteed their foreign competitors captive markets abroad. Each issue in this field is complex and beyond the scope of this paper. However, with particular attention since 9/11 to nonproliferation issues, export controls will be an element of concern in any international cooperation involving high-technology products or know-how. Successful collaboration with the U.S. will obligate other nations to provide rigorous enforcement of their own export control regulations and to come down hard on violators.

7.1.4. Intellectual property rights

Another issue affecting international S&T cooperation is intellectual property rights (IPR). The negotiation of bilateral agreements has sometimes been seriously delayed or even derailed by U.S. insistence on standard IPR language in all such agreements, even though IPR issues have very rarely arisen in these cooperative programs. IPR is not a trivial issue, and universities throughout the world are beginning to recognize the value of IPR in their research and to seek early patent protection. But I have always felt that IPR issues should be worked out on a project basis between the cooperating parties, and that including somewhat draconian IPR boilerplate in umbrella agreements is counterproductive. In the corporate world, where the stakes are high, detailed IPR agreements are worked out between the parties based on specific projects or programs. If agreement cannot be reached, the project does not proceed. That should be possible within our government S&T cooperative relationships as well.

7.1.5. Marginalizing S&T considerations

The final issue is what some outside scientific observers call the marginalization of S&T considerations by the foreign policy community. Of course, that is the reason the S&T Advisor position was created at the Department of State. In the past three years, I believe we have made some significant progress on these issues. I have worked for Under Secretary Dobriansky and Secretary Powell and with many other colleagues at the State Department with great enthusiasm, and I welcomed the appointment of my successor to sustain this department-wide effort.

Yet, for all of the Fellows, the individual S&T initiatives and the strong support from the top of the department, I still believe that S&T has only shallow roots in the Department of State as an institution, and there is much more that can be done. It behooves the outside S&T community, which has so strongly supported the NAS/NRC study and our efforts to turn its recommendations into reality, to continue its vigorous support and to remain involved. Eternal vigilance should remain the watchword in following future developments in the fascinating interplay of S&T and foreign policy.

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BIOGRAPHY FOR NORMAN P. NEUREITER

Norman P. Neureiter has a Ph.D. in organic chemistry from Northwestern University. Following six years of research in the oil industry, he spent two years at NSF and then entered the U.S. Foreign Service, serving in Germany and then in Poland (1967–1969) as the first U.S. Science Attaché in Eastern Europe. He was responsible for international affairs in the White House Office of Science and Tech-

nology (OST) during the Nixon Administration. Upon disbandment of OST in 1973, he joined Texas Instruments (TI), finishing a career in corporate relations and international business development as Vice President of TI Asia, based in Japan. After retirement in 1996, he was a consultant to government and business, until his recent three-year assignment as the first Science and Technology Advisor to the U.S. Secretary of State. He is presently a Distinguished Presidential Fellow for International Affairs at the National Academy of Sciences.

Chairman BAIRD. I would very much like to thank our witnesses for your work. Some incredibly eloquent testimony today, and inspiring testimony, and we appreciate your daily work, and the information that you have provided this committee. I want to thank my colleagues for their participation. As I have said before, this is one of the central issues that this committee will occupy itself with over the year. Dr. Fedoroff, I am very excited about this, I don't know, gathering is maybe the best word, maybe you have got another word, of university directors, and we hope to learn more about that in the future.

With that, this hearings stands adjourned, and with the gratitude of the Committee, thank you.

[Whereupon, at 11:36 a.m., the Subcommittee was adjourned.]

Appendix:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by John H. Marburger, III, Director, Office of Science and Technology Policy

Questions submitted by Chairman Brian Baird

Q1. Is there a role best served by a non-governmental organization, such as the Civilian Research and Development Foundation, in maximizing the "soft power" effectiveness of science and technology cooperation to meet U.S. foreign policy objectives?

A1. Non-governmental science and technology (S&T) organizations (NGO's) such as CRDF, the American Association for the Advancement of Science, Alfred P. Sloan Foundation, Carnegie Foundation and many others continue to have an important role in influencing what others think of the United States and help promote U.S. foreign policy goals. S&T NGO's are able to form connections to organizations, scientists, and citizens globally. They communicate the culture, processes, values and ideas that form the foundation for U.S. S&T such as transparency, openness, peer review, and intellectual property rights. These ideas can then be transferred outside of the scientific community to other parts of society.

Q2. How can the Federal Government more effectively capitalize on the scientific expertise and innovative spirit at our research universities in pursuit of our foreign policy goals?

A2. Studies have shown that foreigners continue to have high admiration and respect for U.S. science, technology, and innovation capabilities and want to come to the U.S. to study. The Federal Government can capitalize on the scientific expertise and innovative spirit at U.S. research universities for foreign policy goals by continuing to support the exchange of foreign scientists and students to the U.S. to study and work. This includes easing visa difficulties and providing a welcoming environment (increased public diplomacy) for foreign students. We also encourage U.S. undergraduates, graduates, and post-docs to do some of their training in other countries to increase their abilities to form international collaborations in their later careers and to tap into overseas knowledge. The exchange between U.S. and international scientific communities not only strengthens the health of our S&T community but also provides an opportunity to influence potential foreign S&T leaders in government, academia and society.

Q3. There exists no single point of contact in the U.S. government with the authority, the budget and the coordinating function to initiate new cooperative research activities, even with countries with whom we have already signed a formal agreement or with whom we regularly collaborate. The National Science Board made some recommendations to improve the process by which international collaborations are established, including the designation of a lead official in each agency empowered to promote and develop international science and engineering strategy and coordination. What is your response to that particular recommendation, and what else might your office or other agencies do to improve the process by which new international collaborations are established?

A3. Each USG technical agency has an office dedicated to international cooperation. Staff responsibilities are to promote international collaboration in support of their agency's goals and missions. Additionally, senior Administration officials serve on a variety of international organizations and groups that promote international scientific collaborations (UNESCO, G8 Science Ministers, Heads of Research Councils, OECD/GSF). These activities help to support agency to agency or researcher to researcher international collaborations in support of U.S. diplomatic objectives. These offices work closely with the State Department which has responsibility to coordinate and establish U.S. diplomatic objectives. As stated in my written testimony, OSTP has found that drawing together the USG technical agencies around specific topics or focused on a particular country have proven the most successful way to promote coordination and strategic thinking in our international collaborations.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Arden L. Bement, Jr., Director, National Science Foundation

Questions submitted by Chairman Brian Baird

Q1. You mentioned in your testimony that the Office of International Science and Engineering is currently leading an effort to develop a goal-oriented strategic plan that will inform coordination of international activities across the Foundation. What is the timeline for that plan? Does NSF currently maintain a directory of all of its international projects and grants or is one being developed as part of the strategic plan?

A1. The planning framework is being developed with input from an internal Foundation-wide International Coordinating Committee. The draft framework will be shared with NSF's external Advisory Committee for International Science and Engineering over the next few weeks and their advice will be incorporated. The draft will then be reviewed by the NSF Director and other senior management with the intent of finalizing the plan by summer 2008.

NSF does not maintain a directory of international projects and grants. However, NSF electronic files identify awards with international activity so that reports can be developed as needed. The recent Office of International Science & Engineering (OISE) International Data Working Group project resulted in substantially revised international implication data collection for awards effective December, 2007, with future enhancements planned. This change should improve reporting on international activity NSF-wide by requiring identification of planned international activity at initial award. Over tune, this should allow easier analysis of international activities embedded in proposals across NSF,

Q2. In your testimony you discussed the benefits of the Partnerships for International Research and Education (PIRE), including the 15 PIRE projects involving collaboration with scientists in developing countries. You also discussed the joint program with Pakistan. Across the Foundation, what percentage of the budget supporting international collaborations involves U.S. scientists and engineers working with scientists and engineers in developing countries on research projects of mutual interest but also with direct benefit to those countries, including for capacity-building?

A2. Foundation-wide budget information on international collaborations is not readily available. However, international implications data discussed in the response above indicate that roughly 37 percent of all NSF awards issued in FY 2007 had an international component. These awards involved a total of 145 different countries.

Budget information is available for OISE programs with respect to developing countries. In FY 2007, nearly 31 percent ($11 million) of the OISE research and education budget ($36 million) was spent on awards involving U.S. scientists and engineers collaborating with counterparts from developing countries. (If the Committee would like to receive relevant budget information beyond OISE, NSF would be happy to discuss a framework and timeline for providing such data.)

OISE seeks to ensure that the next generation of STEM scientists and engineers are globally engaged; thus we have a number of mechanisms to give U.S. students and recent graduates experience in doing research throughout the world, and especially in developing countries. In order to strengthen ties with developing countries in particular, we have recently entered into a partnership with the U.S. Agency for International Development whereby they will provide support to the non-U.S. participants in projects of mutual interest to both agencies.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Nina V. Fedoroff, Science and Technology Advisor to the Secretary of State, U.S. Department of State; Administrator of USAID

Questions submitted by Representative Russ Carnahan

Q1. By statute, you report through the Under Secretary of State for Democracy and Global Affairs rather than directly to the Secretary.

Q1a. Does this statutory reporting inhibit you in any way from providing advice and input directly to the bureaus and offices across the Department, including those in other reporting lines?

A1a. No. The current Science and Technology Adviser to the Secretary of State is also serving in the same capacity to the Administrator of USAID/Director for U.S. Foreign Assistance. This broadened responsibility provides an opportunity to further align the missions of USAID and the State Department. To implement this broader vision, the Adviser is currently working with Secretary Rice and Administrator Fore to transform the Adviser's office to further enhance the contribution of science and scientists, engineers and other technologists to the missions of both USAID and the State Department, as articulated in the Secretary's Transformational Diplomacy Initiative. The Adviser interacts directly with the Secretary and the Under Secretaries and the Administrator through briefings and in a multiplicity of other settings, reflecting the growing role of science and technology in our foreign policy and foreign assistance activities.

Q1b. What do you think of the suggestion from the Secretary's Advisory Committee on Transformational Democracy to either make the Science Advisor and the Assistant Secretary for OES the same person or alternatively, to make the Science Adviser a Principal Deputy Assistant Secretary so that there is only one line of reporting and one individual responsible for bringing senior attention to the full range of science and technology challenges and opportunities across the Department.

A1b. The Adviser acts as the principal interface between the larger scientific and technical community and USAID and one of the principal interlocutors among scientists, engineers and technical experts and the State Department. The current procedure for appointing the Adviser, which involves nominations generated by a committee at the highest levels within the National Academy of Sciences, followed by State Department interviews, including an interview with the Secretary of State, is extremely important to maintaining the credibility of the position both within the government and within the scientific and technical communities.

Combining the position of the Adviser with that of the Assistant Secretary (A/S) or the Principle Deputy Assistant Secretary (PDAS) would limit the ability of the Adviser to focus on her core functions. The A/S and PDAS have responsibility for a large range of administrative, environmental and ocean-related issues which need to be informed by science but which are not science functions, per se. STAS works closely with OES on many initiatives, and they play reinforcing and complementary roles to each other.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Jeff Miotke, Deputy Assistant Secretary for Science, Space, and Health, Bureau of Oceans, Environment, and Science, U.S. Department of State

Questions submitted by Chairman Brian Baird

Q1. If Congress or the public were to request a comprehensive list of international science and technology cooperation activities currently being funded by the Federal Government, where would we/they turn for this information? Given that international science and technology activities across the agencies are coordinated by your office, is this a list that your office or another in the Department of State does or could maintain?

A1. Currently, there is no comprehensive list of international science and technology (S&T) cooperation activities being funded by the Federal Government. As an indication of the breadth of USG international S&T activities, Congress or the public should turn to the State Department's Bureau of Oceans, Environment, and Sciences (OES) to obtain a comprehensive list of framework (or "umbrella") S&T agreements between the United States and other countries. This list is available on the State Department website: *http://www.state.gov/g/oes/rls/fs/2006/77212.htm*).

The OES Bureau can prepare lists of cooperative activities taking place in specific countries upon request. Two examples are for India and China. For India, at the request of the Office of Science and Technology Policy, the OES Bureau polled the technical agencies and prepared a spreadsheet listing all of their S&T cooperative activities with that country. For China, Congress has requested the State Department to prepare a biennial report, agency by agency, on all S&T collaborative activities, with a special emphasis on security issues. This report therefore also provides a complete listing of all Federal Government funded S&T activities in that country. Often considerable time is required to prepare such information because of the number of federal agencies that need to be contacted and the extent of their activities.

Q2. There exists no single point of contact in the U.S. Government with the authority, the budget, and the coordinating function to initiate new cooperative research activities, even with countries with whom we have already signed a formal agreement or with whom we regularly collaborate. What would your office do to improve the process by which new collaborations are established?

A2. All relevant USG technical agencies have a seat at the table when the Department of State convenes S&T coordination meetings with partner countries to review the status of S&T cooperation. The review proceeds under the auspices of existing or new "umbrella" S&T cooperation agreements. With our major partners, these "Joint Committee Meetings (JCM)" convene once every two years; with others, they occur less frequently. Interim meetings at lower levels can also be held to check on progress between JCMs. Our internal USG preparatory process before each of the JCMs allows us to understand what each USG agency hopes to gain from collaboration with our international partner and what resources that USG agency can devote to that collaboration. Agency priorities are, in turn, influenced by a number of factors, including the annual list of overall U.S. R&D priorities developed by the Office of Science and Technology Policy, congressional preferences and agency mandates. Given the manner in which U.S. S&T priorities are set and resource are allocated, the current system—while not perfect—works fairly well and provides for considerable flexibility to accommodate scientific progress and changing national priorities over time.

The technical agencies have also been responsive to some strategic U.S. foreign policy priorities; their support for our S&T partnerships with predominantly Muslim countries is a good example. The current system is perhaps least effective in our relationships with less developed countries which are in need of S&T capacity building and lack the other resources necessary to cooperate with U.S. science agencies and other institutions. Our answer to the next question describes a new effort to help bridge the gap with developing countries.

Q3. You stated in your testimony that the State Department could be doing more to interact with the private sector, academia, and other nongovernmental organizations. Can you elaborate on this statement? In particular, I would like to understand how both the State Department and the Federal Government generally could more effectively capitalize on the scientific expertise and innovative spirit in academia in pursuit of our common goals of science for diplomacy, development, and international decision-making?

A3. We are working to create new opportunities for the private sector (business, foundations, academia, and non-governmental organizations) to work with the State Department and USAID to carry out its core foreign policy and foreign assistance objectives.

OES has on-going dialogues with a number of countries, such as South Africa and Vietnam, regarding development of business accelerators and has raised the subject in meetings with the OECD and AFEC. Since the promotion of technological entrepreneurship is of great interest to many partner countries, discussions on accelerators are frequently associated with recently signed bilateral agreements on S&T cooperation. We have structured our bilateral talks to allow these partners to interact with State and local officials, as well as with private sector representatives, in an effort to help them build a variety of ties and public/private partnerships with many different S&T related organizations in the United States.

We have also benefited from the generosity of the private sector: e.g., Sun Microsystems, and many other companies, contributed significant resources and expertise in the development of the Iraq Virtual Science Library in cooperation with the Departments of State and Defense. The State Department's Education and Cultural Affairs Bureau (ECA) also draws on the expertise of the U.S. scientific community for its grant, mentoring and exchange programs, including the Fulbright S&T scholarships. For example, under its Labs-to-Market program, ECA will bring budding young researchers to high-tech centers in the United States, such as Silicon Valley. These researchers are given a crash course in everything needed, from intellectual property rights to venture capital, to translate research results into marketable products.

The National Academies have provided administrative support to recruit and interview tenured, university professors interested in serving in the Jefferson Fellows program. This program, established by the S&T Adviser with generous support from the MacArthur Foundation and Carnegie Corporation, enables distinguished scientists and engineers to work for one year at the Department of State or at USAID, and subsequently to serve as consultants after they return to their universities. STAS and OES are discussing ways to further tap into this growing network as well as the expertise of academia and the private sector to enhance the Department's scientific capacity, while addressing specific needs of our international partners.

A recent example of broadening the involvement of academia and the private sector in development and science diplomacy is provided by the Higher Education Summit for Global Development convened on the 29th and 30th of April, 2008, by Secretary of State Rice, Secretary of Education Spellings, and USAID Administrator Fore with strong support from the S&T Adviser and her office. The conference brought together university presidents from around the world, both developed and developing, together with representatives of companies, foundations and NGOs, to discuss new means and mechanisms of involving the colleges, universities and research institutes of the developed world in strengthening higher education, research and knowledge-based entrepreneurship in the less developed world.

During the conference, a historic agreement was signed between the National Science Foundation (NSF) and USAID that will allow researchers in the developed and developing worlds to receive funding from NSF for the American collaborator and funding from USAID for the foreign collaborator. The meeting was funded, in part, by a grant from the Lounsbery Foundation to Higher Education for Development (BED), an NGO that provides administrative support for USAID-funded university collaborations. The grant application was written and submitted by the Office of the Science Adviser to the Secretary of State (STAS) and funded the travel of a number of university presidents from less-developed countries. As a follow-up from the conference, STAS is working with a private sector CEO and several presidents of top U.S. universities to establish a Global University Network to support the kinds of novel capacity-building interactions between companies, foundations and universities discussed in the course of the conference.

The S&T Adviser is also currently working with the Secretary of State and the Administrator of USAID to transform the Adviser's office and promote the role of science and scientists, engineers and other technologists both in foreign policy and in the foreign assistance functions of the State Department and USAID. We seek to convene scientists, engineers, and other technical professionals from academia, government, and the private sector to better address the fundamental challenges of development today, ranging from addressing the current global food, water and energy crises to powering economic development through scientific and technical education and research and knowledge-based entrepreneurship.

Questions submitted by Representative Russ Carnahan

Q1. At present, many of the science counselors in U.S. embassies are junior officers with broad portfolios. (A) How could the Department of State both increase the number and elevate the role of qualified science attachés at key U.S. embassies to promote science, engineering, and technology in host countries? (B) How can you increase science and technology literacy in the Foreign Service more broadly?

A1. In response to question (A), the Department has many excellent officers that have served as Environment, Science, and Technology, and Health (ESTH) officers, with varying degrees of technical expertise. As their title indicates, these officers cover a wide variety of issues, from climate change to space cooperation and avian influenza. An ESTH officer, for instance, would commonly be asked to advocate for the U.S. position on any one of several multilateral environmental agreements.

When they face an S&T issue, our objective is not to have these individuals do the work of a scientist but rather to be able to manage the science policy issues at hand and, when necessary, to know how to access more specific expertise for a program or problem that might arise in the country in which they are stationed. Among their many tasks, an ESTH officer might engage his/her counterparts on possible large scale joint scientific facilities, such as the space station or ITER. He/she will facilitate the exchange of scientists and technical delegations. He/she will need to understand the views and influence of the local scientific community on issues of importance to the United States, such as agricultural biotechnology.

To address trans-boundary environmental issues, and to support officers at U.S. embassies working on the broad range of OES issues, the Department established 12 regional environmental Hubs, located in embassies around the world. The Hub concept is based on the idea that trans-boundary environmental problems can best be addressed through regional cooperation. The regional environmental officer's role complements the traditional bilateral ESTH officers stationed in U.S. embassies in many countries of the world. Rather than dealing with a single country, Hub officers engage with several countries of a region on a particular issue, with the aim of promoting regional environmental and scientific cooperation, sharing of data, and adoption of sound policies that will benefit all countries in that area. The Hubs work closely with other USG agencies and support their efforts by raising key issues at the diplomatic level. They also cooperate with non-governmental organizations on scientific and environmental activities within their region. In addition, there are ESTH officers working with the U.S. Mission to the UN and the U.S. Mission to the EU.

A very limited number of U.S. embassies in countries where major S&T partnerships exist are staffed by attaches from the Department of Energy, the National Science Foundation, the Department of Health and Human Services, and NASA.

One way to increase the number of science attaches is to expand the existing interagency Embassy Science Fellows program that is administered by the Department of State. This program places USG scientists overseas at U.S. embassies for one to three months. Proposals come in from U.S. embassies requesting Fellows. The proposals are developed in conjunction with host governments. Since the start of the program in 2001, the State Department has placed 210 scientists and science administrators in about 45 countries. In 2007, we had 55 requests, with some embassies submitting more than one, and filled 40 of them. We have a unique cost sharing program, in which the sending agencies provide salary, expenses, training, and airfare, while the hosting embassy covers local costs and housing.

Regrettably, not all of our technical agencies participate in the program due to the cost they must absorb for placing scientists overseas. Likewise, embassy and State Department resources are limited. As a result, support for the program is uneven due to the somewhat ad hoc nature of funding for the program. We would like to lengthen the time that Embassy Science Fellows remain at post, and significantly increase the number of Fellows serving at foreign posts.

The State Department's Public Diplomacy and Public Affairs sections support many activities related to S&T diplomacy, especially in its Education and Cultural Affairs bureau. Most effective have been visitors' programs and other exchanges, the Fulbright S&T scholarships, and more recently grant competitions for science and technology education and women's scientists mentoring programs.

In terms of elevating the role of our ESTH personnel abroad, first and foremost, we must insure a certain level of science literacy. If our officers are not sufficiently well-versed or do not know how to tap into the vast pool of scientific expertise in this country, they will not be able to understand, much less manage, the many complex ESTH issues that commonly arise. We describe our work to enhance science literacy below in some detail.

In addition to science literacy, we need to attract the best and brightest of the Foreign Service to bid on these positions both at home and abroad. Recently, the Department has given the Bureau of Oceans, Environment, and Science (OES) an equal role in selecting Foreign Service Officers (FSOs) for bilateral ESTH positions. We aggressively recruit to fill these positions but it can be difficult to convince an FSO that an ESTH position will be as career enhancing as others assignments, such as one in a regional bureau. Previously, the Department created a separate specialization for ESTH officers and provided a mechanism for officers serving in these positions to be given additional recognition in the promotion process.

In response to question (B), there have been numerous calls to improve science literacy in the State Department, such as in the 1999 National Research Council report entitled *"The Pervasive Role of Science, Technology, and Health in Foreign Policy: Imperatives for the Department of State."* One of the report's recommendations was to establish the office of the Science and Technology Adviser to the Secretary (STAS). Her office's functions include making recommendations on how to increase science and technology literacy in the Foreign Service more broadly.

A more recent report, that of the Secretary's Transformational Diplomacy Report and the 2025 Working Group, reiterates that the Department needs to increase science and technology literacy in the Foreign Service more broadly. The 2025 Working Group Report suggests that:

A) The Department should increase its recruitment of personnel with significant training, education, and/or experience in science, engineering, and technology fields with a goal of having a minimum of ten percent of U.S. diplomatic personnel with appropriate technical backgrounds by 2025.

B) The Department should develop means of increasing the level of scientific literacy and awareness among current FSOs and other officials of the Department and the U.S. Agency for International Development in matters relating to foreign policy. This training should be ongoing through their career, with opportunities to work in and interact with scientists and engineers in U.S. technical agencies, academia, and the private sector.

Consistent with these recommendations, the Foreign Service Institute (FSI) has a regular program of instruction for FSOs and for Foreign Service Nationals (FSN) who are working in ESTH positions. The Department also offers year-long mid-career programs of study at U.S. universities in S&T related fields. Literacy, however, is a constantly moving target, as new scientific issues emerge and as ESTH officers move on to other, unrelated assignments. OES and STAS are therefore working with FSI to strengthen the curricula and scientific expertise available to the new generation of FSOs and FSNs to expand science capacity within the Foreign Service.

In addition to enhancing FSO literacy, the Department also hires a number of trained scientists and engineers. The primary way scientists serve within the Department is through fellowship programs in Washington and as embassy science officers abroad. The American Association for the Advancement of Science (AAAS) Diplomacy Fellow Program provides one way for the U.S. Government to quickly increase its scientific expertise involving individuals with in-depth understanding of a scientific discipline and broad commitment to bringing that knowledge to the policy process. This program has suffered from declining resources and funding, particularly at USAID. Other fellowship programs, such as the Foster and Jefferson Fellowship Program, bring the specialized expertise of distinguished scientists to the Department for a year, following which they continue to serve as consultants to the Department for five years.

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