Joint research in medical and health care will receive modest support through the new U.S.-Czechoslovakia Science and Technology Agreement. However, access to information available in the United States and elsewhere remains severely limited due to budget stringencies that curtail subscriptions to basic medical journals and on-line medical data bases, and limit attendance at international symposia.

Czechoslovakia also looks to the U.S. for assistance in developing medical and health care organization, delivery and financing systems. USAID is funding Project HOPE activities that focus on nursing education and women's and neonatal care, as well as developing biomedical engineering programs.

Energy, Environment and Economics

Acquisition of reliable, environmentally benign sources of energy at both low cost and free market prices is an elusive and perhaps not entirely realizable goal for Czechoslovakia. However, as a country that has a very wasteful energy input-output production ratio and some of the world's most serious environmental pollution problems, and is dependent upon unstable neighbors for a large portion of its energy supplies, Czechoslovakia can reap substantial incremental benefits from the right mix of energy, environment and economic assistance and reforms.

There has been considerable U.S. government and private sector assistance in this area. For example:

- USAID provides technical assistance to the Czechoslovak government, including advisors in environmental policy.

- A 5-year, USAID-funded cooperative program between the Czechoslovak Academy of Sciences and Florida A&M University will use mayflies, an aquatic invertebrate thought to be very sensitive to environmental changes, to assess environmental pollution caused by the burning of soft coal. This research project is to be the first in a series of bilateral links with universities.

- In environmental management, a center for a clean air policy assistance program has been developed for local and regional governments, under a cooperative agreement with USAID.

- A $4 million USAID program with non-governmental organizations conducts sectoral analyses in agriculture, energy and industry.

Battelle Pacific Northwest Laboratory, supported by USAID through the Department of Energy, is working with Czechoslovak scientists, non-governmental organizations, industry and government representatives to promote energy efficiency, through the Center for Energy Efficiency in Prague. The program encompasses policy research and development, promotion of private joint ventures in energy-efficient technologies and services, training and demonstration projects, and public education and information services.

• USAID, the Department of Energy and the Environmental Protection Agency have established a joint regional energy efficiency project that continues and expands assistance provided under the current U.S. Emergency Energy Program. The four year, $34 million regional project seeks to improve energy efficiency, reduce energy-related environmental damage and develop the policy and institutional framework for energy investment and trade.

Emerging Technologies

Cooperation in critical technology areas is heavily dependent upon a country's possession of advanced technology, much of which Czechoslovakia lacks. Czechoslovakia nonetheless possesses some excellent scientific talent, especially at the basic research end of the spectrum, in selected areas of optics, materials science, life sciences, physics and chemistry which have broad technological applications. Trip reports from U.S. scientists suggest that some world class work is being conducted in a number of research institutes. Czechoslovak scientists are actively seeking contacts with Western colleagues, but they often lack funding, specialized laboratory equipment, and specific information about work taking place abroad and on procedures for applying for joint research grants.

The Czech and Slovak Academies of Science are cooperating to promote the development of industrial research in conjunction with selected domestic universities and investment agencies.

Agriculture and Natural Resources

The U.S. Department of Agriculture's Cochran Fellowship Program provides high quality training to Czechoslovak scientists on agricultural systems necessary to meet domestic food needs and strengthen trade links with U.S. agricultural interests. In FY-1991, 12 scientists (six each from the Czech lands and Slovakia) received training in agricultural credit and banking; agricultural production, marketing, service and supply industries; dairy breeding; sugar agribusiness; drug use in animal feed; and privatization of veterinary services. Additional such programs were slated for FY-1991. The Department of Agriculture also supports exchanges of scientists and agricultural research administrators.

USAID provides a grant to Volunteers in Overseas Cooperative Assistance (VOCA), a private, non-profit organization helping to promote development of private agribusiness and other support systems for private farmers in Czechoslovakia. USDA's Economic Research Service plans to work with Czechoslovak counterparts to develop an institutional capability to carry out the economic analyses necessary to support the emergence of a market economy. It is also providing a commodity outlook program and technical assistance and training in applied market economics, to assist government analysts and decision makers. Finally, the Economic Research Service is helping Czechoslovakia develop a domestic agricultural information collection, analysis and dissemination program.

EUROPEAN COMMUNITY

General

The EC affords its research, development, and environmental policies equal status with the other major areas of community policy in accordance with the Single European Act of 1987. The Act calls for a framework program laying down the objectives, priorities and overall budget for the community's R&D activities. It allows for international cooperation in support of these objectives. The Act stipulates that there be coordination between EC R&D policy, establishment of the European common internal market, and implementation of Community policies related to trade and competitiveness. The general approach used in deciding what S&T the EC should support is "subsidiarity," i.e., only those things which require intra-EC cooperation.

The EC made progress during FY-1991 toward full adoption of its framework program of "pre-competitive" research for the years 1990-1994 (funded at a level of $6.4 billion). The program includes the areas of information and communication technologies, industrial and materials technologies, environment, marine science, biotechnology, agricultural and agro-industrial research, biomedical and health research, nuclear fission safety, nuclear fusion research, non-nuclear energies, technology for developing countries, and development of human resources in the S&T area. The EC also advanced proposals for S&T cooperation with eastern Europe.

The U.S. and the EC continued during FY-1991 to broaden and strengthen their cooperative relationship in science and technology. Central to this effort was the first meeting, in February 1991, of the U.S./EC Joint Consultative Group on Science and Technology -- a consultative body to consider priorities and mechanisms for future S&T collaboration. Topics discussed included information technology, biotechnology, energy and environment, cooperative S&T opportunities with eastern Europe, and participation in international large-scale science initiatives.

Basic Science

With respect to large-scale science projects, the U.S. and EC co-sponsored a meeting in Brussels involving the President's Council of Advisors on S&T (PCAST) and senior European S&T officials to exchange views on international collaboration in "megaprojects." One current example of such collaboration is the International Thermonuclear Experimental Reactor (ITER) project. Representatives from the participating entities, the U.S., EC, Japan, and USSR, reached agreement during FY-1991 on location and plans for the project's next phase, engineering design.

Health and Life Sciences

In the biomedical and health area, the EC Commission seeks to maximize the effectiveness of member state investments in health research and to stimulate Europe's diverse laboratories to provide a research base for emerging bio-industries. EC projects emphasize work on (a) illnesses and conditions with particular social impact -- AIDS, cancer therapeutic techniques, cardiovascular disease, nutrition and development, neurological diseases and mental health;

(b) harmonization of clinical protocols, analytical methods, and use of biomedical materials; and (c) human genome analysis. The Commission also attaches high priority to addressing the health and environment needs of developing countries.

During FY-1991, U.S. and EC experts met routinely to exchange views on biomedical and health issues. Also in 1991, a third in a series of meetings was held between the U.S. Food and Drug Administration (FDA) and the Commission to discuss S&T concerns in the areas of food, human and veterinary medicines, human biologics, and convening of a special session on medical devices.

Energy, Environment, and Economics

A major goal of the Commission is to harmonize environmental standards within the Community, with particular emphasis on fulfilling the EC's commitment to stabilization of CO_2 emissions. The EC is represented in international environmental fora, working towards common positions on such issues as global climate change and ozone layer protection. Two main issues for Europe in the energy area are dependence on energy imports, and the damage to the environment often associated with energy production, transportation and consumption.

Most of ten major U.S.-EC S&T cooperation agreements or exchanges of letters are in the areas of nuclear affairs, environment, and energy resources, including: peaceful uses of atomic energy; radioactive waste management and nuclear safety; nuclear reactor safeguards; renewable energy sources; health and environmental effects of radiation; environmental matters; mineral technology; and controlled thermonuclear fusion. As of the end of FY-1991, proposals for expansion or renewal of U.S.-EC agreements were in abeyance as the two sides had not yet achieved agreed language regarding allocation of intellectual property rights.

In FY-1991, U.S.-EC environmental bilaterals resulted in agreement to continue periodic technical consultations on hazardous chemicals and on motor vehicle emissions. The U.S. Environmental Protection Agency (EPA) and EC representatives worked on a statistical study of greenhouse gas emissions to establish a common statistical base to aid research in this area.

U.S./EC annual energy consultations during FY-1991 included energy policy issues such as the balancing of environmental and energy policy objectives and global climate change. Officials from the U.S. Department of Energy (DOE) also continued work with their EC counterparts on a study of the socioeconomic costs of producing electricity from a variety of fuel sources.

Emerging Technologies

The Community's 1990-1994 R&D program addresses many research fields associated with emerging technologies, including information and communications technology, new materials, improved materials production processes, chemicals, aeronautics, biotechnology, and bioecology.

The issue of advanced technologies was a topic of considerable discussion at the FY-1991 session of the U.S./EC High Technology Working Group, which meets annually to review emerging high tech priorities and issues, including specific trade-related concerns as well as opportunities for collaborative R&D activities.

Also in FY-1991, the U.S.-EC Task Force on Biotechnology Research convened its second meeting to review respective activities. Included in these discussions was the issue of promoting public acceptance of biotechnology. A meeting on biotechnology and the environment was also convened in connection with U.S./EC environmental consultations. Biotechnology was a topic on the 1991 agenda of the U.S./EC High Technology Working Group.

Agriculture and Natural Resources

The Commission seeks to strengthen research and industrial applications in agriculture and fisheries, oriented toward ensuring benefits particularly for small and medium firms, harmonizing European guidelines in this sector, and benefiting the environment. Research areas include: a) primary production in agriculture, forestry, and aquaculture; b) agricultural and forestry "additives" -- environmentally sound practices, pest control, management of genetically-modified organisms; c) treatment of primary biological materials -- new processes of separation, extraction, use of byproducts and waste management; and d) product utilization -- quality and toxicological control, handling of biodegradable substances. During FY-1991, U.S. and EC officials explored the possibility of strengthening cooperative activities in these areas, consistent with similar U.S. bilateral efforts with EC member states.

FRANCE

General

The French government continues to give high priority to research and development (R&D) despite growing budgetary pressures. Government civil R&D expenditures in 1992 are slated to increase by 7% over 1991, to 51.1 billion francs ($9.1 billion). Total national spending on R&D will rise to about 2.44% of GDP, a percentage exceeded only by the United States, Germany and Japan. The French government's share has remained stable at approximately 1.24%. Industry's contribution has increased steadily in recent years, and, if current trends continue, will match the government's share by 1993. Of government-funded R&D, about one-third is defense-related.

Publicly-stated priorities for French R&D are: sustained R&D growth with the objective of reaching an expenditure level of 3% of GDP, basic research, industrial and technological research, and addressing the European dimension of R&D, e.g., through European cooperative programs.

French interest in U.S. science and technology remains high. Exchanges between American and French researchers are active, although there is some concern in France about the small number of U.S. researchers and students coming to France for long-term stays. French science policy makers make it clear that they do not want to see traditional French scientific ties with the U.S. weakened by the impetus that EC economic union and European science programs are giving to intra-European cooperation.

U.S.-France relations in the area of science and technology are generally healthy. The French government shares U.S. concerns over the proliferation of nuclear weapon and missile technology, as demonstrated by its decision announced in June 1991 to adhere to the nuclear nonproliferation treaty and by its active role in the missile technology control regime.

France is a major participant, through the European Space Agency, in Space Station Freedom and is also a leading proponent of an independent European manned space program. France and the U.S. have differed in multilateral negotiations over the need for targets and timetables to limit emissions of carbon dioxide and other greenhouse gases. Under provisions of U.S. environmental legislation, France has been identified as a high-seas driftnetting nation and as a possible intermediary nation for embargoed tuna, which may lead to restrictions on French fish exports to the United States. Differences on intellectual property rights have held up the renewal of two bilateral science and technology cooperation agreements, and French officials have called publicly for the revision of a 1987 Franco-American accord allocating patent rights for the AIDS virus blood test.

Basic Science

French basic research in such disciplines as particle and solid-state physics, molecular biology, geophysics and mathematics is internationally respected. French officials recognize that some institutional problems remain. Traditionally, a high percentage of basic research has been carried out by civil servants working for national government research institutions. At the largest one, the National Center for Scientific Research (CNRS), almost 80% of the budget is for salaries, leaving little for laboratories, equipment and materials. A modernization program has been underway at CNRS for over a year but its impact has thus far been limited.

The rising cost of large-scale basic research facilities has been a matter of concern. French officials look increasingly to international cooperation and cost-sharing, particularly at the European level, as a possible solution. While the French government has shown little interest in participating significantly in the Superconducting Super Collider (SSC), it has favored strengthening research capabilities at the European Particle Physics Research Center (CERN), located on the French-Swiss border near Geneva. The European Synchrotron Radiation Facility (ESRF), under construction in Grenoble, is scheduled for completion in 1993.

French investment in science (and R&D) is driven increasingly by concerns about French commercial competitiveness, and the "competitiveness" of French defense technology, which was perceived as wanting during the Persian Gulf War. These priorities enjoy broad-based public support. France continues to give priority to its "grandes programmes" in space, aeronautics, nuclear energy, and telecommunications. More recently, there has been increased emphasis on computer and information technologies, micro-electronics and biotechnology.

Health and Life Sciences

Life sciences research in France is conducted principally by two public research organizations, CNRS and the National Institute of Health and Medical Research (INSERM), and by two government-supported private foundations, the Pasteur and Curie Institutes. In addition, private firms are heavily involved in the development of pharmaceuticals. French researchers played pioneering roles in genome sequencing and AIDS research, and developed a contraceptive pill (RU-486) that is already widely used in France and is under consideration in several other countries.

New information regarding the circumstances surrounding the discovery of the AIDS virus has prompted French officials to call for the revision of a 1987 agreement dividing royalties from the AIDS blood test between U.S. and French research teams. There has also been some controversy about U.S. connections with French AIDS vaccine tests on human subjects.

Energy, Environment and Economics

The French government has in recent years placed increased emphasis on environmental policy. In international fora, France has pushed for a ban on mineral resource activities in Antarctica, called for targets and timetables to limit emissions of carbon dioxide and other greenhouse gases, advocated a carbon tax to reduce EC carbon dioxide emissions, and, in the context of the U.N. Conference on Environment and Development (UNCED), called for new and additional assistance for sustainable development in the Third World.

France has invested heavily in nuclear power, which now generates about three-fourths of the country's electricity. The French government, which presides over the world's second largest civilian nuclear program (after the U.S.), is aggressively pursuing opportunities to market French nuclear technology abroad, and has offered assistance to improve nuclear power plant safety in Central and Eastern Europe. France has announced its intention to become a party to the nuclear non-proliferation treaty, and to apply full-scope safeguards to transfers of nuclear technologies.

Emerging Technologies

Notwithstanding such technological successes as the Ariane launcher, the TGV high-speed train, the Airbus commercial aircraft, and the MINITEL Videotex system, the French government remains concerned about the country's industrial competitiveness. It has adopted tax incentives and other programs to encourage industrial research and transfer of technology from government laboratories to industry.

A special organization, the National Agency for the Promotion of Research (ANVAR), was created in 1982 to promote industrial innovation and technological development among small and medium enterprises. Since its founding, ANVAR has invested approximately 11 billion francs ($2 billion) in 15,000 French firms. The French are also looking increasingly to strategic acquisitions or alliances, particularly of or with European and U.S. firms, to strengthen their position in high-technology industries.

Agriculture and Natural Resources

In France, the world's number two exporter of agricultural products, government policies have favored the agricultural sector and agricultural R&D. The National Institute for Agronomic Research (INRA), with an annual budget of about 2.9 billion francs ($519 million), is the principal national organization for agricultural research. Its mission is to carry out research on agricultural productivity, food storage and processing, biotechnology, energy and chemicals from agriculture, and natural resource management. Other government agencies involved in the agriculture and resource sectors are the National Center for Agricultural Machinery, Rural Engineering, Rivers, and Forests (CEMAGREF), with an annual budget of about 184 million ($33 million); the Center for International Cooperation in Agriculture and Development (CIRAD) (619 million francs/$111 million); and the Institute for Scientific Research for Cooperative Development (ORSTOM) (952 million francs/$170 million).

GERMANY

General

The severe pressures on the German federal budget due to the costs of reunification slowed the growth of federal funding for civil research 1991. The focal points for Germany's S&T planning are restructuring and rebuilding of science and technology in the five new states in eastern Germany; strengthening the competitiveness of small and medium-sized companies; and building German competence in new research fields. Almost 18% of the federal research budget, the largest single slice, is allocated to space science and technology, followed by information technology, environment and climate research, nuclear energy research, and health sciences. Of these, the only areas where substantial growth in funding support is planned for 1992 are space science and technology (about 4.6%) and environment (6.8%).

On October 3, 1990, German reunification started the process of amalgamating the science community of the former German Democratic Republic (GDR) with that of the Federal Republic of Germany (FRG). Since funds for equipping these facilities in the east with new instrumentation and for supporting the new research teams being formed must come primarily from the federal research budget, federal budgetary support has had to be curtailed for much of the research performed at established scientific centers in western Germany.

The task of restructuring science and technology in the five eastern German states has placed a heavy burden on the German science budget in the short run. However, new research programs that are being established will strengthen German scientific endeavors over the longer term. Areas of strength for the emerging research institutes in eastern Germany include bio-medicine, optics, high energy physics, and the geosciences. The research facilities and a portion of the manpower of the former GDR science establishment are being integrated as part of the institutions (e.g., the Max Planck Society and Frauenhofer Society institutes) of the FRG, and scientific research is being linked more closely to the universities in eastern Germany.

Basic Science

Despite the pull of EC-centered programs, the German research community continues to regard the United States as its most important scientific partner. The success of U.S./German science cooperation is due in large part to the growing number of researchers who participate in international exchanges. Over 5,600 scholars from both countries now take part in exchange programs each year, and the number of university-to-university exchange programs now exceeds 200.

With German science regaining the preeminence it achieved prior to World War II, scientific exchanges are anticipated to expand. For American scientists visiting Germany, the primary interest has been physics/astrophysics/astronomy, followed by biosciences, and then by chemistry/pharmacy/food sciences. German scientists visiting the U.S. have been primarily interested in the biosciences and in medicine and veterinary medicine, followed by physics/astrophysics/astronomy and then by

mathematics/statistics/computer sciences. The German research foundation (DFG) has initiated new programs to support short-term visits from eastern Germany, thus helping to provide opportunities for establishing research collaboration with this emerging science community.

In contrast to the flourishing of contacts between individual researchers, proposals for increased cooperation between U.S. and German technical agencies have been held in abeyance in many fields as efforts continue to find a formula for protecting intellectual property rights that is acceptable to both governments. Areas in which proposals for new agreements as well as renewal of existing ones have been put on hold include non-nuclear energy technology, the geosciences, health sciences and nuclear safety. However, cooperation in space and environment programs has continued to grow.

Space research and technology is a particularly important area of science cooperation between the United States and Germany. Germany plans to supply the propulsion module subsystem and scientific instrumentation for the Comet Rendezvous and Flyby (CRAF) mission currently scheduled for launch by the mid-1990's. Germany also contributed one of the four high energy telescopes for the U.S. Gamma Ray Observatory, which was launched in April, 1991. In Spring 1993, a shuttle launch will be dedicated to carrying aloft a German spacelab, D-2. Working through the European Space Agency (ESA), Germany is a major participant in Columbus, the European contribution to Space Station Freedom.

Although Germany has not decided to contribute to the Superconducting Super Collider (SSC), the German high energy physics community has expressed strong interest in collaboration on the next generation of major projects, including detectors, accelerator technology, and superconducting cavities. U.S. researchers are participating in the Hadron Electron Ring Accelerator (HERA) project, which should be commissioned in early 1992 and is part of the German electron synchrotron facility in Hamburg (DESY).

The German continental drilling program in Windischeschenbach in northeast Bavaria has attracted widespread international interest. NSF has funded two projects related to this program, and ten more have been proposed. Pending a resolution of the intellectual property rights issue, DOE has been participating on an informal basis in the program. A ten-kilometer-deep bore hole is being drilled to examine the suture between two continental plates. Drilling has already reached a depth of 4,500 meters and is expected to be completed in 1994.

Health and Life Sciences

Bio-medicine was one of the relatively few areas in which the former GDR research institutes clearly excelled. German research capabilities will be considerably strengthened as the eastern and western German research programs are linked. The German gene-engineering program amounts to only one-tenth of the U.S.'s in terms of funding and manpower, but produces output of high quality in certain areas.

Energy, Environment and Economics

Reflecting the widespread public support for an activist approach, Germany has taken a number of major technology-forcing initiatives to address environmental concerns. Prior to reunification, the cabinet set a goal of reducing CO_2 emissions by 25% by the year 2005, a goal which the parliament increased to 30% following unification. The technological paths for complying with these regulations or meeting these goals have in most cases not been fully defined. German industry has been encouraged to develop and implement its own solutions in ways which minimize the economic impact.

For its part, German industry has pressed the government to campaign for similar initiatives on a global, or at least a European, basis so that it will not be at a competitive disadvantage. An energy strategy is being prepared which will set forth the principal steps required to meet Germany's CO_2 emissions target. An EC-wide energy tax is expected to be an important element of this strategy. It is not yet clear whether additional reliance upon nuclear power will also be a key element, since strong public concern over nuclear safety would first have to be successfully addressed. There is substantial U.S.-German interaction in areas such as fusion, through the International Thermonuclear Experimental Reactor; fission, on various advanced reactors programs; and renewable technologies, through the International Energy Agency.

Emerging Technologies

German research funding is oriented increasingly towards information technologies, manufacturing processes and technologies, biotechnology, physics technologies, lasers, materials research, and the environmental sciences. Special government programs encourage research in new fields such as biosensors, neurobiology, brain research, and nano technologies, together with the transfer of these technologies to the private sector.

Biotechnology research programs have been productive. Research discoveries at genetic research centers in Heidelberg, Cologne and Munich have been the basis of a growing number of pharmaceuticals based on recombinant DNA. These German laboratories have attracted a rising number of foreign visitors, including U.S. post-doctoral researchers. At the same time, German researchers have been constrained by legislation restricting genetic screening and by narrow interpretation of other laws governing biotechnology. This restrictive regulatory environment reflects long standing and deeply held public concerns about genetic research. These restrictions have led German industry to move much of its biotechnology activity abroad, including to the United States.

Agriculture and Natural Resources

The federal Agriculture Ministry's research budget increased by over 50% between 1990 and 1991, reflecting in part the requirements for funding research programs in the five new states in eastern Germany. Strong German research programs in animal health and animal nutrition have provided opportunities for fruitful bilateral collaboration. U.S. and German scientists have also cooperated on programs keyed to the third world, such as grasshopper eradication in the Sahel.

HUNGARY

General

During FY-1991, its first full year of implementation, the U.S.-Hungarian Science and Technology Joint Fund granted a total of U.S. $1.0 million and the equivalent in Hungarian currency to 49 projects. Approval of funding was in accordance with priorities stipulated in the Joint Fund Agreement of October 1989: basic science 20%, environmental protection 20%, agriculture 14%, medical sciences and health 14%, engineering research 14%, energy and natural resources 14%, others 4%.

Fundamental reform continued in Hungary's scientific community, particularly at the Academy of Science (MTA) and its 39 constituent institutes. Designed to free scientific research from traditional bureaucratic constraints, a new draft Academy Act which would establish self-governing status for the MTA was submitted to Hungary's Parliament and was due to be considered in early 1992. In addition, institute directors are now elected directly by the institute boards and only confirmed by the MTA secretary general. Previously, institute directors had been appointed by the Secretary General.

Many organizational and policy changes have taken place at the National Technical Development Committee (OMFB), the coordinating body for Hungary's S&T programs. In February 1991, the Hungarian government decreed that OMFB's Office of International Relations will manage all S&T agreements with industrialized countries. A new open grant system was created concurrently, funded initially at 6 billion Hungarian forints (1 U.S. dollar equals about 70 forints) and open to both Hungarian and foreign researchers and corporations resident in Hungary. Under the new system, peer review and grant decisions are conducted outside OMFB to preserve integrity and independence.

Hungary's scientific ties with European Community programs continued to multiply. A joint S&T subcommittee with the EC was set up in December 1990 to study how Hungary could be more effectively integrated into European scientific programs. In April 1991, Hungary signed a cooperative S&T agreement with the European space agency. There were discussions on possible membership for Hungary by mid-1992 in CERN, the European nuclear research agency. The Hungarian Academy of Science has been a member of the European Science Foundation since late 1990.

Basic Science

MTA and the institutes continued to face increasingly stringent budgetary constraints. Efforts continued to cut expenses, for example, through workforce attrition. MTA granted more financial leeway to the institutes, and, most noteworthy, permission for the institutes to earn income on their own.

To address the budget problem, and specifically to assure foreign collaborators that adequate Academy resources would be available, the MTA Presidium examined new schemes to strengthen the Academy's financial position and to institute

forward budgeting procedures. MTA has received government funding in monthly installments. As of late FY-1991, a proposal was under active consideration that MTA receive its entire annual budget appropriation in one lump sum, allowing the academy to utilize these funds as it sees fit.

Cooperative MTA agreements currently exist with over 35 countries. In 1990 and 1991, new agreements were signed with counterpart academies or agencies in Belgium, France, Israel, Norway, Estonia, Taiwan, Sweden, Finland, and UNESCO. The volume of exchanges dropped 25% in the last year, principally with the Soviet Union (down from 450 in 1990 to 100 in 1991). The number of exchanges with western countries remained constant.

The U.S. National Science Foundation (NSF) and the Hungarian Academy of Science organized a two-stage workshop on science policy in Washington April 29 - May 2, 1991 and in Tihany, Hungary September 29 - October 3, 1991. The workshop examined each country's national research system, the bilateral relationship and how it could be strengthened, and Hungary's formulation of a new science policy. Of special value to the Hungarians was information on the U.S. peer review and competitive grant systems. In addition to the NSF-MTA workshop, three representatives of the Hungarian scientific establishment received USAID fellowships for a one month program to study the U.S. peer review system.

In an attempt better to coordinate scientific research and post-graduate training, help young university researchers keep pace with developments in their fields, and make institute expertise available to universities, MTA established "the Athenaeum Project." This comprises a commission of representatives from the Academy and Hungarian universities, which has been tasked to elaborate a common national system of post-graduate scientific curricula designed to preserve high standards for degrees in science.

Hungary remained highly concerned over a perceived brain drain of top scientists, especially to the U.S. In the last year the requirement was dropped that Hungarian scientists obtain permission of Academy or other supervisory authorities in order to travel, and many are expected to seek out the best research opportunities available outside of Hungary. On the positive side, most scientists already outside of Hungary maintain contacts with their former Hungarian institutions.

Health and Life Sciences

Concept legislation for a complete overhaul of Hungary's health care and social insurance system pointed to adoption of a western European health and social insurance model in due course. While the level of collaboration between the National Institutes of Health (NIH) and Hungarian medical institutions remained essentially unchanged during the past year, additional U.S.-sponsored health related programs for Hungary were channelled through USAID. Two projects under the Partnerships in Health Care program for central and eastern Europe were approved. An influenza vaccine program begun in 1990, sponsored by USAID and managed through Project HOPE, continued. Project HOPE commenced programs in post-secondary education for nurses and postgraduate health management training at medical schools.

Energy, Environment and Economics

Hungary continued to grapple with crafting a full range of economic and environmental laws to replace the existing discredited legal structure. With the assistance of outside experts, the Ministry of Environment and Regional Planning continued drafting a completely revamped environmental code which incorporates OECD-type policies, standards and penalties. However, the difficulties confronted by the GOH in its efforts to implement, within the existing regulatory vacuum, laws on privatization, banking, investment, and other essential financial and economic issues distracted parliamentary attention from proposed environmental legislation. Serious consideration of an environmental code by Parliament was not expected to take place before early 1992.

In July 1991, EPA and USAID reached agreement with Hungary on specific areas for bilateral environmental cooperation. Primary focal points of the agreement were: 1) policy, strategic planning and management; 2) education and public awareness; 3) legal and regulatory frameworks; 4) pollution remedying and mitigation; 5) international cooperation; and 6) natural resources management. The first step in the EPA/AID assistance program was long-term assignment of a senior institutional analyst to assist with local government programs.

Most domestic fuel and energy price subsidies were eliminated by July 1991. In order to cushion the impact of these price increases on lower income energy consumers, and as a condition for a USAID energy sector grant, the GOH was to budget resources to assist these groups. The USAID program seeks to support the institution of a system to monitor and regulate energy consumption and to help the GOH continue policy reform. In addition, USAID, in cooperation with the Department of Energy and the Environmental Protection Agency, agreed on an energy assistance package for Hungary to improve energy efficiency, reduce energy-related environmental damage, and develop a policy and institutional framework for energy investment and trade.

The extent of serious environmental damage at former Soviet bases became clear only after the final withdrawal of Soviet troops in June 1991. Much direct contamination occurred shortly before the troops' departure. Action to reverse spreading groundwater pollution from the bases became a top priority but resource constraints will likely make the cleanup agonizingly slow.

A longstanding heated controversy remained between Hungary and the Slovak Republic over completion of the allegedly environmentally unsound Gabcikovo-Nagymaros hydroelectric project on the Danube river. With widespread public support, the GOH has decided to dismantle the Nagymaros portion of the project, which is wholly located on Hungarian soil, and restore the Danube bend to its original state. Dismantling work could begin in 1992. Stated Slovak intentions to complete the Gabcikovo portion unilaterally led to confrontations with environmentalists and a serious row with the Hungarian government.

Regional Environmental Center for Central and Eastern Europe

During his July 1989 visit to Hungary, President Bush announced a U.S. Government initiative to establish in Budapest a Regional Environmental Center (REC) for central and eastern Europe. By the end of its first year of operation in September 1991, the Regional Environmental Center had already approved over 100 grants totalling approximately 1.3 million ECU's for distribution to central and eastern European environmental non-governmental organizations (NGO's); established an environmental clearinghouse network and database for environmental information; co-sponsored numerous workshops and conferences in the region; and created a system to facilitate business collaboration and assistance. The USG's three-year, $5 million contribution to support the REC leveraged donations from the EC and its member countries, and from Canada and Japan. In-kind contributions from regional governments and the private sector were also forthcoming.

During its first year, most of the Center's programs and grants were oriented toward Hungary, but during FY-1991 the Center expanded its outreach to member countries. As of the end of FY-1991, four focus centers were to be set up soon in Warsaw, Bratislava, Bucharest and Sofia. They are to be linked to Budapest through a "RECNET" computer network, whose establishment was to benefit from considerable "pro bono" work by a U.S. firm. The Center hopes that the focus centers will help to decentralize REC activities, enhance the dispersal of information and help overcome the severe communications, financial and transportation infrastructure handicaps which afflict central and eastern Europe.

Emerging Technologies

In April 1991, the GOH created an Office for International Technology Cooperation (NTEI) to support the spread of advanced technologies for commercial purposes. To encourage foreign capital investment in Hungary, NTEI locates and promotes indigenous technologies, usually those being developed at institutes of the Hungarian Academy of Science, which have commercial potential but require additional development and capital. An NTEI seminar on the commercialization of technology, co-sponsored by the U.S. Department of Commerce, was held in Budapest in September of 1991.

Hungary possesses significant commercial and collaborative potential in the areas of biotechnology, software development, chemistry and agro-technologies. Those areas which Hungarians believe could greatly benefit from more collaboration with U.S. industry include applied fields such as energy, environmental protection, and space research.

INDIA

General

India has a long tradition of scholarship. It has a very large science establishment with several elite research and teaching institutions. Most research is carried out at institutions of the central government (Council of Scientific and Industrial Research, Atomic Energy Commission, Department of Space) or at universities that are centrally funded. India is also among the world's largest industrial nations, but there is an almost complete dichotomy between industry and trade on one side and the scientific establishment on the other. This largely frustrates the expectation that science and technology will enable India to feed, house and employ its masses of people. Only the chemical industry collaborates closely with academic research, and the rate of innovation in the rest of Indian industry is low. Indian scientists rarely work on problems with direct industrial or commercial applications. S&T collaborations between the United States and India are therefore generally limited to fundamental scientific research.

Indo-U.S. collaborations began in the early 1960s, first in agriculture, then in education, life sciences and medical services, and finally in a broad range of scientific areas. As these collaborations expanded, both governments began to realize their political value. Several U.S. Presidents and Indian Prime Ministers have pointed to this connection and, beginning in 1973, bilateral agreements between the two countries formalized S&T collaboration. A further agreement in 1987 provided a dedicated source of funding, the United States India Fund (USIF).

Indo-U.S. collaborations have generated significant and tangible scientific results in support of basic science. They have also developed capabilities and institutions that will endure after specific collaborations have ceased. Examples are the Wildlife Institute of India, which grew out of a collaboration between the U.S. Fish and Wildlife Service and USAID with the Ministry for Environment and Forests; and the Rehabilitation Program for Persons with Handicaps, developed jointly by the National Institute of Disability Research and Rehabilitation (NIDRR) of the U.S. Department of Education and the Indian Ministry of Welfare. Indo-U.S. collaborations have also led to numerous useful personal contacts, promoted access to high level government officials and opinion leaders, and created a reservoir of goodwill that furthers our political objectives.

Basic Science

Indian scientists carry out research in nearly all areas of science that are of current interest in the U.S. or Europe. The Indian government strongly supports this research, much of which is of excellent quality. Several laboratories are working on high temperature superconductivity, a topic where Indian scientists have made strong, fundamental contributions. Physics and chemistry of metal oxides is a traditional research subject in India, which has large deposits of rare earths, a main ingredient in high temperature superconductors. Cold fusion experiments

were paralleled in India only weeks after the first publications in the U.S. and are still continuing. Formal Indo-U.S. collaborations cover all of the subjects that tantalize today's physical scientists: high energy physics, including work on the Superconducting Super Collider (SSC); lasers; particle accelerators and storage rings; supernova physics; relativistic electron beam-plasma interactions; and computer modeling and simulations -- for example, studying large-scale weather phenomena over the Indian ocean.

There are over one hundred collaborative physical science projects either active or in various stages of implementation. Among the participating U.S. federal agencies are the National Science Foundation, representing a large number of universities; the National Institute of Standards and Technology; the Office of Naval Research; several bureaus of the Department of the Interior; and the Department of Energy. These and other U.S. agencies use the collaborations to support their domestic mission objectives by taking advantage of unique facilities or environments in India, and of special capabilities of Indian institutions. U.S. universities enrich their teaching programs by enabling students to work in India on topics related to their field of study.

Accomplishments of these collaborative projects have been impressive. Many scientific papers have been published in reference journals, many new scientific concepts and methods have been developed and a large number of Masters and Ph.D. theses have been completed. In 1990, the Indian Department of Science and Technology performed an internal audit of the accomplishments of the program, the positive findings of which surprised and pleased even the most faithful supporters of the collaborations.

Collaboration in certain areas has been limited because of U.S. concern for Indian lack of patent protection.

Health and Life Sciences

The laboratories of the Indian Council of Medical Research (ICMR), the All India Institute of Medical Science (AIIMS) and several other central government institutions carry out a wide ranging research program aimed at fighting India's many endemic diseases and improving medical services to the public. The U.S. Public Health Service (PHS) participates with Indian scientists in research on many tropical diseases which are endemic in India and afflict American travelers, or occur in the United States but often in numbers too small to carry out research on therapy or vaccine development.

During FY-1991, the broad Vaccine Action Program (VAP), which is jointly funded by USAID and PHS, continued to emphasize developing and utilizing vaccines to prevent important diseases such as polio, typhoid, cholera and other enteric (digestive tract) diseases, rabies, hepatitis and respiratory diseases. Some of these diseases occur only rarely in the U.S. For example, during 1982-86 there were an average 369 typhoid cases in the U.S. per year, four cases of cholera in

1987 and none reported of human rabies or polio. Research must be carried out where appropriate studies are possible due to prevalence of the disease in question, and where sufficient infrastructure and stability exist to allow studies to be successfully completed. India provides the most appropriate study environment for many diseases.

A wide range of collaborative projects continued to deal with the development of treatment methodologies and health care delivery systems, rehabilitation and training of persons with a variety of handicaps, control of iron deficiency anemia in rural India, health manpower training, prevention of blindness in children caused by dehydration and vitamin A deficiency, and early intervention services for children with delayed development. Many projects deal with the collection of data, for example, on oral cancers, assessing the incidence rates of diseases, and other health statistics. Neurological and mental disorders are also studied and treated.

Energy, Environment, and Economics

India's per capita electric power generation is about 300 kwh per year vs. 12,000 kwh per year in the United States. Over 40% of the country's energy needs are supplied by non-commercial sources: fuel wood, dried cow dung, and agricultural waste. The depletion of forest resources is dramatic. Air pollution in the major cities is among the worst in the world. But India can only devote a small share of its limited resources to dealing with the issues of environment and climate change, which are perceived as remote. Nonetheless, the seriousness with which Indians at both public and private levels have seized upon these issues is impressive.

India's climate change program focuses on those areas where climate change may affect large sectors of the population, especially sea level rise and impacts on agriculture. The Council of Scientific and Industrial Research (CSIR) has set up a task force made up of several of its laboratories to investigate, among others, the following areas: greenhouse gases and global warming, sea level monitoring, air-sea interactions, earth system history, and mathematical modeling for possible global climate change. The GOI also has a small but growing program to investigate non-conventional sources of energy production, including wind, solar and biogas.

Since the early 1970's, the GOI has enacted a variety of laws to protect forests and wildlife, control water and air pollution and to regulate, from an environmental standpoint, factories, mines, and the use of insecticides, toxic chemicals and atomic energy. Most importantly, the Environment (Protection) Act of 1986 was designed to fill gaps left by earlier legislation and provide a comprehensive focus for environmental protection throughout the country.

Emerging Technologies

The commercialization of technology is hampered in India by many of the same problems encountered in the United States and, in addition, by cultural and societal problems unique to India. The rate of innovation, i.e., the embodiment

of new technology in products or processes, is very low. According to a high Indian government official, only 4-5% of products manufactured in India were developed there. Most "innovation" in India consists of technologies long known abroad but replicated by Indians for import substitution and indigenous production. The slow rate of commercialization is in part caused by market conditions and the business climate in India, a lack of "technology pull" (i.e., interest in newer technologies), and in part, by lack of a functioning system to move discoveries from the laboratory into the market place. A few of the CSIR laboratories work closely with industry and have collaborated successfully with Indian companies in developing new technologies.

Materials

During FY-1991 a very lively program of U.S.-India collaboration in the materials sciences was continued. A collaborative study between the Naval Research Laboratory (NRL) and the Indian Institute of Science (IISC) has resulted in the synthesis of a new quasi-crystal phase. An NRL/Bhaba Atomic Research Center (BARC) investigation of corrosion cracking has led to the development of a new pulse laser deposition technique for the coating of surfaces with corrosion resistant alloy films. An NRL study in collaboration with India's naval chemical and metallurgical laboratory is examining the accelerated corrosion of marine alloys. It was found that a specific aerobic bacteria reduces the corrosion rate. An NRL/Indian Institute of Technology (IIT) study of tribological coatings has led to the characterization of several friction-reducing carbide and nitrite films. An NRL/National Metallurgical Lab (NML) project is on the development of advanced high strength ferrous alloys, and an extension of this project deals specifically with the basic understanding of the physics of very low carbon steel alloys.

The U.S. Office of Naval Research (ONR), in collaboration with India's defense R&D laboratories and various other Indian institutions, has sponsored workshops on various aspects of materials science. The subjects have included spectral analysis, microstructural characterization of materials, solidification principles, materials processing, properties of interfaces, advanced ceramics and metastable microstructures. The interaction resulting from the many NRL projects and the various ONR-sponsored workshops has generated a significant and mutually beneficial flow of information between U.S. scientists and scientists from India's defense research and development institutions.

Manufacturing Processes and Technologies

Because of insufficient protection of intellectual property rights afforded by Indian patent law, U.S. engineers and scientists have long avoided collaborative work in India that could lead to new products or processes. Also, there are few Indian institutions that carry out first class research in frontier areas of manufacturing processes and technologies. Therefore, no collaborative work on manufacturing technologies was carried out during FY-1991.

Information and Communications Technologies

Research and development in India in this area is still catching up with developments in the West. The opportunities for collaborations during FY-1991 were therefore limited. Also, the insufficient protection of intellectual property rights afforded by Indian patent law continued to dissuade U.S. scientists and engineers from collaborating with Indian colleagues. A project dealing with underlying theories for characterizing optical fibers and components, and developing standard measurement methods to be used in trade, continued with excellent results.

Biotechnology

Biotechnology is a high priority area in India. Research and development policies are set by the Department of Biotechnology (DBT) and to a lesser extent by the Department for Non-Conventional Energy Sources (DNCES), and are carried out by a broad range of institutes and universities. Work sponsored by DBT includes development of drugs, pharmaceuticals and other fine (pure) chemicals, as well as bulk chemicals. DBT also sponsors research in genetic engineering, although most of that work is carried out by the Indian Council of Agricultural Research (ICAR). U.S. scientists collaborate on many aspects of this work, specifically in the development of fundamental concepts of enzyme catalyzed reactions and coherent sets of thermochemical data that are of value to a broad range of biotechnology applications. DNCES supports biogas generation from agricultural waste.

Energy and Environmental Technologies

In recent years, also, the GOI has taken steps to implant an infrastructure capable of implementing its corpus of environmental legislation, and has set up a network of laboratories and scientific institutions with capabilities to monitor the Indian environment. Among the leading scientific institutions in this field are the National Environmental Engineering Research Institute (NEERI) in Nagpur, the National Chemical Laboratory in Pune and the National Physical Laboratory in New Delhi, all part of the Council of Scientific and Industrial Research (CSIR).

Because of the Intellectual Property Rights problem, U.S. scientific institutions do not collaborate with Indian institutions on technology development but do carry out collaborative research on the underlying scientific concepts. USAID, however, continued a highly successful Program for Acceleration of Commercial Energy Research (PACER) that brings together U.S. and Indian companies to develop commercially viable energy technology for use in India and for export. USAID also has a new, similar program on Energy Management, Consultation and Technology (EMCAT) which makes U.S. energy technology available to the Indian private and public energy sector. The main purpose is to increase power output from existing Indian plants and distribution systems through incremental improvements in management and technology. Both programs will strengthen the Indian private sector and develop business opportunities for U.S. companies.

Agriculture and Natural Resources

Over the past twenty years India's agricultural production has risen dramatically on the basis of new crop varieties and massive inputs of irrigation water, fertilizers and agrochemicals. Increased demand for food, fiber and fuel has made agricultural production on marginal lands essential. These lands include dry, low rainfall, partially irrigated, salty and/or swampy wetlands and other non-traditional production areas. Almost half of India's surface area consists of marginal lands, in many of which areas the Indian government has research institutes where collaborative research goes on.

During FY-1991, Indian and U.S. scientists continued to collaborate on developing adapted crops and testing new approaches and technologies to enable production on these marginal lands. Other collaborative work looked to enhancing production predictability and sustainability and reducing producer risks while protecting the environment and natural resources. The work entails developing and testing systems for biological control of pests, effective use of fertilizers and agricultural chemicals, and improved cropping sequences. Systems that prove effective under Indian conditions may also be introduced into the United States. Indian and U.S. researchers are also able to study animal and plant diseases which do not occur in the United States but constitute a potential threat to U.S. agriculture.

Reduction of the atmospheric ozone layer could have potentially detrimental effects on plants as well as humans and animals. Therefore, collaborative studies of the effect of increased ultra-violet-B (UV-B) radiation on photosynthesis and plant growth are being conducted, as are studies on the effect of an increase in greenhouse gases on plant production.

It is estimated that 25% of the total increase in the concentration of atmospheric methane is due to rice cultivation. During FY-1991, researchers from the U.S. Department of Agriculture and their Indian colleagues considered research to identify practices and cultivars (cultivated varieties of plants) which produce less methane as well as nitrification inhibitors.

INDONESIA

General

The government of Indonesia assigns high priority to the role of science and technology in stimulating and supporting its industrial development. A renegotiated U.S.-Indonesia Agreement on Cooperation in Science and Technology, signed in November 1991, put into place key new provisions for protection of intellectual property rights.

Since 1978, activities under or enabled by U.S.-Indonesia science and technology agreements have not only stimulated joint research and economic development activities, but provided major commercial opportunities for U.S. suppliers of such goods and services as aircraft and aircraft components, avionics, civilian nuclear technology, and telecommunications equipment. Through extensive collaborative programs in rural development, aerospace engineering, nuclear power, health care and others, the U.S. has done much to advance its own and Indonesian national interests.

Basic Science

Indonesia possesses a reasonably strong tradition of basic scientific research in tropical biology, tropical medicine and agriculture. Governmental actions beginning in the mid-fifties have also produced a state-sponsored science establishment heavily oriented toward applied research and engineering in support of national economic development.

Presidential decrees from 1978 to 1984 required the State Minister for Research and Technology, advised by the National Research Council (DRN), to prioritize and coordinate the activities of a host of sub-departmental agencies. These agencies (LPNDs) are publicly financed research organizations through which the Government of Indonesia (GOI) strives to link the application and benefits of S&T to the attainment of basic economic and industrial development needs. LPNDs have been built up in the past decade to be Indonesia's key institutions for science and technology research. University research, which for the most part is under the auspices of the Department of Education and Culture, is of a more theoretical nature. Efforts are underway to bridge the gap between university basic research and LPND applied research. Currently, basic research in the private industrial sector is still embryonic.

GOI direction and coordination of state science and technology programs are implemented in compliance with a so-called national matrix for research and technology which embraces five priority areas: basic human needs; natural resources and energy; industrialization; defense and security; and social affairs, economics, culture, philosophy, politics, law and regulations. The matrix is linked in turn to "strategic industries" deemed crucial to economic development via technological and industrial transformation: aeronautics and aerospace; shipbuilding and maritime transportation; surface transportation;

telecommunications; energy; engineering; agricultural equipment; and defense. Linkages among these eight "vehicle" industries and their supporting services are defined as a "ninth vehicle" for industrial transformation.

Health and Life Sciences

U.S. Naval Medical Research unit no. 2 (NAMRU-2), located in Jakarta, is part of the U.S. Naval Medical Research and Development Command and has been present in Indonesia since the late 1960's. NAMRU-2 operates under a continuing intergovernmental agreement. It conducts research in the Indonesian archipelago on diseases of both military medical and public health importance. All programs are conducted with Indonesian counterpart participation. Significant areas of research during FY-1991 included malaria, typhoid fever, cholera and other diarrheas, dengue, HIV and other viral diseases.

The NAMRU laboratory's specific activities include World Health Organization (WHO) sponsored field trials of oral typhoid vaccines on the island of Sumatra and in Jakarta; trials of oral rehydration solutions in Jakarta on adults with severe secretory diarrhea caused by cholera; evaluation of a recombinant cholera vaccine; and defining the spectrum of drug resistance of malaria parasites throughout Indonesia. There is a cooperative study to investigate the entomological factors in malaria transmission and develop methods to reduce man-vector contact.

Two more studies deal with novel approaches to control transmission vectors of dengue virus, the techniques of which are being evaluated for control of vector populations in both urban and rural environments. Another program is developing radioactive and enzyme labelled salmonella typhi DNA probes for rapid diagnosis of typhoid fever. Still another study involves isolation and identification of pathogens that cause diarrhea among expatriates living in Jakarta. Finally, malaria and filarial parasites are cultured for pharmacological, biochemical and immunologic studies.

Included are efforts aimed at development of an anti-malaria vaccine, and identifying the frequency of occurrence of drug resistant parasites. The Department of Defense (DOD) malaria vaccine development program, to which the NAMRU laboratory is a contributor, benefits from Indonesia's geography and medical professionals. Indonesian scientists trained at NAMRU-2 have transferred both their skills and life saving medical technology back to their parent organizations.

Energy, Environment and Economics

Among the developing countries, Indonesia has been a leader in officially recognizing the wisdom of environmental and natural resources management in supporting a sustainable pattern of economic development. Indonesia has shown increasing awareness of its international environmental responsibilities; it signed (although by the end of FY-1991 had not yet ratified) the Montreal Protocol on substances that deplete the ozone layer, and has participated in the Intergovernmental Panel on Climate Change (IPCC) and other international environmental fora.

The U.S. Information Service (USIS) regularly attracts Indonesian governmental, academic and private sector representatives to its Worldnet interactive program series on environmental issues, notably those on protection of the ozone layer, urban environment, global climate change and tropical forest management.

USAID/Indonesia has actively encouraged improved policy direction from the GOI and coordination among donors interested in environmental assistance. USAID has developed a seven-year, $25 million project ($18.5 million USG grant) in natural resource management (NRM). The NRM has two main sets of activities: on sustainable economic development, and on sustainable management of forests and protected areas.

Other areas of activity include global change and climate studies. This broad category includes current and prospective cooperation in atmospheric, oceanographic and natural hazards research. During FY-1991, the National Oceanic and Atmospheric Administration (NOAA) and the Indonesian Agency for the Assessment and Application of Technology (BPPT) conducted negotiations toward a Memorandum of Understanding on collaboration that may include climate studies and ocean and atmospheric monitoring. It was anticipated that other U.S. technical agencies such as NASA, NSF, USGS, and ONR may also participate in collaborative research under this MOU.

Amindo Jaya ("American-Indonesian Success") is the name of a joint survey program between the U.S. Naval Oceanographic Office and the Indonesian Navy's hydrographic office. The program encompasses geodetic, hydrographic and magnetic surveys. Indonesian waters are presently the most important of the "accessible requirements" areas in the Pacific region because the archipelago straddles all communications lines between the Pacific and Indian Oceans.

Indonesia, an OPEC member, has rapidly expanded its domestic production of both natural gas (often processed as LNG) and coal, but capacity constraints and market forces -- more than OPEC production allocations -- will likely constrain further increases in Indonesia's oil production. The Minister of Mines and Energy has stated that Indonesia could become a net importer of crude oil by the year 2000 if new discoveries continue to lag the depletion of proven reserves and the rapid increase in domestic consumption. Natural gas is becoming a major source of domestic energy as well as a major export in the form of LNG. Production has grown at a 7.5% annual rate since 1981, making Indonesia the world's largest LNG exporter. The coal sector is also growing, as total foreign investment of $1.5 billion will result in increased production to over twenty million tons annually by 1994, mainly for export.

Indonesia is also planning for nuclear power in its long-term energy strategy. Civil nuclear cooperation is highlighted by the successful U.S.-Indonesia Joint Steering

Committee (JCS) arrangement, which was created to enhance cooperation in key nuclear fields including radioisotope production and application, instrumentation, nuclear safety and training. Indonesia has also invited the U.S. Nuclear Regulatory Commission to consult on approaches to strengthening the GOI's regulatory structure, and the National Atomic Energy Agency (BATAN) has requested that the JCS expand its scope to include nuclear power technology.

Under a USAID assisted project at the Indonesian Center for Science, Research and Technology, Indonesia is also establishing a high-quality non-oil/gas energy research laboratory as part of a larger effort to improve capabilities in assessing energy efficiency and conservation options. Although not yet formally inaugurated, by late 1991 the laboratory had procured research equipment for investigating combustion properties of domestic coal and technologies for efficient combustion and pollution control. A technical assistance team of long-term advisors and short-term specialists will assist in developing the laboratory's capabilities.

Emerging Technologies

During the past two decades, a number of factors, including oil export earnings, political stability, and government economic policy, have resulted in Indonesia's achieving rapid economic growth. Nevertheless, Indonesia has yet to become competitive as a source of research or production in the critical technology areas of materials, manufacturing, information and communications, biotechnology, surface transportation, or energy. A strong aircraft industry is a notable exception, and Indonesia's nuclear research capacity is promising.

Indonesia is an industrializing nation whose strategy is to lift itself into economic, technical and scientific modernity through judicious selection of "strategic industries" rather than through "critical technologies." However, these industries often apply critical technologies and are significant due to their contributions to the development of Indonesia's intellectual and physical infrastructure (e.g., aeronautics, air transportation, communications systems, and trained manpower).

Agriculture and Natural Resources

The U.S. Agriculture Department's Foreign Agricultural Service (FAS/Jakarta) supervises USDA's cooperative program with Indonesia in a wide range of activities from human health and nutrition to livestock and poultry breeding, feed technology, training in aquaculture, and upgrading of the flour milling industry. USAID/Indonesia employs a number of USDA scientists and agricultural experts to implement specific research and assistance programs. FAS staff also provide guidance to the GOI in areas of agricultural policy. A number of U.S. land grant colleges and universities have research partnerships with Indonesian institutions in pest management, crop diseases and food research. USAID supports what has been evaluated as the world's most impressive integrated pest management program. It is presently aimed primarily at rice culture but USAID hopes to expand it to other crops. FAS/Jakarta is also involved in coordinating special training in the United States for Indonesian officials in inspection techniques for poultry meat and other foods.

ITALY

General

During FY-1991, Italy attempted to reduce its budget deficit significantly as a part of preparations to enter the European Monetary Union (EMU) and for internal political reasons. Cuts were planned in many programs, including government spending for R&D and by the Environment and Research Ministries. The budget stringency posed the potential for lowering Italian resources invested in S&T research further from their peak of about 1.38% of GDP in 1989. Such reductions would run counter to recommendations of the Organization of Economic Cooperation and Development (OECD), which completed a one year study of the Italian research scene in March 1991.

The OECD suggested that Italy increase the share of its GNP going to R&D, particularly in the private sector, if it wished to be competitive in the Europe that will emerge after 1992. The OECD also recommended that public research bodies and universities be held more closely accountable for the results of their research spending and be funded in a manner that produced quality research -- not just an equal distribution of research funds. Among many other suggestions, the OECD recommended that Italy step up its international S&T cooperation.

Italy has long been one of the United States' most valuable European partners in S&T cooperation, in an extraordinarily wide variety of fields. An example was the biannual U.S./Italy science and technology review meeting held in November, 1990. The two sides reviewed specific cooperative programs in ten traditional fields: space, basic nuclear and sub-nuclear physics, earth sciences, technology-meterology-standards, environment, human health and biomedical sciences, intellectual property, energy research, basic sciences/engineering, and agriculture. New areas of cooperation were developed including global climate change and advanced materials research.

At a special concluding seminar on EC S&T cooperation programs, U.S. and Italian participants agreed that bilateral science relations would remain important after 1992. The participation of high-level Italian science and political figures in the conference provided clear evidence of the importance which Italy attaches to the bilateral S&T relationship. However, Italy and the U.S. continued to disagree about intellectual property rights (IPR) in bilateral science cooperation. As of the end of FY-1991, conclusion of two agreements, one on basic science and another on energy cooperation, stalled for lack of agreed IPR language.

Basic Science

Italy is striving to revamp its scientific organization through a newly formed Ministry of University and Scientific Research (MURST), which includes a National Science and Technology Council (CNST) as a consultative and advisory body to the Minister. Italy's National Research Council (CNR) had been the sole responsible agency for addressing research in Italy, and at the end of FY-1991 it was still unclear how CNR and MURST would interrelate.

Scientific research in Italy has many sectors in which it is predominant or promising. Areas of strengths such as particle physics, mathematics, informatics, automation and space assure the continuity of an excellent cooperative relationship between Italy and the United States. The Italian government is attempting to promote science in the south of Italy (Mezzogiorno) through financial incentives to research organizations to relocate there. Also, science parks are increasing in number throughout Italy in an effort to extend research facility support to small and medium sized firms.

During FY-1991, Italy continued to exploit its comparative advantage in particle physics by putting more emphasis on its Gran Sasso laboratory, with the cooperation of several scientists of different nationalities, including Americans; and to expand facilities at the Frascati national laboratory. Italy continued to show strength in fusion energy research, including high field tokamak machines. U.S.-Italian talks were held during the year regarding possible Italian interest in participating in construction and operation of the Superconducting Super Collider (SSC), but Italy continued to reply that it considers the large hadron collider, to be built at the European Center for Nuclear Research (CERN) on the French-Swiss border, to have priority. In the fall of 1991, an important step in space cooperation came when U.S. and Italian negotiators reached agreement on a bilateral cooperative program on use of Space Station Freedom and the construction of logistics modules.

Health and Life Sciences

Public sector research is not as advanced as other research areas, to the point where Italy may be coming to lag others in molecular biology and biotechnology. Diagnostics are adequate but the application of therapy is a weak point of Italy's public health system, which is plagued by financial deficits and what some charge is excess political influence. During FY-1991 the Italian Parliament moved toward major reforms to lessen political influence in the health care system by increasing the share of administrative appointments going to persons with proven medical or managerial skills.

Italy's private sector health research establishment was more internationally competitive. In the search for new drugs, firms like Fidia and Sigma Tau, and in biotechnology the Fiat group's Sorin company, compared favorably with the most advanced European research organizations. Cancer study was quite advanced at the Milan National Institute of Cancer and the private research foundation "Mario Negri." Drug abuse is still a growing problem in Italy in terms both of increased mortality and as a means for HIV virus transmission among the young. Nutrition began to concern Italian health authorities as affluence shifts many consumers away from a healthy "Mediterranean" diet to choices traditionally associated with more northern climes and diet-related health problems.

Italy's population growth rate may be the lowest in Europe, even below that of such countries as Germany or Sweden. The aging of the population is generally attributable to a liberal abortion law, difficulty for newlyweds to find suitable housing, and increased desire for personal consumption.

As acknowledged at the S&T review meeting, a great deal of U.S.-Italian cooperation in health and biomedicine is informal and arranged on a scientist to scientist basis. Scientific cooperation fostered by government agencies is particularly noteworthy in pre-clinical and clinical research related to cancer, immunotherapy and comparative studies of health problems of the elderly such as cataracts and Alzheimer's disease. Past and current cooperation was reflected in several U.S.-Italy workshops and symposia covering such topics as cardiovascular diseases in women, prenatal medicine and the health effects of air pollution. In late FY-1991, both governments were considering further cooperation in molecular biology, biotechnology and human genome mapping and sequencing.

Energy, Environment and Economics

Italy took a leading role in highlighting the interplay of energy and the environment when, during Italy's presidency, the EC agreed to a cap on carbon dioxide emissions and a burden sharing arrangement in the context of the global climate change negotiations. During the same period, Italy developed a modest but complete research program for global change. One fruit of Italy's increased research is its cooperation with a climate modeling agency of the U.S. Department of Commerce located in Colorado (NCAR). Italy also took steps in cooperation with France, within the framework of the Committee on Earth Observation Satellites (CEOS), to establish an earth observation world information center in Venice. Italy also offered to host a branch of President Bush's proposed Global Change Research Institute.

In the summer of 1991, ENEA, Italy's Nuclear and Alternative Energy Agency, completed a long conversion from its earlier focus on nuclear power to emphasizing research into alternative energies and innovative environmental technologies. (Italians voted to abandon nuclear power in a 1987 referendum.) ENEA, together with the National Electricity Board (ENEL) and the National Hydrocarbons Agency (ENI), is actively studying new methods to decrease air pollution caused by the oil and coal fired power plants from which most Italian electricity is obtained. Italy is increasingly using imported natural gas for heating and cooking, with consequent decrease in carbon monoxide and nitrogen oxide emissions. ENEA is seeking to revive solar energy and photovoltaic research through a former nuclear enterprise, Fabricazioni Nucleari.

U.S.-Italian cooperation has tended to approach energy, environment and economics as separate disciplines. In the environmental area, the two countries continue discussions on hazardous waste management, particularly cleanup activities, and have begun a few exchanges at Italian regional levels. The U.S. and Italy also continue to work together to advance environmental programs in NATO's Committee on the Challenges of Modern Society. In the energy area, research is focused on clean fuel technologies utilizing coal, combined cycles and fuel cells, photovoltaics, and nuclear power reactors with passive safety features.

Emerging Technologies

The EC's European Research and Coordinating Agency (EUREKA) and other framework programs tend to steer Italy's public sector international cooperation initiatives in technology to other European countries. Italian private sector research, which is also affected but to a lesser degree by programs of European integration, shows a greater tendency to seek out U.S. partners, particularly in technology sectors where the U.S. continues to lead.

Italy joined the race to develop and utilize new materials rather late compared to Japan and the U.S. Current efforts are concentrated on ceramics and plastics. Interest in ceramics stems from a long artisan tradition, and advanced production methods are coming on stream intended to launch new and imaginative applications. Plastics are also a mainstay of Italian research and are being studied for new uses in the automotive industry. The two leading companies conducting this kind of research are Fiat and Montedison. During FY-1991, a plant to produce 200,000 tons a year of polyethylene based on the Montedison Spherilene method was under construction at Lake Charles in Louisiana.

The public sector is also joining in this type of research. The CNR recently approved a research project dealing with special materials for advanced technologies, with total financing of 135 billion lire (about $100 million) over a five year period. In addition, the Ministry of University and Scientific Research has approved a national program of research for advanced and innovative materials with financing of 725 billion lire (about $560 million).

In the area of manufacturing processes and technologies, Italy has developed several CAD and CAM systems for applications in small and medium size traditional industries. It has become a leader in and an exporter of simple and modular robotic systems that reduce both labor costs and production time. Fiat is a leader in this field by virtue of its ownership of the robot maker Comau, which has engineered and developed for its parent company some of the world's most advanced production facilities. Fiat's car production facilities in central and southern Italy are among the most automated plants in the world.

Technology and research parks are a relatively new development on the Italian research scene. The government is using them to help small and family businesses to computerize their production processes. A recent example is Bari's "Technopolis," which provides such services to about 60 small shoe producers operating in southeast Italy. The public sector is also conducting research into factory automation through CNR research projects such as robotics, with a five-year budget of 70 billion lire ($56 million); fine chemicals, with a five-year budget of about 145 billion lire ($116 million); and building technology, with a five-year budget of about 155 billion lire ($124 million).

In information and communications technologies, Italy is above the European average in some sectors and is holding its own in others. During FY-1991, an Italian laboratory announced construction of a massively parallel supercomputer (APE 100) currently designed to reach a speed of six gigaflops (billions of floating decimal point operations per second), and projected eventually to reach 100 gigaflops. To support the use of supercomputers, Italy has developed a high speed computer network called GARR with 2 megabit (million bits of information per second) trunk lines. Olivetti is a European industrial leader in the computer and information field and, notwithstanding a recession in the information industry, is active in the whole gamut of informatics from personal computers to education systems, expert systems and neurocomputers with voice recognition and artificial intelligence.

Italy is moderately advanced in Optoelectronics compared to other Western European and U.S. competitors. Optoelectronic applications are being sponsored by the government, and optical fiber cables for communications and data networking are being installed throughout the country. The public sector is also contributing through CNR research projects in telecommunications with a five year budget of about 79 billion lire ($63 million), and informatic systems with five year financing of about 83 billion lire ($66 million).

The Italian government is seeking to reduce a biotechnology gap between Italy and its international competitors by launching a 41 billion lire ($33 million) national research plan in biomedical technology. Italian problems in this field were recently highlighted by Italy's disproportionately small presence in the EC biotechnology research program named Bridge, which has a budget of $110 million over a four year period. 524 European research laboratories are participating in the project, only 46 of which are Italian. Private industry investment in this research sector is scant. A bioethics national committee was created in 1990 to advise the government on legislation concerning biotechnology research and applications. The CNR has started a research project on biotechnology and bioinstruments, with five year financing of about 85 billion lire ($68 million).

Italy continues to do well in pharmaceutical research, where it is seventh in the world in number of researchers and and value of investment. There is government funding of 276 billion lire ($221 million) for a national plan on pharmaceutical research.

In the area of space/aeronautics and surface transportation, since the early 1960's and the construction of the San Marco launch facility, Italy has been deeply involved in space technology. Spending in this sector has skyrocketed over the last fifteen years, and Italy projects space expenditures of $1 billion per year in the current five year plan. The large size of the Italian program has helped to push Italy to the forefront of some space-related fields.

Italy's strong participation in the European Space Agency has encouraged research into sophisticated apparatuses for use on satellites, and these are now being manufactured by such leading firms as Laben, Fiat and Telettra.

Italy is also joining the movement in Europe toward high speed rail transportation. In summer 1991, it formed a company called TAV (Treno di Alta Velocita - High Speed Train), 45.5% of whose capital belongs to the state railway and the remainder to Italian and foreign banks. Italian companies involved include Ansaldo, Fiat and ENI in a five to seven year project.

The private sector, mainly Fiat, has for some time been testing an electric powered vehicle to be employed in city transport to combat urban air pollution. Ansaldo is participating with Dutch, French and Belgian firms in the manufacture of an urban transportation bus using alkaline combustion cells and nickel/cadmium batteries. The vehicle should be ready for testing by 1994.

Agriculture and Natural Resources

A cooperative effort in this field ended in 1990 when the USDA's biological control of weeds facility was transferred from the outskirts of Rome to France and consolidated with another USDA lab. However, practical research cooperation, which had languished, received a boost in November 1990 when the bilateral review meeting on science and technology cooperation agreed to a series of short-term exchange visits. During FY-1991, there were exchanges on biotechnology regulatory policy, physiology and genetics of drought tolerant hardwoods, use of geographic information systems and remote sensing for agriculture, as well as an exchange on physiological responses of wheat to water stress. Italian private sector firms formed a consortium called Agrital Ricerche to do agriculture research in the province of Rome. In addition, private research is being performed at Cesena into the use of bacteria to replace pesticides.

ISRAEL

General

Israel is a small country in both size and population with few natural resources. In order to prosper, Israel relies on the education and training of its citizens, with the emphasis on scientific and technical fields. Today, Isreal has the highest number of scientists per capita in the world. These scientists generate the largest number of publications per capita in the world.

In FY-1991 Israel faced two big challenges, Soviet immigration and the Persian Gulf crisis, that directly affected its science and technology community. A total of approximately 350,000 Soviet immigrants have come to Israel since December 1989, many of whom have advanced training. The Persian Gulf crisis saw many researchers called up for Army reserve duty for a substantial part of the Gulf War, slowing the pace of their research activities. In addition, many international S&T conferences scheduled to be held in Israel were cancelled or postponed due to the crisis.

Cooperative S&T activities between the U.S. and Israel continued to be strong in FY-1991. Three U.S.-Israeli binational foundations -- the Binational Science Foundation, the Binational Industrial Research and Development Foundation, and the Binational Agricultural Research and Development fund -- obligated approximately $35 million for cooperative R&D projects during the year. The number of bilateral U.S.-Israeli S&T agreements increased to fifteen with the signing of an MOU between EPA and the Ministry of the Environment (MOE) in February 1991. USAID provided $7 million for trilateral R&D projects between U.S., Israeli and Egyptian scientists under its Middle East Regional Cooperation (MERC) program, and $2.5 million for bilateral projects between Israeli and developing country scientists under its Cooperative Development Research (CDR) program. A number of U.S. agencies, including NIH, DOD, and USAF, again acknowledged the high standards of Israeli S&T research by funding a variety of research activities during FY-1991.

An estimated 20% of the recent arrivals from the USSR are scientifically or technically trained. While this influx offers a very large new pool of scientific talent and expertise for Israel, a challenge lies ahead in creating jobs for them.

Basic Science

The Binational Science Foundation (BSF) continued to fund most of the cooperative U.S.-Israeli activities in the basic sciences, supporting research in all fields except agriculture. Ninety one new projects having total first year funding of $2.6 million were approved in FY-1991. BSF spent a total of $12 million during the year for new and continuing projects and workshops. Since its inception in 1974, BSF has awarded approximately $110 million dollars for almost 2000 research grants.

Health and Life Sciences

Approximately 45% of the BSF's research budget was devoted to projects in the health and life sciences in FY-1991, accounting for the bulk of support for bilateral U.S.-Israeli projects in these fields. The fields of research of new BSF projects included: cancer, heart and lung, allergy and infectious diseases; arthritis; and neurological diseases.

Israeli scientists in the health and life sciences typically do well in competing for NIH research awards. For FY-1990 (the latest year for which figures are available), NIH awarded $5.3 million to Israeli scientists under BSF or through other channels.

USAID's MERC program funds two health projects for cooperative research between U.S., Israeli, and Egyptian scientists. One project, entitled "Epidemiology and Control of Vector-Borne Diseases" received approximately $600,000 in FY-1991 and will have received a total of some $12 million over the life of the project (10 years, ending in FY-1992). Research has centered on five diseases: rift valley fever, malaria, leishmaniasis, filariasis, and rickettsia. In the U.S., the project is administered by the NIH/National Institute on Allergies and Infectious Diseases (NIAID). The second MERC health project is a new research program entitled "Infectious Disease Research." It is administered by the Israeli Institute of Medicine and has a five-year budget of $4.3 million. The research will focus on chronic diarrhea and hepatitis B.

Energy, Environment and Economics

Israel imports virtually 100% of the fossil fuel it uses for power generation and industrial purposes. In order to decrease its dependence on foreign energy sources, the GOI has been exploring a number of options for potential indigenous sources of energy. Through PAMA, the Israeli energy resources development company, the GOI has been developing an oil shale-fired power plant. In FY-1991, the GOI began discussions with U.S. companies on the possibility of building a 150 megawatt oil shale-fired plant. The Israel Electric Corporation (IEC) has begun studying the feasibility of building a 800 megawatt pumped storage generating facility on the Dead Sea. IEC has had discussions with U.S. companies on this project. The Minister of Energy has also stated his interest in developing an Israeli nuclear power generating capability. However, Israel's refusal to sign the Nuclear Non-proliferation Treaty will be a barrier to international cooperation on such a project.

On February 20, 1991, a new MOU on cooperation in the field of environmental protection was signed between the EPA and the Israeli Environment Ministry. The first activity under the MOU was a workshop, held in Israel in October 1991, on environmentally safe reuse of wastewater.

Emerging Technologies

The Binational Industrial Research and Development Foundation (BIRD) supports joint projects between U.S. and Israeli companies for industrial R&D leading to the introduction of new products or processes into the marketplace. In FY-1991, 39 projects, with total funding of $13.7 million, were approved. Since it was established in 1978, BIRD has spent approximately $98 million in support of 296 projects. The fields in which BIRD has supported projects (and the percentage of BIRD funds devoted to those fields) are: Computer software (29%); communications technologies (18%); medical products (17%); semiconductor equipment (15%); electronic equipment (11%); machinery and equipment (7%); and agrotechnology (3%).

Agriculture and Natural Resources

The Binational Agricultural Research and Development fund (BARD) provided $9 million dollars for the funding of 39 new projects between U.S. and Israeli scientists in FY-1991. Since BARD's inception in 1979, $105 million have been approved for the funding of 575 projects. BARD supports projects in the fields of agricultural economics, agricultural engineering, animal production and protection, aquaculture, cellular and molecular biology, field crops, horticulture, plant protection, post-harvest studies, and soil and water conservation.

USAID has obligated $27.7 million for cooperative agriculture projects between U.S., Israeli, and Egyptian scientists under its Middle East Regional Cooperation (MERC) program. These projects are designed to be of direct benefit to agriculture in Israel and Egypt, but their results are applicable to many semi-arid to arid regions of the world. Topics under investigation include: use of saline water for arid lands crops; improved fodder shrubs for sheep and goats; new industrial arid lands crops; medicinal uses of desert flora; solar heating of soils for pest and weed control; improved dairy production; neonatal diseases of cattle and water buffalo calves, diagnosis and control of brucella melitensis; foot and mouth disease studies; and development of innovative low-cost technologies for the treatment and reuse of domestic waste water for fish production and irrigation.

MERC has also supported marine and water projects under a Marine Technology Program. Projects have included primary productivity of the eastern Mediterranean, aquaculture, seafood toxins, protection of shorelines aganist erosion, climate prediction, recycling of waste water, and lakes management.

The Forestry Department of the Jewish National Fund (JNF) has, since before the founding of the State of Israel, been the key agency responsible for Israel's afforestation and reforestation programs. The U.S. Forest Service (USFS) has cooperated with the JNF on these types of programs for years. During FY-1991, several USFS delegations visited Israel to work with JNF in the areas of afforestation and forest fire prevention and mitigation.

USAID's Cooperative Research Development program to foster cooperation between Israeli and developing country scientists utilizes Israeli expertise in solving problems relevant to LDC's. It has some 60 active projects in agriculture representing a total commitment of approximately $10-11 million dollars. Areas of research include: reducing post-harvest losses; developing new varieties of crops useful to LDC's; aquaculture; insect control; improving irrigation techniques; and various livestock studies.

JAPAN

General

The United States and Japan maintain a significant and growing relationship in science and technology cooperation. Although foreign access to Japanese R&D continues to be less open than in the United States, this trend has been gradually changing over time. Over the last few years, the Japanese have continued to open their domestic governmental research programs to international participation in scientific research efforts that range from the small to the large and the basic to the applied. Access to Japanese research on high technologies, applied and industrial subjects is growing, but is hindered by dissimilarities in language and culture and by the fact that much of Japan's S&T strength is in the private sector, where the technology is often of a proprietary nature. This issue was highlighted in the September 1991 annual GOJ white paper on science and technology. Significantly, the white paper also noted that Japan's basic research activity did not accord with that country's station in the world.

The GOJ reached a consensus in the mid-1980s that Japan should pursue a policy of "globalization" or "internationalization" -- One aspect of this concept is that Japan should contribute more to world S&T since its prosperity and quality of life depend on access to global markets, S&T, and culture. One result of these efforts during the past three years was the tripling, to over 750, of the number of foreign researchers engaged at GOJ research institutions.

The U.S.-Japan Agreement on Cooperation in Research and Development in Science and Technology (UJST), signed in 1988, has proven to be an important mechanism for encouraging greater openness and understanding, in addition to enhancing and coordinating the vast number of cooperative activities between the two governments. Under the Agreement, U.S. Presidential Science Advisor D. Allan Bromley and Minister Santo of the Japanese Science and Technology Agency (STA) co-chaired the third meeting of the Joint High Level Committee in Tokyo on October 17-18, 1991. The meeting provided the U.S. side an opportunity to urge the Japanese to participate in the Superconducting Super Collider (SSC); to announce that the U.S. would provide funds for the Human Frontier science program; and to discuss a set of initiatives for cooperation in basic research, ocean exploration, environmental protection, industrial technology, and aging. Preparatory meetings had been held during FY-1991 by the UJST's Joint Working Level Committee and the Joint High Level Advisory Panel, the latter being a distinguished joint panel of non-governmental experts.

Basic Science

GOJ efforts to increase funding for basic research have increased over the last few years, but appeared to reach a heightened level of political attention in 1991 due in part to the United States' request for Japanese participation in the Superconducting Super Collider (SSC) program. According to Japanese figures, expenditures

on basic research in JFY 1989 (April 1989-March 1990) reached 1.39 trillion yen (about $10.7 billion), up almost 8% from the previous year's figure of 1.29 trillion yen. Approximately half of the basic research funding goes to the Ministry of Education (Monbusho) to support university research in Japan. (Care should be taken in comparing these figures to other countries since about 60% of basic research expenditures are for salaries rather than equipment and supplies.)

In November 1991, the National Science Foundation (NSF) and the Japan Society for the Promotion of Science (JSPS) celebrated the 30th anniversary of an agreement which the two administer, which brings together hundreds of scientists annually from both sides and produces some 300 publications yearly. Additionally, NSF is very active in helping to place American scientists and engineers in Japanese academic, government and corporate laboratories for long-term research stays. In the last three years, over 200 American researchers have been placed in Japan. Additional support for such exchanges will soon be made available through the Japan Foundation Center for Global Partnership, established in April 1991.

The GOJ has also been an integral factor in increasing the number of U.S. researchers in Japan. Specifically, Monbusho, the Science and Technology Agency (STA), the Ministry of International Trade and Industry (MITI) and the Ministry of Foreign Affairs (MOFA) all have programs and/or fellowships that have made cooperation among scientists grow tenfold over the last few years. In addition, NSF coordinates with Monbusho, STA, MITI and the MOFA to place American scientists and engineers in Japanese academic, government, and corporate sector labs for long-term research stays.

NSF's Summer Institute program brought 49 U.S. science and engineering graduate students to Japan for two months during the summer of 1991. In addition to Japanese government labs, the University of Tsukuba and seven private Japanese companies located in the science city of Tsukuba participated in the program in 1991.

Bilateral cooperation in space is conducted under the Standing Senior Liaison Group (SSLG). NASA Administrator Richard Truly visited Japan in July 1990 for the most recent SSLG meeting, demonstrating the importance NASA attaches to its relationship with Japan. Bilateral cooperative space science and applications activities are conducted in five areas: astrophysics, solar system science, earth observation, life science, and microgravity science.

Japan has a relatively small (compared to the U.S.) but active space program that has scientific research as well as commercial objectives. The National Space Development Agency of Japan (NASDA) and the Ministry of Education both maintain launch facilities in southwestern Japan. The Japanese space probe Sakigake (Pioneer) made a flyby of Halley's comet during its 1986 appearance and relayed data to Earth that has contributed to our understanding of comets. In 1990, Japan launched a small research probe into orbit around the moon. In October, 1991 the Japanese satellite Yohkoh, carrying a joint U.S.-Japanese X-ray telescope, began

its observations of solar flares in a collaborative U.S.-Japanese project aimed at learning more about this phenomenon that can cause serious disruptions of communications and power grids on Earth. NASDA is also developing a new booster rocket, the H-II, to enhance its capability to launch heavy payloads into Earth orbit.

NASDA is also the organization which is conducting the design and development activities for Japanese participation in the Intergovernmental Agreement between the U.S., Japan, the European Community and Canada to build a manned, orbiting space laboratory - Space Station Freedom. The Japanese are committed to provide the Japan Experimental Module (JEM), which consists of a Pressurized Module, an Experiment Logistics Module and an Exposed Facility, for the Space Station.

The government of Japan has been considering the U.S. invitation to join as an official partner in the Superconducting Super Collider. As noted above, Dr. Bromley raised the issue during October's Joint High Level Committee meeting in Tokyo. Whether to participate is a subject of considerable controversy within the Japanese scientific community, and as of the end of 1991 the GOJ had not yet reached a decision on the issue. Nevertheless, Japanese and U.S. scientists are working together to develop some of the SSC's detectors.

Japanese superconductivity research occurs mostly in the private sector, including the R&D efforts of the International Superconductivity Technology Center (ISTC). In addition, research on both high and low critical temperature superconducting materials is underway in both university and government laboratories under the auspices of STA, MITI, the Ministry of Transportation (MOT) and the Ministry of Posts and Telecommunication (MOPT). GOJ funding for this research was 14.9 billion yen in JFY 1991.

The Ministry of Education has been an active partner in the International Ocean Drilling program, coordinated by NSF. STA has announced plans to build an advanced core-sampling deep-sea research vessel by the end of the decade to study the geology of the ocean floor. In addition, the "Shinkai 6500" submersible, a research submarine that can dive to depths of 6,500 meters (21,325) feet, will also be used to study ocean floor geology in the Pacific.

Health and Life Sciences

DHHS Secretary Dr. Louis Sullivan visited Japan in October 1991 to discuss the Japanese health care delivery system with senior Japanese officials. The visit highlighted an extensive life sciences relationship that has seen the United States and Japan cooperate in medical and health research for several decades. Results of one of the oldest bilateral projects, the Cooperative Medical Science Program, have reduced the incidence of a variety of diseases throughout the world.

One of the Cooperative Medical Science Program's panels deals with AIDS. As of June 1991, AIDS was a relatively minor problem in Japan, with only 1,810

people infected with the HIV virus, of whom 397 were diagnosed as having AIDS. Since the first AIDS statistics were recorded in March 1985, 198 people have died of AIDS in Japan (as compared to over 130,000 AIDS deaths in the U.S.).

The GOJ is spending almost 100 billion yen (over $700 million) on life sciences in JFY 1991, nearly 45% of which (44.2 billion yen) are for biotechnology research. Principally involved in biotechnology research are the Ministries of Education, Agriculture and Health. National biotechnology programs include efforts at cancer control, mapping of the human and rice genomes, and research on the sugar-chain mechanism. Ministries are also emphasizing study and understanding of biological mechanisms useful in developing new medical treatments, generating less harmful agricultural chemicals and producing higher yielding crop strains. This year, the life sciences panel of the Prime Minister's Council for Science and Technology revised its guidelines for the conduct of recombinant DNA experiments by private firms and national research and experimental institutions. At the same time, the Monbusho promulgated similar new regulations for universities.

Coordination of GOJ human genome policy is handled by the Prime Minister's Council for Science and Technology. The ministries most involved in human genome research are STA (913 million yen - mostly to the Institute of Physical and Chemical Research (Riken), which has developed a system to analyze DNA bases automatically); the Ministry of Health and Welfare (400 million yen); and the Monbusho, for two five-year scientific investigations and a future genome analysis center at Tokyo University's Medical Science Institute. The Ministry of Health and Welfare is also providing 2.3 billion yen to the private sector to develop medicines and medical instruments that utilize the results of biotechnology research.

The Human Frontier Science Program (HFSP), which deals with neurobiology and molecular biology research and was the first international science project ever initiated by Japan, continued into its third year in 1991 with GOJ funding at a level of about $20 million a year. In April 1991, the program announced its second set of research grants. They included projects involving 139 researchers, of which 46 were Americans.

Under the bilateral Cooperative Cancer Research Program begun in 1974 between NIH and the Japan Society for the Promotion of Science, scientists are investigating four areas of cancer research; etiology, biology and diagnosis, cancer treatment and interdisciplinary programs.

In 1975, the U.S. and Japan jointly established the Radiation Effects Research Foundation (RERF) as an independent, non-profit binational foundation to replace the U.S. Atomic Bomb Casualty Commission (ABCC) originally established in 1947. The mission of the RERF is "to conduct research and studies, for peaceful purposes, on the medical effects of radiation on humans with a view to contributing to the maintenance of the health and welfare of atomic bomb survivors and to the enhancement of the health of all mankind. Scientific results from RERF activities

have generated global interest and have contributed significantly to the understanding of the health effects of ionizing radiation. The U.S. and Japan provide equal funding for the Foundation.

The U.S. and Japan also cooperate on research on medical issues concerning aging and the elderly, under an MOU between the U.S. National Institute on Aging and the Tokyo Metropolitan Institute of Gerontology. The GOJ has been very concerned for some time about its demographic situation -- the population is aging and Japanese couples are having fewer children. Japanese have the world's longest life expectancy, at 81.8 years for women and 75.8 years for men. People over age 65 comprise 12.1% of Japan's population, but are projected to comprise 25% by the year 2025. The current birthrate in Japan is only 9.9 births per 1,000 people, leading to predictions that Japan's population, presently 125 million, within two decades will peak at only 130 million, then begin to decline, and dip below 100 million by the year 2070.

Energy, Environment and Economics

The acquisition and efficient use of energy has always been an area of keen concern to the GOJ. The GOJ has long been a strong advocate of nuclear power and has invested heavily in establishing facilities for operation of the complete nuclear fuel cycle. In July 1991, the Prime Minister's Council on Science and Technology adopted an energy R&D plan that gives priority to environmental preservation, including the role that nuclear power can play in environmental preservation. The plan also called for diversification of energy sources and higher energy efficiency, and set targets for the year 2010 for solar power utilization and for improved energy efficiency in transportation systems.

The United States and Japan have a long history of cooperation in energy related research and development, as well as energy trade. The U.S. is a major source of enriched uranium and fossil fuels for Japan. The U.S. and Japan began cooperation in the area of advanced nuclear reactor research in 1969, and signed a broad Agreement for Cooperation in R&D in Energy and Related Fields in 1979. The U.S. and Japan also maintain an Agreement for Cooperation on Peaceful Uses of Nuclear Energy. Under these agreements, joint research is conducted by the Department of Energy and Japanese Government agencies in a number of fields, including advanced nuclear technology - fusion and fission - high energy physics, synthetic fuels, clean coal and coal conversion, geothermal and solar energy, nuclear safety and radioactive waste management.

The two countries have worked together since 1975 under a bilateral environmental cooperation agreement, co-managed by the U.S. and Japanese Environmental Agencies. A periodic joint planning and coordination meeting under this agreement was held in Japan in 1991.

MITI's Energy and Industrial Technology Development Organization (NEDO) held a tenth anniversary symposium in October 1990 on the subject of "new energy and the global environment." NEDO was established to develop oil-alternative

energy sources to the stage where they can be commercially viable, and to support R&D on industrial technologies. In JFY 1991, NEDO is spending 60.9 billion yen on R&D for new energy sources, a decrease of 13.2% from the previous year. Among sources being investigated are coal, solar, geothermal, alcohol, biomass, and others.

Japan recently initiated a variety of programs involving technology development related to climate change. In October 1990, the GOJ announced a new "Action Program to Arrest Global Warming." The program's goals are to: (a) stabilize per capita and total CO_2 emissions by the year 2000 at the 1990 level; (b) stabilize the emissions of methane, nitrous oxide and other greenhouse gases at 1990 levels; and (c) conserve and expand CO_2 sinks. A policies and projects document was published in June 1991.

Also in autumn 1990, Japan's Environment Agency created a new Center for Global Environmental research within its National Institute for Environmental Studies (NIES). MITI also established a MITI Research Institute for Technology for the Earth (RITE) near Osaka. The Institute will research methane sources and sinks, carbon dioxide fixation and disposal, and CFC substitutes.

The Science and Technology Agency has established a Green Planet Project, in which technologies are to be developed to reduce scientific uncertainties involved in forecasting global climate change phenomena. The Central Research Institute of the Electric Power Industry (CRIEPI) began last year to research methods for recovering and liquefying CO_2 released by thermal power plants, liquefying it, and storing it on the ocean floor at depths of at least 3,000 meters. CRIEPI hopes to develop this into an international project.

Japanese researchers joined a visiting NASA team of investigators in September 1991 to study acid rain and global warming over the Pacific ocean. NASA's Pem-West mission to study atmospheric chemistry was a part of the International Geosphere-Biosphere Program (IGBP).

Emerging Technologies

Japanese industry outspends U.S. industry in R&D on civil technologies, a gap that is widening. Japan's industrial growth rate, 14% percent in 1990, exceeds that of the U.S. Since 1986, Japan has been the world's largest exporter of high-technology goods. Japanese applicants received nearly 25 percent of the patents issued in the United States and 85 percent of those in Japan. Some recent Japanese studies predict that Japan will surpass the U.S. in civil technology by the year 2000. One such study ranks Japan at the top in new materials and devices (semiconductor lasers and memories, CCDs, LCDs, and solar cells), at a middle level in biotechnology, and low in software.

Japan offers significant opportunities for technological cooperation. In September 1991, Department of Commerce Undersecretary for Technology

Dr. Robert M. White led a group of industry leaders on a manufacturing study mission to Japan in an effort to determine what technologies might be transplanted to the United States.

The U.S. private sector has been active in opening R&D facilities in Japan, both to develop products for the Japanese market and to gain access to advanced Japanese S&T research. The GOJ appears to have been helpful in this process; 80% of foreign firms reported in a survey that they had no problem with government regulations in carrying out their R&D activities in Japan.

The GOJ has also sought to promote international cooperation in its industrial technology R&D projects. Since 1989, MITI has opened up eight of its new research projects to foreign participation. These include hypersonic engine development (1989), non-linear photonics materials (1989), software architecture (1990), advanced chemical processing technology (1990), quantum functional devices (1991), technology of complex carbohydrates (1991), production of hydrogen (1992), and micromachines (1992). As of the end of FY-1991, General Electric and Pratt and Whitney were participating in the hypersonic engine project, Boeing in an aeronautic component project, and several foreign companies, including Motorola, were considering joining the micromachines project. During FY-1991, negotiations were well advanced concerning U.S. participation in two other MITI research projects, Intelligent Manufacturing Systems (IMS) and New Information Processing Technologies.

Other initiatives begun by MITI pertained to global environmental technology. These include NEDO's R&D program begun in 1990 to develop technologies to protect the global environment, and establishment in July 1990 of a Research Institute of Innovative Technology for the Earth (RITE). RITE is to develop CO_2 fixation technology using biological and chemical reactions to recover carbon from carbon dioxide, and systems to reuse the resulting carbon. Another goal is to develop biodegradable plastics. A third RITE theme under NEDO is to develop next generation refrigerants to replace ozone destroying freons. An additional plan is to develop a chemical synthesis bioreactor that uses biofunctions and bioenergy.

MITI's biochemical industries division will begin in JFY 1992 a seven-year, 10 billion yen project to develop technology to use microorganisms to decompose and process environmental pollutants. The division has already supported projects on biodegradable plastics, third-generation freons, CO_2 fixation and utilization, and chemical synthesis bioreactors.

Japanese companies and universities have been leaders in superconductivity applications. Two examples are the prototype Magnetic Levitation Train developed by the Railway Technical Research Institute, which uses superconducting magnets for both propulsion and levitation and has reached speeds of over 500 km/hr (300 mph) in trial runs on a seven kilometer (4.35 mile) long track, and the Kyushu University TRIAM-1 experimental nuclear fusion reactor, which is the world's only tokamak device to use superconducting magnets for plasma containment.

Agriculture and Natural Resources

The U.S.-Japan Cooperative Program in Natural Resources (UJNR), established in 1964, provides a forum to promote the development and conservation of natural resources through cooperation in applied science and technology. The Science and Technology Agency exercises overall coordination of the UJNR program in Japan but other agencies sometimes run specific panels. Nine UJNR panels (Conservation, Recreation and Parks; Earthquake Prediction Technology; Fire Research and Safety; Forage and Seeds; Forestry; Mycoplasmosis; Protein Resources; Toxic Micro-Organisms; and Wind and Seismic Effects) address non-marine activities and are coordinated in the United States by the Department of Agriculture (USDA). The seven panels (Aquaculture, Diving Physiology and Technology, Marine Facilities, Marine Geology, Marine Instrumentation and Communications, Marine Mining, and Sea Bottom Surveys) concerned with marine S&T are coordinated in the U.S. under auspices of the National Oceanic & Atmospheric Administration (NOAA). The panels typically meet annually.

Following a four-year pilot project, the Ministry of Agriculture, Forestry, and Fisheries (MAFF) began a seven year rice genome research project in April 1991. The GOJ approved funding of 600 million yen annually for the project. The Japan Horse Race Association plans to contribute 700 million yen annually, which will support participation of private industry in the project. The Horse Race Association also plans to contribute two billion yen in 1992 to build a laboratory in Tsukuba to house what it hopes will be called the "Rice and Horse Genome Research Institute." Japanese and American scientists, including some from MAFF and USDA, participated in the August 1991 meeting in Tokyo of the International Rice Genome Organization. The GOJ also provided some support in August 1991 to the Third International Workshop on rice molecular biology, in Sapporo, and to an international forum on current progress in rice genome research, in Tokyo.

On August 9, 1991, the GOJ adopted a 15-year national forest program that shifts emphasis from large-scale harvesting and reforestation toward treating forests as a part of the country's natural heritage. The program covers national and privately-owned forests in 44 areas nationwide.

KOREA

General

The close science and technology relationship between the United States and the Republic of Korea was highlighted by a September 1991 visit of Science and Technology Minister Kim Jin-Hyun to the United States, where he reiterated the importance of continued close cooperation with the U.S. science and technology community. In December 1991, the two countries initialled a renewed text of the U.S.-Korea Science and Technology Agreement, which had been under negotiation for over three years while issues regarding protection for intellectual property rights (IPR) were resolved. Once signed, the Agreement will provide an important framework for yearly consultation and coordination on the overall S&T relationship. It will also provide protection for IPR discoveries and copyrighted materials which might be made in the course of intergovernmental cooperation.

For the Koreans, cooperation with the United States is an imperative for realizing the goals set forth in their seventh five-year plan for the promotion of science and technology (1992-1996). The plan is primarily designed to enhance the international competitiveness of the Korean manufacutirng industry, through efficient utilization of scientific and technological R&D resources. It also calls for bringing Korea into the ranks of the G-7 countries in a number of selected strategic industrial technologies by the year 2001. Regarding cooperation with the United States, the plan specifically calls for Korea to expand joint research activities in such areas as atomic energy, avionics and space, bio-engineering, and automobile technology. Korea is also very interested in further cooperative efforts on joint development and manufacturing of semiconductor production equipment. Given these ambitious goals, the Koreans will continue to place top priority on the development of generic technology and scientific research projects which are applicable to industrial use.

Basic Science

While there is interest in furthering basic research among Korea's scientific community, the need for advanced technology in the commercial realm as a means for fueling economic growth continues to be of paramont interest, absorbing the bulk of both government and industrial resources. The limited basic research activities which are undertaken continue to be promoted primarily through Science Research Centers (SRC) and Engineering Research Centers (ERC), which are patterned after the U.S. National Science Foundation (NSF). During FY1991, there were 30 SRCs and ERCs with a total budget of $45 million, located at key universities in Korea and managed by the Korea Science and Engineering Foundation (KOSEF).

NSF and KOSEF maintain there is active and very successful cooperation under a longstanding agreement between NSF and KOSEF. At the 15th annual meeting between NSF and KOSEF, held in May 1991, the two sides agreed to establish visiting research professorships in Korea for American scientists, as well as launch six joint seminars for the coming year. In addition, the two sides agreed to pursue a new summer program at

Korean research institutes, aimed at familiarizing U.S. graduate students with Korean research activities and modeled on the very successful NSF-coordinated "Summer Institute" program between the U.S. and Japan. Cooperation in 1991 included 21 joint research projects, two joint seminars, and three scientific exchange programs.

With respect to Korea's joining international science projects, Korea has established a Superconducting Super Collider (SSC) promotion committee chaired by Seoul National University professor Kim Je-Wan, and has agreed to establish a joint working group with the U.S. Department of Energy to explore ways for Korea to become involved in the SSC project. Discussions are continuing.

Health and Life Sciences

Under a Memorandum of Understanding between the U.S. National Center for Toxicological Research and the Korea Research Institute of Chemical Technology, a successful joint research program continued involving exchanges of scientists to work on development of a new toxicology methodology.

A Genetic Engineering Research Institute (GERI) was founded in 1985 as an affiliate of the Korean Institute of Science and Technology to serve as a National Research Center for Biotechnology. Current research projects being carried out at GERI focus on solving the problems of human diseases, food, energy and national resource needs. A joint research project, supported by the Korean government and the U.S. National Institutes of Health, to develop an expression vector system for certain yeast genes proceeded between the University of Tennessee at Memphis and GERI, in Taejon, Korea. The research objective is to isolate and economically produce large quantities of biomedically active compounds. GERI hopes to develop an improved yeast artificial chromosome vector (YAC), which will be an essential element for facilitating the progress of the human genome projects.

Energy, Environment and Economics

Nuclear energy research continued as the leading area of S&T cooperation between the United States and Korea. A joint standing committee for Nuclear and Other Energy Technologies (JSCNOET) has been active for over twelve years, promoting cooperative activities and having annual meetings alternating between Seoul and Washington. The Korean government recently issued its draft long-term power development plan, which calls for construction of 75 power plants by the year 2006. The plan envisages that 40% will be nuclear, 30% coal, 20% LNG or oil-fired, and 10% hydro-electric. Nuclear power generation in 1990 was 5.2 million kwh, or 49.1% of total power generation in Korea. Power consumption increased at an average annual rate of 13.8% percent per annum over the past four years, far faster than Korea's economic growth during that period. The U.S. has played a significant role in providing the technology for this program and a significant portion of the enriched uranium nuclear fuel.

Sister laboratories agreements between institutions under the Korean Ministry of Science and Technology and U.S. National Laboratories under the Department of Energy exist to cooperate in the areas of energy conservation, solar energy and coal

technology. For example, a U.S.-Korea Joint Workshop on Coal Utilization Technology has been held annually since 1984 between the Pittsburgh Energy Technology Center (PETC) and the Korea Institute of Energy and Resources (KIER) to exchange coal related technical information, as well as on coal energy policies, marketing, mining and safety, coal conversion and environmental controls. The ninth workshop is scheduled to be held in October 1992 in the U.S.

During 1991, the environmental movement won increased support from the general public and local lawmakers, prompted by a number of well publicized environmental accidents. Korea also became more cognizant of its relationship to the world environment and appointed an Ambassador-at-large for International Environmental Affairs.

Emerging Technologies

The Korean government recently identified 14 national projects involving emerging technologies which it would like to see developed to the level of the G-7 industrialized countries by the year 2001. The Korean government has been seeking to identify possible areas of cooperation with the United States for joint development of some technologies.

Selected Korean national critical technologies and products include:

VLSI semiconductor chips including 256-megabit DRAM
Integrated services digital network (ISDN)
High-definition television
Electric-powered automobiles
Intelligent computers
New medicines for cancer, hepatitis and AIDS
Pollution-free agricultural chemicals
Computer integrated manufacturing systems
Advanced materials for the information, electronics and energy related industries
Transportation technology
Bioengineering technology
Environmental engineering technology
Advanced energy technology
Advanced nuclear reactor technology

Agriculture and Natural Resources

The Korea Ocean Research and Development Institute (KORDI), in cooperation with the U.S. Geological Survey, has conducted seven joint scientific research cruises for exploration of potential resources of manganese, cobalt, copper and nickel nodules and crusts on the deep seabed. Such exploration has taken place in the deep seas of the northeast and central Pacific and in territorial waters of western Pacific island nations over the past three years. KORDI believes this cooperative research program between USGS and KORDI is an exemplar of mutually beneficial research cooperation between developed and developing countries.

MEXICO

General

During FY-1991, broad-based and growing private and government efforts continued to create a more flexible structure for U.S.-Mexican cooperation in science and technology. President Salinas' personal commitment to both the environment and S&T were key. A 20% growth in spending on S&T in 1991 was expected to continue in 1992, and Mexico is seeking additional funding from international development banks for research and development and environmental protection.

Basic Science

U.S.-Mexican environment, science and technology cooperation is covered by some thirty MOU's (Memoranda of Understanding). While there is a growing level of U.S.-Mexican cooperation in S&T research activities conducted through agency-to-agency channels, a large amount of research also proceeds via direct contacts between researchers and scientists in universities, industry, and private institutions.

The highest level forum is the U.S.-Mexico Binational Commission, led on the U.S. side by the Secretary of State, which reviews all aspects of the U.S.-Mexico relationship, including S&T issues such as environment and health. The U.S.-Mexico Joint Mixed Commission, with U.S. participation headed by the Assistant Secretary of the Department of State's Bureau of Oceans and International Environmental and Scientific Affairs (OES), meets every two years and coordinates the activities of most U.S. technical agencies. Finally, the U.S.-Mexico Joint Fish and Wildlife Committee, co-chaired by the U.S. Fish and Wildlife Service (FWS) and Mexico's SEDUE, is enjoying a considerable increase in cooperative activities, highlighted by Mexico's accession during FY-1991 to the Convention on International Trade in Endangered Species (CITES). Three active MOUs cover fisheries and marine research. The Mex/US Gulf, Mex/US Pacific, and the Mex/US Information Exchange MOUs provide for research in species migration, turtle excluder devices (TEDs), marine mammals, remote sensing and other topics in oceanographic science.

FY-1991 saw the incorporation, with strong Congressional support, of a U.S.-Mexico Foundation for Science in Washington to support S&T cooperative activities between the U.S. and Mexico. In September, approximately 60 high level U.S. and Mexican government officials, as well as scientists and academics from both countries, attended the inaugural meeting of the Foundation. An interim steering committee was established to finalize the Foundation's charter and the structure of the governing board, as well as to raise private matching funds for the Foundation. The U.S. and Mexican Academies of Science, Medicine and Engineering, together with other research and educational institutions, are charter members.

Principal U.S. technical agencies which directly or indirectly fund basic research activities in Mexico are the National Science Foundation (NSF), the National Institutes of Health (NIH), the Department of Energy (DOE), EPA, FWS, the

National Institute of Standards and Technology (NIST) and the National Oceanic and Atmospheric Administration (NOAA). NIST has had a long term relationship with the Mexican National Council of Science and Technology (CONACYT). Through its guest researcher program, NIST brings Mexican researchers to the U.S. to conduct studies in a wide variety of fields.

In addition, a NIST official visited Mexico in September to continue negotiations with Mexican representatives from CONACYT and the Secretariat of Commerce and Industrial Development (SECOFI) on a proposed MOU between the three agencies. The MOU would allow for scientific and technical cooperation in the measurement sciences of chemistry, physics, and engineering. Proposed activities include assignment of exchange scientists to each party's laboratories, research programs by CONACYT personnel at NIST under the NIST Guest Researcher Program, mutual development and exchange of standard reference materials and intercomparison of national standards. Negotiations are progressing well.

During FY-1991, NOAA and the Mexican Secretariat of Agriculture and Hydraulic Resources (SARH) worked on a five year extension of the U.S./Mexico Meteorological Observation Program. Specifically, the agreement will facilitate the operation and maintenance of the network of Rawinsonde observation stations and the acquisition of new equipment by Mexico. As a result, Mexico has initiated a major increase in its meteorological data collection platforms. The agreement will also provide for the international dissemination of the observation results, as well as for the exchange of meteorological data between the U.S. and Mexico.

The U.S. Embassy Science Division handles all requests for research permits made by U.S. scientists, both public and private. Noteworthy advances were made in simplifying the research permit process in the 1990 meeting of the U.S.-Mexico Mixed Commission for Cooperation in Science and Technology, in La Jolla, California. Nonetheless, reducing the time and cost of the application process remained a high priority for the 1992 meeting. U.S. applicants account for some 80% of the requests for research permits in Mexico.

Health and Life Sciences

The U.S. Public Health Service, working through NIH and the Centers for Disease Control (CDC), is the leading participant in U.S.-Mexico health research. The U.S. Agency for International Development (USAID) sponsors numerous programs geared toward improving health and well-being in Mexico, with special emphasis on impoverished areas. USAID supports programs to reduce infant mortality, to educate the public on the prevention of AIDS and to assist ongoing vaccination programs. A food program provides essential nutritional supplements to more than one million Mexican families. In addition, working with the Mexican government and private voluntary organizations, USAID spent some $9 million on population assistance. Priority is given to the extension of health and family planning services in rural areas.

Energy, Environment and Economics

Facing the difficult task of balancing environmental protection with economic growth, the Mexican government is especially attuned to the interrelationship among energy, the environment and economics. Environmental planning and protection has become one of the most extensive and important areas of cooperation between the U.S. and Mexico.

The interaction of energy and environmental concerns has been especially visible in negotiations for the North American Free Trade Agreement (NAFTA). In his May, 1991 statement responding to concerns over NAFTA-related environmental issues, President Bush supported several key environmental initiatives with Mexico, including an integrated environmental plan for the Mexico-U.S. border area and the drafting of a comprehensive "Review of U.S.-Mexico Environmental Issues" with reference also to environmental effects in free trade. It also called for the development of joint technology transfer and training programs, including the Energy and Environment Clearinghouse, for database interchanges with Mexico; and the U.S.-Mexico Environmental Business Committee, to assist small and medium sized Mexican businesses in meeting environmental regulations.

Under auspices of the 1989 Mexico City technical assistance agreement between EPA, the Mexican Federal District Department (DDF) and SEDUE, extensive training and technical assistance has been provided to help in combating pollution in Mexico City. For example, technical presentations in the U.S. and Mexico have assisted Mexico in designing vehicle inspection and auto emissions verification programs. Officials from Mexico have visited U.S. labs to learn about fuels formulation and automobile engine testing practices. U.S. technical assistance continues to aid Mexico in calibration of its monitoring equipment and development of new technical standards for vehicle emissions.

The link between energy, the environment and economics is prominent in the ongoing, three-year project MARI (Mexico City Air quality Research Initiative) project to develop a computer model of Mexico City's atmospheric conditions and pollution sources. This $9 million project, jointly sponsored by the U.S. Department of Energy's Los Alamos National Laboratory and the Mexican Petroleum Institute (IMP), will allow the city's planners to evaluate the results of any mitigation strategy. The complete model will consider not only environmental impacts, but also be an operational tool to assess the social and economic impact of various government plan scenarios.

In respect to nuclear energy, at the invitation of the Mexican Committee on Nuclear Security and Safeguards (CNSNS), in February 1991 U.S. Nuclear Regulatory Commission (NRC) officials met with senior Mexican counterparts to discuss procedures for the exchange of technical information and cooperation, to become more familiar with the overall Mexican nuclear program, and to tour nuclear facilities at the Instituto Nacional de Investigaciones Nucleares (INIS) and the Laguna Verde nuclear power station.

In the area of global environmental initiatives, SEDUE, the Mexican electronics industry, Northern Telecom, the Industry Cooperative on Ozone Protection and the U.S. EPA have embarked on a ground-breaking cooperative program to exchange information, management strategies and technology to help halt the use of chlorofluorocarbons and solvents used by the Mexican electronics industry that could contribute to atmospheric ozone depletion. A fund of $85,000, contributed by EPA, has been set up at the U.S. embassy to support a SEDUE office which will carry out the program.

Representatives from EPA met in August 1991 with SEDUE to discuss a proposed U.S./Mexico study on global climate change. Both sides expressed strong interest and named chief contacts for the project. The study would include work on inventories and technology assessments in specific sectors of each country's economy. Mexico also responded positively to President Bush's initiative to design an Environmental Research Institute to address climate change issues in the context of economic and scientific knowledge. Presidential Science Advisor Dr. D. Allan Bromley and Dr. Guillermo Soberon of SEDUE met repeatedly to discuss President Salinas' support for this institute.

USAID/Mexico continued to fund a variety of training and technical exchange activities in support of global climate change, energy, NAFTA and environmental health programs. Recent years have also seen significant growth in USAID's global climate change activities with Mexico. USAID is making a major contribution to the development of sound environmental policies and operational programs dealing with protection of tropical forests and reduction of greenhouse gas emissions via innovations in energy efficiency and conservation. In FY-1991 USAID provided approximately $2.4 million for management of seven to ten parks and reserves and buffer zones surrounding them in southern Mexico. The energy component of AID's global climate change program focused on Mexico's cooperation on demand side management, energy training, and technical exchange and renewable energy technologies.

Mexico and the U.S. continued to search for ways to lessen in a cost-effective and efficient fashion the negative environmental impact of commercial fishing, and the concomitant potential of environmental concerns to complicate trade relations. A group of experts from the U.S. National Marine Fisheries Service (NMFS), the Mexican Fisheries Institute, the Fisheries Secretariat (SEPESCA) and the Mexican shrimp fishing industry jointly conducted turtle excluder device (TED) training and research trials. Although the Mexican Fisheries Institute contends that the number of turtles trapped in trawling nets without the use of TED's is low, the trials ran smoothly and SEPESCA reported that the response of shrimp trawler crews was satisfactory.

Mexico continued to be considered a model country in the region with respect to both its initiative and cooperation in on shore sea turtle conservation programs. SEDUE and SEPESCA continued jointly to conduct turtle protection projects at key nesting beaches throughout the country. The Mexican government also undertook

new efforts to reduce incidental dolphin kill. The GOM announced establishment of a dolphin and marine turtle reserve in Nayarit state, and establishment of a $1 million fund for research on technology to eliminate incidental dolphin mortality.

In June 1991, President Salinas directed Mexico to apply formally to join the Convention on the International Trade of Threatened and Endangered Species (CITES) This action has greatly encouraged environmentalists and increased the charter and funding for SEDUE's wildlife programs.

Agriculture and Natural Resources

The U.S. Department of Agriculture (USDA) and the Mexican Secretariat for Agriculture and Water Resources (SARH) continued to work together closely on technology transfer, scientific and technical exchanges, collaborative research involving universities and research centers, reimbursable technical assistance and training opportunities. More specifically, USDA, through its Office of Biotechnology, the Agricultural Research Service, the Animal and Plant Health Inspection Service, the Forestry Service, and the Soil Conservation Service, continued cooperative research and development with Mexican counterparts on animal and plant health issues, biotechnology, library exchanges, cotton genetics, soil conservation and erosion and forestry preservation.

The U.S. Geological Survey (USGS) has worked informally for several decades with Mexican geologists on investigating geologic and mineral resources. USGS sent an expert to Mexico in March 1991 to assist the Consejo de Recursos Minerales (CRM) in the design of a national computer system for geologic mineral prospecting. In September, a USGS representative traveled to Mexico to discuss the possibility of a formal MOU. The proposed agreement would provide for scientific and technical cooperation in the geological, hydrological and mapping sciences. A proposed annex to the MOU would provide for cooperation in developing a U.S./Mexico digital seismographic network.

The two countries are also contemplating cooperation in natural hazards reduction. Officials from the Federal Emergency Management Agency (FEMA) visited Mexico in October to explore prospects for revitalizing the U.S./Mexico Consultative Committee on Natural Disasters, possibly through training courses and joint training exercises. USAID supports several programs oriented towards both disaster prevention and mitigation.

NORTH ATLANTIC TREATY ORGANIZATION (NATO)

General

In 1957, NATO undertook a program of scientific and technological cooperation, under the concept that true security did not rest only on military foundations. A Science Committee of National Representatives was established along with the position of Science Adviser (subsequently Assistant Secretary General). In 1969, NATO expanded this effort by creating the Committee on the Challenges of Modern Society (CCMS), to deal with environmental and other social concerns. These two programs constitute NATO's "Third Dimension." Both were created with strong U.S. backing and the U.S. has continued to play a substantial role and has been among the most active of the allies in promoting and participating in activities under the programs.

Although the "Third Dimension" programs sought to support Allied security through excellence in science and technology and through an improved quality of life for Allied citizenry, in retrospect, they presaged the post-Cold War era in reaching beyond NATO nations. Both programs have always been open to cooperation with citizens of non-NATO countries. Even at the height of the Cold War, scientists from then Warsaw Pact countries could and did participate in NATO science activities.

This openness acquired a new dimension at the London NATO summit in 1990. The Science and CCMS Committees were among the first of NATO's various components to put forward initiatives to capitalize on the new relationships with central and eastern Europe (C&EE) and the Soviet Union. The Science Committee devoted much of its agenda to this subject in 1991. It approved two new sets of initiatives to expand the opening in late 1990 of science program activities to fund fuller participation by scientists from C&EE countries. A third set of initiatives was agreed by the Committee for consideration by the NATO Council in October 1991. Participation by C&EE states in CCMS activities also increased in 1991 as directors of several new NATO pilot studies extended invitations to C&EE entities. The U.S. continued to take an active role in formulating initiatives for outreach in both the Science and CCMS committees.

Basic Science

A. NATO Fellowships

The principal focus of the NATO Science Program is support for Basic Science. During FY-1991, the key mechanism for this continued to be the NATO Science Fellowships Program, which received about 50% of the core science budget (the equivalent of about $12.5 million in 1990). NATO fellowships have contributed to the training of nearly 25,000 scientists from Alliance member countries. The U.S. has been the host country for half of all these NATO fellows (12,363 of 24,622 from 1963-1990). In 1990 the U.S. awarded 99 fellowships, and received 592 visiting fellows, out of a total of 1,217.

The principal fields of study have been life and medical sciences, followed by physics, applied sciences and engineering, and social sciences. Administration of fellowships is on a national basis, thereby enabling national priorities to be best served. The U.S. administering agency is the National Science Foundation (NSF).

B. Advanced Study Institutes, Advanced Research Workshops and Collaborative Research Grants

Other elements of NATO's science program continued to offer different kinds of support for basic science. The principal ones are the Advanced Study Institute (ASI), Advanced Research Workshop (ARW), and Collaborative Research Grant (CRG), complemented by special programs including science surveys.

Around 35 percent of the core science program budget is spent in support of ASI's and ARW's. Several thousand scientists are involved each year, including scientists from non-NATO countries. The initiatives taken by the Science Committee in late 1990 produced a significant increase in C&EE participation, up from 250 persons in 1990 to 400 in 1991. Full implementation of the 1991 initiatives should work to increase these figures considerably further during 1992.

The Advanced Studies Institute (ASI) mechanism is a teaching activity in which leading scientists present the latest work in their field. Some ASIs are multidisciplinary, allowing participants to serve as both teachers and students. Typical subjects from the 1991 list included: "The Changing Visual System: From Early to Late Stages of Life"; "Molecular Liquids: New Perspectives in Physics and Chemistry"; "Parallel Computing on Distributed Memory Multi-processors"; and "The Global Carbon Cycle." Over 1700 ASIs have been held since the program began in 1959, with 70 (19 U.S. led) sponsored in 1991. Proceedings are published (over 1000 volumes to date) and thus reach even larger audiences. The program has also tested the use of televised ASIs, further expanding the audience.

The Advanced Research Workshops (ARWs), in contrast, offer occasions for groups of 20 to 40 scientists to engage in intensive discussions of a particular area or problem. The first ARWs were held in 1980 and by the end of 1991 NATO had sponsored over 400, making 76 (30 U.S. led) grants in 1991. Subjects covered in 1991 included "Coherence Phenomena in Atoms and Molecules in Laser Fields;" "Frontiers of High Pressure Research;" and "Emerging Technologies for In-Situ Processing." ARW proceedings are also published.

Finally, the collaborative research grants assist projects based on national funding to incorporate an international element as well, by funding the travel and living expenses of members of the research team while on exchange visits. Such collaboration has synergistic benefits for the scientific work of all participants, and has helped build strong relationships within the Atlantic community. There were 616 projects funded in FY91, bringing the total since 1960 to well over 7000.

C. Special Programs

NATO has a longstanding tradition of funding work targeting a particular scientific concern. In recent years, these programs have been structured to concentrate on areas that are emerging or are undergoing rapid change. Special programs in 1991 included "Chaos, Order and Patterns: Aspects of Nonlinearity"; "Advanced Educational Technology;" "Science of Global Environmental Change" (discussed in more detail below under Energy, Environment and Economics); "Nanoscale Science" and "Supramolecular Chemistry."

In 1990, the science program began a new series of targeted studies on the frontiers of science. Scientists in a NATO science survey will identify areas for new NATO special programs. The first survey forum, which included six Nobel laureates, recommended the special program on nanoscale science as appropriate for further work. Two additional survey meetings were held in 1991, one on chemistry and one on life sciences. The participants in the latter meeting recommended a focus on fundamental genome research to complement national and other international work.

D. Science for Stability

NATO also supports a special approach to the development of basic scientific capabilities in the less prosperous members of the Alliance by strengthening the scientific infrastructure of those states (Greece, Turkey and Portugal). Under this Science for Stability Program, national authorities develop projects, with involvement of universities, research institutes, and private industry. NATO funding supplements national funding with approximately 150 million Belgian francs allocated each year (about $4.7 million in 1991). Projects supported in 1991 included work on cement (Greece), satellite oceanography (Portugal), and microelectronics (Turkey).

Health and Life Sciences

Support for the life sciences is intertwined with NATO's support for Basic Science. The NATO Fellowship program has strongly supported life and health sciences. This field was also well represented among ASI grants during 1991, with topics such as "Advanced Models of Cognition for Medical Training and Practice"; "Targeting of Drugs: The Challenge of Peptides and Proteins;" and "Asthma Treatment: A Multi-disciplinary Approach." Roughly a third of the ARWs dealt with topics in this field, such as "Biology of Salmonella" and "Strategy for Biomarker Research and Application in the Assessment of Environmental Health." Cancer research received attention in an ARW on "Oncogene and Transgenics Correlates of Cancer Risk Assessments," and cardiovascular disease in an ASI on "New Frontiers in Cardiovascular Engineering." Two of the pilot studies in the related CCMS program (described below) dealt with health issues: "Disaster Preparedness Plans Responding to Chemical Accidents - Health and Medical Aspects," and "Dose-response Analysis and Biologically-based Risk Assessment for Initiator and Promoter Carcinogens."

Energy, Environment and Economics

NATO's principal environmental role lies in the Committee on the Challenges of Modern Society, the CCMS. Established by an initiative of the Nixon administration, it has now completed twenty-two years of very successful work in promoting practical approaches to improvement of the quality of life in NATO countries. The CCMS program is based on Pilot Studies by member nations on particular problems. Not all Allies participate in all studies, and each is free to choose which are most appropriate to its needs and expertise.

The pilot studies are intended to help policymakers and stimulate action. Results are available to all. CCMS pilot studies are fully reported through the CCMS publication series. There were 21 pilot studies underway in 1991, with several others awaiting approval. Pilot studies also make the CCMS program an important area for cooperation with C&EE states, by sharing expertise in environmental and other social issues. During 1991, several pilot studies included C&EE participants and further expansion is anticipated in 1992.

During the 1991 review of its goals and activities, the CCMS underlined defense-related environmental issues as a key area for future work, including defense base closure and cleanup. Environmental issues are also included in NATO science program activities. An example in 1991 was an ASI on "Chemical Reactor Technology for Environmentally Safe Reactors and Products." Ten ARWs and two ASIs during 1991 addressed global change topics such as "Prediction of Interannual Climate Variations" and "Biological Implications of Climate Change."

Emerging Technologies

NATO has supported collaborative work in most of the emerging technology areas. In 1991, the program addressed materials issues (an ASI on "Physics and Materials Science of High Temperature Superconductors"); manufacturing processes and technologies (an ASI on "Concurrent Engineering Tools and Technologies for Mechanical System Design"); information and communications technologies (an ARW on "Information Technologies and Mathematical Problem-solving Research"); and biotechnology (an ASI on - "Recent Advances in Industrial Applications of Biotechnology").

Agriculture and Natural Resources

Both the NATO Science and CCMS programs sponsored work related to this area in 1991. The science division supported an ARW on "Biological Control of Plant Diseases" and an ASI on "Risk and Reliability in Water Resources and Environmental Engineering." The CCMS program continued its pilot study on "Desertification in Developed Areas," and launched two new studies titled "Impact on Man and Environment of the Agricultural Use of Pesticides" and "Integrated System for Agrometeorological Support" respectively.

ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD)

General

The 24 member countries of the Organization for Economic Cooperation and Development (OECD) participate in policy formulation and evaluation to foster economic well being through effective government policies, including on science, technology and the environment. In addition to its regular work, the OECD in FY-1991 completed a major three-year study on "Technology and the Economy," and environment ministers endorsed an environmental strategy for the 1990's. Authorities in eastern Europe and the former Soviet Union requested policy advice and technical assistance and sought to participate in some OECD committee work, as they faced difficult science, technology, and environment policy issues including conversion of defense industries to civilian uses. The OECD has attempted to respond within its resource limitations.

Many OECD committees focus on governmental policy evaluation. The U.S. is deeply involved in the policy work of the OECD Committee On Science and Technology Policy, the Environment Committee, the Committee on Information, Computers and Communications policy, which it chairs; the OECD-affiliated Nuclear Energy Agency (NEA), and the R&D Committee of the semi-autonomous International Energy Agency (IEA). The work of all these groups is aimed at stimulating environmentally sound technological change and market-led economic growth.

Basic Science

In response to a June 1991 ministerial call, the OECD Committee for Scientific and Technological Policy (CSTP) undertook to examine both whether and how international, mutually beneficial cooperation in major scientific research projects could be further improved among member governments and research communities on the basis of equitably shared responsibilities. Following upon CSTP recommendations, OECD ministers will also consider how to promote a coherent approach to "big science" cooperation at their meeting scheduled for March 1992. The U.S. has been instrumental in promoting this initiative, which is supportive of U.S. "big science" activities with its major bilateral S&T partners, e.g., Japan, France, Germany, the U.K., Italy and the former Soviet Union.

Energy, Environment and Economics

Setting the stage for activities in FY-1991 was the OECD Environment Ministerial Meeting held January 30-31, 1991, which, with U.S. leadership, agreed on a three-part strategy for the 1990's. The ministers emphasized integrating economic and environmental policies, focusing on the role of market incentives in fostering environmental improvement, sectoral policy integration and trade. The main point to emerge was that full integration of economic and environmental policies is key to sustainable economic development.

The OECD does not itself conduct scientific research. The organization does, however, provide a coordinating mechanism under which energy research and development is facilitated by implementing agreements in which several countries cooperate to pursue an agreed program of activities. The U.S. participates or has participated in 6 Nuclear Energy Agency and 43 International Energy Agency agreements since the inception of those organizations. Active NEA agreements have ranged from information exchanges on decommissioning nuclear power plants to investigation of the Three Mile Island reactor accident in the U.S and to testing geologic formations in Sweden to determine their suitability for permanent waste disposal.

Active IEA agreements cover research, development and sometimes demonstration programs on topics such as alcohol and alcohol blends as motor fuels, high temperature materials for automotive engines, coal/oil mixtures, energy conservation through energy storage, enhanced recovery of oil, production of hydrogen from water, energy technology systems analysis, wind turbine systems, coal combustion sciences and technologies relating to greenhouse gases derived from fossil fuel use, and materials and magnet performance in fusion energy applications. Implementing agreements have also been used to set up the IEA Coal Services, an ongoing network on coal research; an information Center for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET); and an Energy Technology Data Exchange, a repository, centered at the Oak Ridge National Laboratory, of bibliographic information for all related nuclear and non-nuclear technology research conducted by participating countries.

As part of a focus on improving individual domestic environmental performance, the OECD agreed to begin member country environmental policy performance reviews. They also committed themselves to reduce significantly the overall pollution burden in the OECD region in the next decade, focusing on new pollution control strategies and emerging clean technologies. A new program for reduction of risks from man-made chemicals, more comprehensive integrated pollution prevention and control approaches, and reduction of transboundary movements of wastes were also embodied in decisions at the Ministerial.

Emerging Technologies

OECD's "Technology and Economy Program" presented its main findings, after three years work, to OECD's June 1991 ministerial meeting. A policy statement emphasized improving our understanding of the relationship between policy instruments and the innovation process. The statement spotlighted the role of firms as central, along with government responsibilities for establishing an appropriate environment for technological development through market-oriented policies, provision of an adaquate economic infrastructure and policy coordination over the whole range of issues affecting technology innovation and diffusion.

Other than the IEA's work, the OECD's main specific contribution in emerging technologies has been work on biotechnology. Much progress continued to be made in advancing a science-based approach to policy development on the many contentious issues which arise in this area, including biotechnology safety issues. A comprehensive report on agriculture and food impacts of biotechnology was completed and new work on "Biotechnology for a Clean Environment" was begun. This effort will focus on science and technology for prevention, detection, and remediation of air, soil, and water health threats.

POLAND

General

As did other parts of the society, Poland's science establishment faced severe difficulties in 1991 in attempting to cope with the broad changes sweeping the country. New S&T institutions were created while old and familiar ones, such as the Academy of Sciences, were eclipsed. Central control over science funding was broken but resources for basic research grants, the mainstay of most laboratories, were cut sharply in government austerity moves. Although one of Poland's traditional strengths, science has yet to find a role for itself in the restructuring of the country's economy and increasingly looks abroad for confirmation and assistance. In this context, the support for basic research provided by the Maria Sklodowska-Curie Fund (MSC II, equally supported by both governments) and other bilateral arrangements have taken on added importance for Poland's scientific community.

U.S. S&T cooperation with Poland in such areas as agriculture, health and environmental protection is longstanding and remained strong during FY-1991. More recent U.S. initiatives in the field of energy and the environment, in particular President Bush's proposals to help Krakow solve its complex air pollution problems, continued to offer the potential to improve measurably conditions for Poles while also contributing to economic development.

Basic Science

Science reorganization

The framework within which basic research in Poland is managed and funded was radically altered in 1991 with the establishment of the State Committee for Scientific Research (KBN) which reports directly to the Council of Ministers. The Committee will direct a uniform, nation-wide process supporting research, in which merit rather than institutional or personal influence is to be the most important criterion for obtaining government support. The change removed funding control for research from the functional ministries and the Polish Academy of Sciences, thus fundamentally shifting the power relationships within the country's scientific establishment. Under the new procedures, university laboratories, Polish Academy of Sciences laboratories and government research institutes will have to pass through the same merit-based review process. The U.S. National Science Foundation (NSF) has played an important advisory role in this changeover by sharing with Polish authorities its experience in operating a peer review grant system.

The new committee is composed of sixty members elected by all Ph.D.- level researchers in Poland, as well as professional staff of scientific and research institutions. A 19-member executive body is to direct the applied research program. The chairman of the Committee, nominated by Parliament, is Witold Karczewski, a medical doctor and former head of the Neurophysiology Center of the Polish Academy of Sciences Medical Research Center. Professor Cezary Ambroziak, former science counselor at the Polish Embassy in Washington,

and now director of the Institute of Electron Technology, Warsaw, was elected deputy chairman. The committee will direct all state S&T policy, recommend funding levels for all state R&D and scientific activity, and coordinate and cofinance joint activities under bilateral and multilateral agreements.

Full implementation of the new grant review approach is expected to be a slow process as resistance remains strong among many of those, both within and outside the new Committee, who were successful under the old system. The changeover has been complicated by a 30% cut in research funding imposed by the government in 1991 as a budget austerity measure.

Cooperative research

Close cooperation between the United States and Poland in the promotion of basic scientific research continued in 1991 under the umbrella of the MSC II. The Fund, established as a result of an agreement signed by then Vice President Bush in September 1987, provides joint research opportunities for Polish scientists in a broad range of disciplines. In 1991, the U.S. contributed $1.7 million to the fund, bringing to $3.575 million the total U.S. Government (USG) funding support for MSC II since its establishment. The Polish government matches all U.S. contributions in Polish currency, zlotys.

In its April 1991 meeting, the U.S.-Polish Joint Commission for Science and Technology Cooperation, which oversees MSC II Fund operations, approved continuation of a three-tiered approach to research priorities and funding allocations for the fund's cooperative activities, as follows:

- First priority - agriculture, environmental protection, medical science and health protection, basic research and engineering research (70% of the fund total);

- Second priority - geoscience research and exploitation of mineral resources, and energy research (20%);

- Third priority - transportation, construction research, oceans, atmospheric sciences and limnological (lakes, ponds, streams) research, parks management and historical preservation, and fish and wildlife conservation (10%).

Among some of the projects approved for MSC II funding in 1991 were:

- Agriculture: differential serological diagnosis of BVD and HC infections in swine.

- Science: new electrophoretic detection and capillary modification techniques (with the U.S. National Science Foundation).

- Energy: repowering of coal fired plants with Integrated Gasefication Combined Cycle (IGCC); flue gas electron beam treatment process upscaling.

- Basic research: analysis of global thermodynamics of solar flares (with NOAA).

- Health: tumor diagnosis - molecular genetics; effect of nickel compounds on the immune system; monocytes and immunoregulation; environmental factors in low birth weight.

Polish scientists have fared successfully within USAID's Program on Science and Technology Cooperation (PSTC). In 1991, one Polish project qualified for a grant of $150,000 and two were listed among the top 25% qualitatively of project applications received and to be reviewed further for possible grants. Under auspices of the U.S.-Israeli Cooperative Development Research Program (CDR -- a program entailing U.S. support for bilateral projects between Israel and developing countries), eight groups of Polish and Israeli scientists were requested to provide full project documentation for grant awards made in October 1991.

Health and Life Sciences

During FY1991, health care improvement continued to be a primary objective of the government of Poland. A serious shortage of up to date equipment exists in Polish hospitals and the health care system in general lacks trained professional administrators. Polish health care authorities are concerned over the country's incidence, the highest in Europe, of male mid-life sudden death. Widespread smoking, increased animal fats consumption, stress and environmental degradation are thought to be factors contributing to this disturbing phenomenon. Infant mortality (on average 18 per 1000 births) also continues to be a major problem in Poland.

U.S. cooperation with Poland in the area of health care has continued for many years and includes MSC II fund research projects, NIH (Fogarty International Center) scientist exchange programs and institute-to-institute agreements on cooperation in such fields as cancer research and cardiovascular diseases.

Cooperation between the Polish Oncology Center and the National Cancer Institute (NCI) was initiated 15 years ago and continued to be active. There is current focus on epidemiology research, radiotherapy and basic research. In 1991, NCI donated a cancer publications database and a register of cancer clinical experiments (PDQ) to the Oncology Center. With financial support from the MSC II fund, Polish and U.S. scientists are trying to determine the causes of low birth weight in Poland at Krakow, Zakopane and Limanowa, where low birth weight incidence is significantly above the national average. As a part of this effort, the new air monitoring system recently installed by the U.S. Environmental Protection Agency (EPA) in Krakow will be used to help develop relevant environmental indicators.

In late 1991, USAID entered into preliminary design discussions with Poland on a health care financing project aimed at bringing health care to the market place, within a framework of public policy which encourages privatization and ensures quality and cost containment.

In November, 1991 AID/DOC sponsored a health services mission to Poland to assess investment opportunities for U.S. firms in the medical equipment, pharmaceutical , health services and health insurance industries.

The drug abuse situation in Poland, while still not as alarming as in many western countries, is a growing problem. Polish medical authorities are especially concerned over the direct relationship between drug addiction and AIDS cases in Poland, since approximately 80% of HIV positive cases have been drug addicts. According to the Health Ministry, 1900 people have been found to be HIV positive and 70 AIDS cases confirmed, of which 37 have so far proven fatal.

Energy, Environment and Economics

The nexus between energy, environment and economics is readily apparent in Poland, one of the world's least energy efficient and most seriously polluted countries. Wastes and emissions from the power industry have had a devastating impact in many areas of the country. SO_2 and particulate emissions due to poor combustion techniques, and the absence of desulfurization equipment have damaged human health, buildings, and agriculture. Energy inefficiency also directly constrains the country's economic growth. The government is striving to lighten this economic and environmental burden by promoting energy conservation, ongoing conversion to more environmentally safe firing systems in coal-fueled power plants and improvements in coal quality.

The major U.S. initiative to retrofit the Skawina power plant outside Krakow, announced by President Bush during his visit to eastern Europe in July 1989, is directly supportive of the Polish government's effort to manage energy production in an environmentally sound manner. In September 1991, the U.S. Department of Energy (DOE) awarded a $7.7 million contract to the U.S. firm Airpol, Inc. to apply state of the art desulfurization equipment to a 50-megawatt boiler at the Skawina plant. The system is expected to capture up to 98% of the sulfur pollutants currently spewing from the plant. The Polish government has since contracted with Airpol to install similar equipment at a second, adjacent boiler at a cost of $3.4 million. The combined $11 million investment will fully refurbish two of the boilers serving one of the plant's eight turbines. The installation, expected to be completed in 20 months, will serve as a demonstration of U.S. clean coal technology and could pave the way for joint ventures between Polish and U.S. companies in the energy field. When operational in May 1993, the advanced equipment is expected to enable the entire Skawina power plant to meet current air quality requirements as well as improve its operating efficiency.

In tandem with the Skawina project, the United States continued to assist Krakow with its serious air pollution problem caused by the large number of low level sources of emissions, i.e. 1,000 boilers and up to 200,000 small coal-burning furnaces in the city. The basic goal of the project, which is being implemented by

the Department of Energy, is visible improvement in air quality in Krakow by the end of 1993. The $20 million (over 3 years) program is financing pilot projects for alternative technological solutions, including an expanded district heating system, more efficient small furnaces, greater use of gas and electricity and the development of regulatory and market mechanisms that will promote end-user selection of the most cost-effective technologies. Creation of an hospitable climate for private investment, especially joint ventures, is a central element of the strategy.

Two other environmental projects proposed by President Bush during his 1989 visit came to fruition in 1991. EPA completed installation of an advanced $1 million air quality monitoring system in Krakow, composed of seven fixed stations and one mobile unit. A $5 million project aimed at helping the city improve its water quality also reached completion and was officially inaugurated in August 1991. This project, which involved upgrading two drinking water treatment facilities, two waste water treatment facilities and a water quality laboratory, was implemented by EPA in collaboration with the Army Corps of Engineers.

Conservation and management of Poland's natural beauty figures importantly in U.S.-Polish cooperation. In 1991, eight U.S. Peace Corps environmental volunteers arrived in Poland to work as nature park advisors. Also, during the year, AID agreed to provide technical assistance to review and strengthen the management plan for Bieszczady Transboundary park. It was hoped that this assistance will lead to cooperative efforts with Czechoslovakia and the Soviet Union on enlarging the park. EPA was also active in developing an international program to protect Poland's Mazurian lakes region, often called the country's "green lungs."

Debt for Environment

In a major environmental initiative with implications beyond Poland, Prime Minister Jan Bielecki announced in June 1991 the establishment of an environment fund, to be supported innovatively. Financing would come from swap arrangements on the part of Paris Club countries which elect to make an additional 10% voluntary reduction in official Polish debt owed them, as provided for under the Paris Club agreement of April 2, 1991 which reduced Polish official debt by 50%. The U.S. took the lead in promoting this debt for environment swap, which was publicly proposed during President Walesa's March visit to the United States. The U.S. agreed to cancellation of 10% of its outstanding official debt principal for this purpose, effective with the signing of the U.S.-Poland Bilateral Debt Reduction and Rescheduling Agreement of July 1991. Poland will use the local currency equivalent of the cancelled debt to fund projects targeted on nature conservation, and on international environmental objectives such as transboundary air pollution, Baltic Sea cleanup and reduction of greenhouse gas emissions.

Emerging Technologies

An important element for the transformation of Poland's economy is access to advanced technologies and materials. In support of this goal, in May 1991 the United States and its COCOM partners announced implementation of a new system of export controls which greatly increases Poland's access to previously restricted technologies.

Agriculture and Natural Resources

The United States and Poland have a long history of scientific and technical cooperation in agriculture. Most activity in this area occurs under a Foreign Currency Research Program, using local currency from the past sale of U.S. Public Law 480 commodities with matching grants from participating Polish institutions. Joint research continued in 1991 under sixteen active projects with a total grant value of $1.8 million. The Maria Sklodowska-Curie fund also supports agricultural research cooperation. Three new grants were approved in 1991, bringing the total of active projects to eleven with an overall grant value of $1 million. Funds provided under the Foreign Currency Research Program and MSC II can be used for laboratory equipment as well as exchanges of scientists.

The U.S. Department of Agriculture (USDA) and the Polish Ministry of Agriculture initiated in 1991 a three-year project designed to restructure and refocus the Polish agricultural research system. A strategic planning committee, working with a U.S. advisor, recently identified the following priorities for agricultural research in Poland: improving the quality and safety of food products, reducing costs, minimizing post-harvest losses, improving marketing capability and safeguarding the environment. The project is funded by local currency from the sale of Section 416 (b) corn donated to Poland and by dollars provided under Support for Eastern European Democracy (SEED-II) legislation.

As part of the USDA/Agriculture Ministry project, Polish and U.S. officials will also work with Poland's agricultural chemical laboratories to provide analysis and training required to respond better to Polish farm needs. USDA Extension Service advisors assigned to Polish extension centers will also assist in facilitating linkages between scientists and farmers.

SOVIET UNION

Note: the terms "USSR," "Soviet Union" and "Soviet" as used below and throughout this report refer to the former Union of Soviet Socialist Republics as it existed in FY-1991. Portions of this narrative have been modified to reflect the momentous changes which took place in the last quarter of calendar 1991 and to address S&T relations with successor states to the USSR.

General

As the Soviet Union disintegrated during 1991, its science sector endured wrenching changes. The likelihood emerged of eventually having to deal with twelve successor state S&T establishments. Some degree of cooperation will continue among the scientific institutions of the former Soviet Union, but the shape and extent of this cooperation is far from clear.

FY-1991 saw an unprecedented new commitment to openness and a desire on the part of scientific institutes to show to Western audiences the results of their work -- often previously classified as military secrets. Visits to formerly restricted sites and institutes became commonplace; access to facilities previously closed became possible and even welcome; closely held technology suddenly was offered commercially to Western partners and potential partners.

Forces of decentralization and disintegration directly both affected science policy and the day-to-day life of Soviet scientists. The upheaval threatened to disrupt the future development of science as funding for scientific research became less certain. However, the changes could also afford opportunities for new fruitful interactions between successor states' scientific communities and the U.S. and others.

Basic Science

As the Soviet Union's principal successor, the Russian Republic inherited an impressive science sector, including:

- a space program which has launched more satellites than any other and is the leader in studying human adaptations to habitation in space;
- low, medium and high-energy physics institutes conducting world-class theoretical and experimental research; and
- an extensive nuclear power industry that supports advanced experimental facilities in almost all areas of contemporary fission and fusion energy fields. Particular strengths include fuel cycle and advanced technology for fast-breeder and space-based reactors.

There were indications that the Russian Republic would seek to continue the former USSR's S&T relationships with the U.S., including aspects which were negotiated during FY-1991. The potential for basic science cooperation was broadened as a result of an amendment to the 1989 U.S.-Soviet agreement for cooperation in the field of basic scientific research. At a meeting of the U.S./Soviet Joint Commission on Basic Sciences held in Moscow in May 1991, the two sides agreed to add social sciences to the list of areas for cooperation and to include experimental as well as theoretical physics on the list. The Joint Commission also heard positive reports on the continued growth of cooperation under the agreement, took note of activity under the memorandum of understanding in geosciences, and considered planned new cooperative activities.

The National Science Foundation organized a workshop for Soviet government and science officials on how NSF operates. The program included detailed discussion of NSF's peer review system, grants management, industry-government linkages and international cooperation. NSF undertook to stay in contact in conjunction with development of new competitive grant making institutions.

U.S.-Soviet joint space cooperation reached new levels in 1991. Under the Total Ozone Mapping Spectrometer (TOMS)/Meteor-3 program, U.S. equipment was installed in a Soviet satellite and launched on a Soviet rocket from Plesetsk Cosmodrome. This was the first time U.S. scientists had ever been granted access to this sensitive facility. In another case, U.S. heavy nuclei collectors were launched on two Soviet rockets under the "Trek" project. An exchange of high-level visits by space officials further explored the new openness and opportunities for expanded cooperation. Threatened by rapidly shrinking state financing, but also encouraged by the new openness of society, Soviet space scientists enthusiastically sought enhanced cooperation not only with NASA but also with leading U.S. laboratories and universities. The U.S.-Soviet Joint Working Groups on solar system exploration, space biology and medicine, and solar-terrestrial physics all met and initiated new projects in 1991.

Other successor states acquired rich scientific inheritances. Ukraine and Byelarus are strong in selected high technology areas such as cybernetics and new materials; Armenia has a world-class astrophysics institute; Georgia is renowned for theoretical mathematics; Kazakhstan is strong in geology and has a key element of the space program; and Tadzhikistan has a good seismology institute.

Health and Life Sciences

A delegation from the Academy of Sciences of the USSR visited the National Institutes of Health (NIH) early in 1991 to explore basic biomedical science cooperation. Areas of possible cooperation addressed included cancer, immunology and AIDS, molecular biology and genetics, neurobiology, clinical research and scientific information exchange. Scientific projects in these areas were

discussed and by year's end, a significant number of exchanges had taken place, particularly including activity in the areas of cancer and immunology.

A new area of focus that developed during the year was health care management. As facilities and schools that were formerly funded by the central Soviet government move toward privatization, priority is being given to medical insurance, hospital management, organization and content of medical training, and administrative training.

Energy, Environment and Economics

The interactions of energy production and use, economics and environmental quality are perhaps more graphic in the former Soviet Union than in any other country. During FY-1991, the USSR's new openness brought to light vividly the degree to which the distorted domestic price structure had resulted in misallocation of resources and squandering of energy on a massive scale for decades. On average, the Soviet Union used 50-100% more energy per GNP unit than the U.S. Shielded from competition and lacking an economically efficient means of allocating energy costs, Soviet enterprises were saddled with outdated, inefficient technology. To give but one example, the use of (obsolete) open-hearth steel manufacturing remains commonplace.

Republic governments, though worried about safety, continued to be reluctant to close older nuclear power plants because of fear of power shortages, and lack the means to finance needed safety improvements.

The absence of effective administrative or economic instruments to control pollution continued to aggravate these structural problems, causing severe, and in some cases catastrophic, environmental damage.

In 1991, the U.S. initiated several programs intended to improve Soviet understanding of the energy-environment-economics relationship:

- At the tenth meeting of the U.S.-Soviet Joint Committee on Cooperation in the Peaceful Uses of Atomic Energy (PUAE), in July 1991, the U.S. advocated more emphasis and activity under the U.S.-Soviet Memorandum of Cooperation on Environmental Restoration and Waste Management.

- At the same meeting, work under the PUAE Memorandum of Cooperation in Civilian Nuclear Reactor Safety, covering eleven working groups, was also highlighted. Ten of the working groups met and actively pursued projects during 1991.

- At U.S. initiative, in April the Joint Commission of the U.S.-Soviet Agreement in the Field of Environmental Protection added cooperation in environmental economics to its ongoing activities. Both sides planned to share information and experiences in using market mechanisms to limit damage to the environment.

- American natural gas pipeline experts made two visits to the USSR to examine ways to reduce leakages of methane, a greenhouse gas, from Soviet pipelines. (Methane emissions from the Soviet natural gas distribution network, the world's largest, amounts to between 6% and 10% of the total transported, and thus are a significant fraction of the world's industrial source methane emissions.)

- U.S. private sector representatives, with valuable support from DOE and EPA, held a series of workshops with Soviet policy officials on creating effective procedures and legislation regulating ownership and development of energy resources.

Emerging Technologies

Also at the July 1991 meeting on PUAE, the two sides began a new phase in long-standing cooperation in the areas of magnetic confinement fusion and fundamental properties of matter by signing two new memoranda of cooperation into force. The U.S. side also proposed Soviet participation in the construction and operation of the Superconducting Super Collider (SSC) and cooperation on the planned Burning Plasma Experimental Reactor. Both countries reaffirmed their commitment to work together with Japan and the EC on the International Thermonuclear Experimental Reactor (ITER) project.

Agriculture and Natural Resources

U.S.-Soviet activities in 1991 were hampered by Soviet financial difficulties, which prevented USSR organizations from implementing most of their planned programs. In December 1989, a two-year program of nearly 60 exchanges was adopted for work in the areas of agricultural research, forestry, and economic research and fact-finding. Most activities in 1990 were carried out as scheduled, but in 1991, the level of activities decreased substantially, most notably on the Soviet side. The United States continued in 1991 to send teams to the USSR in each of the agreed areas, although a few of planned activities were not implemented. Because of lack of funds only a few of the Soviet proposals were carried out. In the absence of a new agreement, no initiatives were in prospect for a program of activities in 1992.

Outlook

Over a long history of cooperation that came to transcend Cold War politics and the arms race, the United States' two main Soviet science interlocutors were the USSR Academy of Sciences and the State Committee on Science and Technology (GKNT). In the wake of the failed August 1991 coup, these organizations were taken over and restructured by the Russian government by the end of 1991. GKNT was absorbed by the new Russian Ministry of Science and Technology Policy (MINSCI), and the USSR Academy reacquired its pre-Stalinist name as the Russian

Academy of Sciences. Other successor states began to take stock of their S&T resources and management organs. There were signs that the newly independent republics were disposed to forge inter-state cooperative links and mechanisms in areas such as space and the environment.

The future of science in all these countries, however, was threatened by a potentially serious brain drain, uncertainty over funding (the Soviet military lavishly supported fundamental research and provided secure employment to more than 70% of the former Soviet Union's scientists), and the challenges of conversion to a market economy. Science policy makers in the new republics are seeking a middle passage between the Soviet model of science-by-command and more laissez-faire, self-supporting scientific enterprises. The end result will likely be leaner, more applications- and commercially-oriented science sectors, with continuing research and cooperation opportunities for the U.S.

SPAIN

General

With one of the fastest growing economies in Europe, Spain has accelerated the pace of and raised the level of its performance in science and technology. Spain is a significant participant in EC S&T programs, joint European S&T labs such as CERN, the European Space Agency (including Space Station Freedom), Antarctic research, international astronomy and AIDS research.

1991 saw renewal of a U.S.-Spanish agreement on space cooperation. Besides providing for joint R&D activities, the agreement makes available Spanish airports available to NASA as emergency landing sites for the space shuttle. Such availability is essential to the space shuttle program.

In 1991, Spain also forswore construction of new nuclear power plants until the year 2000. Though not closing the door forever on new plants, the government expressed confidence that safer and more efficient reactors could be built in ten years' time. Spain currently has nine operating nuclear plants.

Despite its recent significant investment in R&D, Spain remains a large net importer of the technology it needs to build its economy. As Spain strives to modernize its industrial base in an effort to raise its economy to the EC average, it often neglected its environment. Spain must cooperate with fellow EC members and others and make large investments in environmental technology -- much of which is necessarily imported -- in order to meet community standards and international expectations. Spain's need for technology to underpin its booming economy and protect its environment makes it a good prospect for U.S. exporters.

Basic Science

Spaniards consider that Spain's achievements in science, especially in areas such as biology where Spain is particularly strong, make it a worthy partner for international cooperation with the United States.

Spain doubled its R&D outlays as a percentage of GDP between 1984 and 1988, while GDP itself was doubling. By 1991 R&D support was about 0.9 percent of GDP. The number of scientists and engineers per thousand in the work force rose to 2.0 in 1991 from 1.1 in 1982. Spain's percentage of published research papers doubled to 1.6 percent of the world total between 1982 and 1990.

These brief statistics indicate Spain's commitment and development as a scientific country. Still not broadly present in the front ranks, Spain is significantly better suited for S&T cooperation than in 1976 and 1982, when supplementary accords to U.S.-Spain defense cooperation agreements last provided significant U.S. funding for joint research.

Formal U.S.-Spanish joint research cooperation ceased at the end of 1989 with the expiration of our bilateral S&T agreement, and has not been resumed due to unresolved differences over the protection and allocation of rights to intellectual property that might be developed during joint research. Informal work continued during FY-1991, along with some formal exchanges. Activity with the U.S. is seen by Spanish scientists as in their professional interest and by the government as a means of cooperating outside the EC framework. The Spanish government pays for a large number of advanced degree candidates to study and do research work in the U.S. and also brings over a hundred Americans yearly to Spain. Although there are more Spanish scholars in the U.S. than U.S. scholars in Spain, exchanges are limited only by funds (more on the U.S. side than the Spanish). Access is not a problem in Spain.

Health and Life Sciences

Cooperative work by the U.S. Centers for Disease Control (CDC) and the Spanish Ministry of Health has continued since 1981, when adulterated rapeseed (cooking) oil left 650 Spaniards dead and 25,000 affected in lasting ways. The ongoing follow-up investigation has implications for identifying toxic agents and their effects in the U.S.

As of late FY-1991 Spain had recorded 8,200 AIDS cases, 3,185 of them fatal, since Spain began keeping such figures around 1982. The Health Ministry has made AIDS a priority, and 75 Spanish R&D groups, many supported by the EC, were engaged on AIDS. Spain claimed this to be the largest effort of any EC country.

Spain is also strong in biotechnology (see below under Critical Technologies).

Energy, Environment and Economics

Spain's national energy plan for 1991-2000 stipulates specific environmental objectives for the first time. One goal is to reduce sulfur dioxide emissions from large facilities by the year 2000 to 42% of their 1980 level. Oxides of nitrogen are to be reduced to 263 kilotons per year.

Much of Spain's industry does not meet EC environmental norms. Massive infusions of capital (tens of billions of dollars) from the government, the EC and industry will eventually be necessary to clean up Spain's power and industrial sectors and to meet community waste water treatment requirements.

Spain is generally supportive of U.S. positions in international global change fora, in which Spain participates actively. Its situation with respect to control of carbon dioxide emissions is less critical than that of other EC countries. The Community seeks to limit its total emissions by the year 2000 to their 1990 level. A relatively low producer now, Spain could increase its current emissions and still be under that ceiling, while more industrialized members will have to reduce theirs.

In 1991 Spain reaffirmed its nuclear moratorium of 1984, definitively postponing any new nuclear power plants until the year 2000 and deciding to dismantle five plants on which work stopped in 1984. The national energy plan for the period 1991-2000 has an R&D component calling for initiatives for new technological developments in advanced nuclear fission reactors, passive safety reactors, intrinsically safe fission reactors and nuclear fusion reactors, so that such reactors may be incorporated into the electrical system after the year 2000. Spanish utilities are interested in affiliating with U.S. firms working on the reactors of the future, and Spanish firms have been planning an advanced reactor in collaboration with Westinghouse. Eight of Spain's nine currently operating reactors are American-built.

Emerging Technologies

When the U.S.-Spanish S&T agreement is renewed, anticipated resumption of S&T cooperation under it will offer attractive possibilities for joint work in the technology areas of advanced materials (including high-temperature superconductors), microelectronics and biotechnology. Only information and communications technologies received a higher priority than materials and biotechnology in Spain's 1988-1991 R&D plan.

During FY-1991, four new Spanish institutes were engaged in study of physical properties of a wide range of materials, including metal-organic conductors, hard materials and magnetic films. The four centers coordinate their work on high-temperature superconductivity. They characterize known high-temperature superconductors as well as fabricate new ones. The total effort on these superconductors involves several hundred workers. A similar new initiative in microelectronics involved laboratories in three cities working on processing, chip design and new device fabrication using silicon and compound semiconductors.

Spain's foremost scientific field, biology (two biology-related Nobel prizes), has provided the basis for strong efforts in biotechnology. While biotechnology R&D is common in the widespread biological institutes, a new center at the Autonomous University of Madrid is entirely devoted to the discipline.

Agriculture and Natural Resources

Spain claims to have 40% of the EC's still-pristine territory but believes it cannot afford to maintain these areas by itself. This belief, together with Spain's inadequate sewage treatment infrastructure, are a source of friction between the government and the EC commission. Desertification and coastal degradation are other mounting problems of considerable economic importance in parts of Spain.

The U.S. Department of Agriculture (USDA), a major participant under the former S&T agreement, still operates a program for training Spanish doctoral and postdoctoral students at U.S. universities. The Spanish government pays all fees and USDA administrative expenses.

Spain has had a research base in Antarctica since 1988 and, in 1991, launched a new polar research ship. Madrid was also the site of three meetings in 1991 to draw up an Environmental Protection Protocol to the Antarctic Treaty. The negotiations were at times very difficult over the question of future Antarctic minerals resources development. Spain was a most helpful U.S. ally, devoted as it was to having a successful conference, and the Spanish chairman's compromise proposal ultimately prevailed. The protocol was signed in Madrid October 4, 1992.

UNITED KINGDOM

General

Science and technology relations between the U.S. and the United Kingdom (UK) remain extensive and close at all levels -- governmental, institutional and individual. Interactions between scientific societies of both countries, frequent exchanges between governmental institutions and fruitful industrial relationships go on continually. While a number of topical or project related memoranda of understanding have been concluded over the years between counterpart U.S. and UK government agencies, there has been no perceived need for an umbrella science and technology agreement.

During the past year the Science Adviser to the Cabinet, Sir John Fairclough, resigned and was replaced by Professor William Stewart, a person oriented toward increased basic and more market-oriented programs, large multi-disciplinary team research and increased international cooperation. Prof. Stewart favors government-industry cooperation, including the encouragement of industrial contracts, in support of research to generate marketable products. The imprint of this approach on government research policy was expected to become apparent over time.

The UK is deeply involved in international collaborations in almost every field and aspect of science. This is especially true within the EC and with the United States. However, most collaborations occur at the individual scientist level or involve the competitive search for research grants and contracts. These processes occur so effectively that there is slight need or occasion for official assistance or intervention. As a consequence, most such collaborations are recorded only in the author lists and credits in the technical literature and not in official governmental publications.

Basic Science

Her Majesty's Government (HMG) is increasingly involving the state in the support and direction of basic and applied science, on the perception that economic progress and sustained national security can depend significantly on the health of a national science program. A high level committee formally chaired by the Prime Minister continued to coordinate research during FY-1991, although much research, both basic and applied, is supported through individual departments. HMG believes that the government's responsibilities extend to basic and strategic research and do not include development of specific products or processes. That is held to be the responsibility of the industrial sector.

Government support is divided into broad-based funding given directly to the universities, and support administered through the Department of Education and Science's five Research Councils. HMG has taken steps to award organizations the intellectual property rights to their creative accomplishments, as means to motivate further the transfer of ideas. It has also formalized a linking mechanism to provide a

framework for collaboration between the various levels of basic through commercial science. To emphasize its commitment to promoting science within the UK, HMG has instituted a compulsory school course program in science and technology for students up to age 16.

While HMG remains firmly committed to scientific excellence, the individual researcher has to struggle to find funds for support. The UK has been investing a nearly constant fraction of the nation's Gross National Product (GNP) in science for the last 15 years. While the UK has enjoyed an increase in scientific personnel during this period, research costs have risen more rapidly than inflation. There is a very competitive atmosphere among scientists and attendant pressures to "publish or perish", to show short term results and to produce quantity rather than quality.

HMG is participating in large projects in molecular biology and environmental assessment. The Medical Research Council (MRC) is contributing 3.2 million pounds (BPS; 1 BPS equals $1.80) to the European Molecular Biology Laboratory. The Natural Environment Research Council (NERC) is putting BPS 1.9 million pounds into the Ocean Drilling Program and the Department of Trade and Industry (DTI) is investing a total of BPS 13.7 million pounds in the earth resources satellite, earth observation polar platform and polar orbiting environmental missions.

Health and Life Sciences

The bulk of UK medical research is conducted by either the research facilities of the Medical Research Council (MRC) or university medical schools using grants from the MRC. Of special importance are MRC's three largest institutions: the National Institute for Medical Research, the Laboratory of Molecular Biology and the Clinical Research Center. Medical research is overseen by four research boards, which assess progress and appraise proposals on the basis of regular reports from research teams and visiting expert subcommittees.

The MRC budget consists of four areas: biomedical, AIDS, health services and training grants. Beginning in 1989, the MRC earmarked funds for Human Genome mapping. This program is now the UK's contribution to the EC's Human Genome Analysis Program. The UK's AIDS research program, directed primarily at vaccine and drug development, consists of some 150 individual projects.

The MRC has become adept at transferring its technological developments from laboratory to marketplace. To accomplish this, the MRC set up a laboratory dedicated to industry funded research, located adjacent to the MRC basic research laboratory, so that inventors of new technology could be simultaneously involved both in basic exploration and the development of marketable products. The pharmaceutical industry is one of the most progressive within the UK, investing large fractions of its income in research and development, and it has taken full advantage of MRC's initiatives.

Energy, Environment and Economics

HMG has set out its position and expressed its heightened concern about environmental issues in an extensive report entitled "This Common Inheritance." UK policy is based on the principle of stewardship, and need for actions to be coherent, scientifically well founded, and with both national and international dimensions. HMG has pledged to keep the public informed and has promised improvements in the environment, while warning of impending costs. The 300-page document covers the environmental policy area comprehensively, including chapters on the greenhouse effect, energy, transport, forests and carbon dioxide, methane, land use, wildlife, pollution control, hazardous substances (including genetically modified organisms), noise, waste and recycling, and nuclear power and radioactive waste. Other UK environmental priorities include tightening controls over vehicle emissions. Because of the international consequences of environmental effects and the importance that the EC places on this issue, international collaboration in environmental research has taken on growing importance for HMG. The UK is playing a notable role in the Intergovernmental Panel on Climate Change (IPCC).

In the energy sector, a principal UK focus has been on increasing the efficiency with which energy is generated and used. Past efforts have paid off, e.g., in 1989 the UK produced 25% more gross domestic product (GDP) than in 1979 while using no more energy. Among energy efficiency measures announced in the recent environment white paper are tougher building regulations, an emphasis on gas in combined cycle gas turbines (CCGTs) as the first choice of fuel for power generation, greater use of combined heat and power (CHP) technology, energy labeling, and speeding up development of renewable sources of energy including wind, hydropower, tidal, burning of dry wastes and use of biofuels.

During FY-1991, privatization of the gas and electricity industries continues to be one of HMG's success stories. Both industries are flourishing, even under current environmental restraints, although there is concern about future environmental regulations. The gas industry believes it would benefit from tighter rules since gas is "greener and cleaner" than other fossil fuels.

The UK's developing energy policy has a very strong EC component to it. Environmental issues were not recognized in the original 1957 Treaty of Rome, but the Stockholm Conference of 1972 acknowledged that economic growth needed to be "linked to improvements in living standards and quality of life ...and to protection of the environment and natural resources." As a result, the EC Commission set forth principles including a directive mandating "best available technology not entailing excessive costs" for new large combustion plants, and requiring large emissions reductions by the year 2003.

The UK has vocal and articulate anti-nuclear activists who ensure that licensing hearings and nuclear policy reviews are drawn out, controversial and costly. This is one reason that the UK nuclear power stations (which generate approximately 20% of the UK's electricity) remain in the public sector. The current UK government

has been a consistent proponent of nuclear power, for its obvious benefits of increased energy supply diversity and not contributing to acid precipitation or possible global warming, and nuclear energy's long-range potential in terms of availability of uranium and prospects for advanced reactors in the future. HMG wishes to maintain the nuclear option, but only if nuclear power becomes more economic and the industry demonstrates it can maintain high safety and environmental standards.

Emerging Technologies

HMG continues to focus on competitiveness as a national objective and encourages cooperation among government institutions, universities and industry to develop technologies that are commercially promising. The financial sponsorship of non-defense research is the responsibility of individual ministries and departments, with much of the more basic and exploratory research being funded through the Universities Funding Council (UFC) and the five Research Councils within the Department of Education and Science. Much of this research is accomplished within interdisciplinary Research Centers for specific technologies, of which there are twenty or more at present, most of which are housed at various universities.

The UK's Link programs made their first award almost four years ago. The Link initiative provides a mechanism by which the public sector, in the form of universities, research councils and government departments, joins with private sector companies to pursue agreed research programs. The goal of the programs is to provide a link between inventor and manufacturer in order to promote the transfer of technology from laboratory to marketplace. While the majority of fields are likely to be in engineering, any exploitable technology is eligible for consideration.

HMG is contributing BPS 10.5 million to Eureka, the pan-European program to promote industry-led projects in all sectors of advanced technology products.

Agriculture and Natural Resources

Again, the UK is heavily involved in international collaboration, most of which is carried out on an informal basis. The Agricultural and Food Research Council (AFRC) is actively engaged in cooperation with other EC members and is seeking to promote strategic links with the rest of the world's scientific community. While the AFRC has no major formal agreements with foreign countries, it is involved in consortia doing between BPS 1.6-1.7 million of EC research. It is also involved in some BPS 4 million of research in developing countries.

The Ministry of Agriculture, Fisheries and Food (MAFF) has lead responsibility for four programs conducted under the EC's R&D program called Framework. The EC supplies approximately 50% of the funding for these programs. In practice, the greater part of MAFF's international collaboration is in the form of information exchange. Additional European collaborations, which include non-EC countries, are conducted through a Committee of Senior Officials on Science and Technology (COST).

YUGOSLAVIA

General

During FY-1991, ethnic internal conflict drove Yugoslavia closer to dismemberment and at times to civil war. Meanwhile, external interests -- in particular the European Community (EC) as well as the U.S. -- worked to try to check the violence and bloodshed. The impact on everything in Yugoslavia, including the conduct of cooperative science and technology programs in all parts of the country, was profound. Budgets were uncertain or non-existent, travel of foreign scientists to Yugoslavia was impeded, science conferences were postponed or cancelled, and working relations among specific parts of the Yugoslav scientific community were strained. These conditions continued past the end of FY-1991.

Despite the turbulence, productive research under the U.S.-Yugoslav Joint Fund for scientific and technological cooperation continued to take place notably well. In FY-1991 the Joint Board approved 47 new research projects valued at $897,550, and endorsed another 83 ongoing grants totalling $884,855.

Basic Science

Yugoslavia is strong in basic science, with about 40% of its research projects under the Joint Fund in this category. The three most developed republics (Croatia, Serbia and Slovenia) have numerous prominent scientists with international standing in physics, chemistry, biotechnology, genetic engineering and electrical engineering, inter alia. Even as Yugoslavia looks increasingly to the European Community for its future orientation, ties with American science endure. A recent survey of Yugoslav graduate students in the sciences studying abroad showed that more than 80% were in the United States. They and many other Yugoslav science personnel connected with the U.S. S&T community through U.S.-Yugoslav joint research projects over the last three decades.

Such projects are carried out at relatively low cost to the U.S. government (significantly less than if the research were performed in the U.S.). An American physicist with long experience in joint research in Yugoslavia noted recently that "the scientific return per taxpayer dollar is probably higher for Eastern European programs than for any other programs in the world."

Science officials from even the most separatist republics have confirmed privately their interest in continuing participation in the Joint Research Program, lauding the practical benefits of their long association with U.S. technical agencies, American scientific institutions and cooperating American scientists. Despite this shared good will to "keep science above politics," during FY-1991 there were operational obstacles associated with the operation of the Joint Board, and with the relationship between the republics and the federal S&T coordinating body. The annual U.S.-Yugoslav Joint Board meeting scheduled for October 1991 was canceled due to the ongoing crisis. In the short term, these problems were addressed by handling much of the business of the Joint Board through correspondence rather than in formal meetings, thereby avoiding unnecessary confrontations as Yugoslav government institutions awaited their future shape and content.

Administrators and scientists from all republics and provinces met in June 1991 to consider the implications of the OECD Technology/Economy Program (TEP) for Science, Technology and Development in Yugoslavia. These science leaders concluded that the government: (a) should preserve the research system in all its component parts; (b) channel and support innovative efforts and improve the infrastructure for technological development, particularly in telecommunications; and (c) halt the brain drain. They called on the international community to find ways and means to increase significantly their support for Yugoslavia in view of the economic and political reforms it was undertaking.

Health and Life Sciences

Cooperative research between the U.S. and Yugoslavia in life sciences has been one of the strongest aspects of the Joint Program for more than two decades. Current research covers such high priority fields as drug addiction, tumor growth factors, prostate cancer and cystic fibrosis, and involves the major medical centers in Belgrade, Zagreb, Sarajevo, and Ljubljana.

International interest in biomechanics research in Slovenia was reflected in the 7th International Conference on Mechanics and Medicine, which was held despite the conflict in Yugoslavia, albeit across the border in a neighboring country. While showcasing achievements in synthesis of walking with the help of functional electrical stimulation, the organizers also brought in experts to promote development in other fields, e.g., tissue and fluid mechanics, ergonomics, prosthetics and orthotics.

Energy, Environment and Economics

The mix of energy sources in Yugoslavia places a heavy reliance on domestic coal (36%), with consequent adverse impact on air quality in both industrial and population centers. Imported crude oil is the second largest energy source (31%), with natural gas (13%), hydropower (12%), and nuclear power (2%) making up most of the rest of the energy picture. Fiscal necessity may force heavier reliance on coal in the short term, with environmental concerns being postponed until the various parts of Yugoslavia sort out their political and economic futures.

The Slovenian legislature has mandated closing Yugoslavia's only nuclear power plant (KRSKO, which uses U.S. technology) by 1995, at an estimated cost of about $2 billion. Importing power from elsewhere will add further to the cost, since Slovenia gets 20% and Croatia 17% of their energy from KRSKO.

During FY-1991 concerns about the environment maintained a toehold in Yugoslavia, with considerable legislation on the books, especially at the federal level. Enforcement, however, was virtually nonexistent. Yugoslavia has sought international support to address its environmental concerns and hosted a fact-finding mission from the G-24 countries in early 1991. The mission was exposed to a wide variety of proposals, and suggested which ones might qualify for feasibility studies by member nations.

Emerging Technologies

Materials

A joint project involving the National Institute of Standards and Technology (NIST) and the Jozef Stefan Institute in Ljubljana is aimed at deepening understanding of rare earth doped titanate ceramics, and is expected to result in development of the appropriate ceramic fabrication technology for controlled densification and optimal microstructure.

Molecular biology

In 1991, after three years of joint research, the U.S. Department of Energy (DOE) arranged for an entire team from the Belgrade Center for Genetic Engineering to move to and continue their work at DOE's Argonne National Laboratory. The work involves application of a new method of DNA sequencing at a pilot plant stage, and could develop into an important advance in this critical technology.

Energy technology

Building on previous joint research, the Department of Energy is working with a major Yugoslav commercial firm and Ljubljana University to study combining underground coal gasification with in-situ oil shale retorting. Such secondary recovery of coal reserves remaining after conventional mining is no longer economical also has environmental benefit -- removal of sulfur dioxide as the gas contacts the oil shale.

Agriculture

Agricultural research has been the largest program under the Joint Fund in recent years. This has been most evident in Serbia and the Vojvodina, where agriculture is the backbone of the economies of both the republic and its constituent province. Investigations by U.S. and Yugoslav scientists during FY-1991 included:

- a hypothesis that embryos can be collected for safe export from donor cows vaccinated against brucellosis in the U.S.;

- the development and use of natural enemies of common ragweed to control this harmful weed;

- promotion of food production by developing new varieties of durum (hard) wheat that would produce higher yields;

- enhancement of maize breeding programs in both countries by interchange of scientific information and elite maize germplasm.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

As "classic" political and security issues abate relatively in the post-Cold War era, the U.S. is at the beginning of a new phase in which the bipolar world is being replaced by a new and quickly evolving multipolar one. The contents of this Title V report strongly suggest that, in this new world, international environmental, science and technology issues are increasingly important.

The rationale for U.S. international S&T cooperation is stronger than ever before for three reasons. First, more research subjects, such as possible global environmental change, are inherently international. Second, increasing proportions of S&T talent, facilities and sites are outside the U.S. Third, fruitful S&T cooperative activities can benefit participants significantly in terms of contributing both to their economic performance, and to their and others' health and societal well-being. The details narrated in Chapters 2 and 3 of this report present a current picture of the degree to which our interests entail continued need to reach out and gain benefit from international S&T cooperation.

The following remarks are keyed to the text of the Title V legislation (quoted in Chapter 1).

1. Personnel Requirements, Standards and Training

Many Executive departments and technical agencies are extensively involved in U.S. international S&T cooperation, because such cooperation enhances the performance of their statutory responsibilities and their ability to benefit the nation's well being and the U.S. public. The genesis of the narrative portions of this Title V report illustrates the nature of Government-wide agency involvement in international S&T. The National Science Foundation was lead drafter for the discussion in Chapter Two on Basic Science. The Department of Health and Human Services took the lead on the discussion of Health and Life Sciences; the State Department on Energy, Environment and Economics; the Department of Commerce on Emerging Technologies; and the Agriculture, Interior and Commerce Departments on Agriculture and Natural Resources. Numerous other offices and agencies contributed comments and suggestions. The database at the end of this report illustrates even more graphically the number and extent of USG departments and agencies involved in international environment, science and technology (EST) activities.

In the White House, the Office of Science and Technology Policy (OSTP) addresses S&T policy issues across the Executive Branch as a whole. The principal forum for coordination of federal government S&T activities is the OSTP-chaired Federal Coordinating Committee for Science, Engineering and Technology (FCCSET) and, as to international aspects, its (sub) Committee on International Science, Engineering, and Technology (CISET), chaired by the Under Secretary

of State for International Security Affairs. Specific U.S. Government international S&T cooperative activities principally originate in and are implemented by the Executive departments and technical agencies, subject to State Department coordination and oversight.

The Department of State plays a key role in assuring that international science and technology agreements and activities are consonant with overall U.S. foreign policies. The Department coordinates the interagency process of authorization to negotiate and conclude agreements (Circular 175). In addition to its CISET role, the Department also coordinates U.S. Government international S&T activities by chairing the Policy Coordinating Committee for International Oceans, Environment and Scientific Affairs (PCC/OES), under auspices of the National Security Council. The State Department coordinates the drafting of this annual Presidential report, which is an important tool for the international S&T oversight and coordination role which Title V assigns to State.

It is necessary to blend many individual human resource capabilities -- S&T knowledge, economic, political and foreign policy skills, foreign language and cultural expertise -- to achieve success in reaping maximum U.S. benefit from international EST interactions. These skills are in varying degrees necessary among people in all U.S. Government agencies involved. Departments and agencies have large numbers of technical and managerial personnel with very extensive experience in, and personal commitment to, international cooperation. These personnel, together with the even larger number of members of the participating non-governmental U.S. science and engineering communities, are the implementors of U.S. Government international S&T cooperation.

Many scientific disciplines are represented in the current cadre of EST officers. It should be noted that for U.S. embassy officers abroad covering EST matters, a central requirement is experience in, or at least an aptitude quickly to grasp, broad foreign policy considerations and their relationship to S&T. U.S. EST officers abroad must field a variety of tasks: conduct traditional diplomacy through demarches, representations and reporting of host government positions and attitudes; report on the state of EST in the host country and on the host government's organization and policy approach to EST matters; develop and cultivate local governmental and non-governmental S&T contacts; and manage U.S. Government science and technology programs. Therefore, managerial experience/aptitude and communications skills are also essential.

The Department of State provides a course which is available to its own personnel who occupy or may be assigned to EST positions, and for personnel from other agencies and outside the government detailed to EST-related assignments in the OES Bureau and U.S. embassies. This training provides structured guidance to embassy EST officers on how to perform their jobs, how and on what to report, and how to craft their reporting to make it most useful to a wide end-user audience.

Recommendations

- Departments and agencies significantly involved in international S&T cooperation and S&T policy should continue to calibrate their approaches and activities to serve U.S. interests in a changing era; for example, by encouraging and increasing the capabilities of their personnel dealing with international EST matters. They should encourage their employees to attend courses given by the Department of State on international EST issues and U.S. foreign policy .

- The Department of State should continue its efforts to attract well-qualified Foreign Service, Civil Service and outside scientific and technical professionals for science and technology-related careers in the Department and Foreign Service and for temporary assignments in Washington headquarters and U.S. embassies. Arranging details between Executive departments/agencies and the State Department offers one way to provide broadening experience to personnel.

- The Department of State should review and evaluate the operation of the present EST Counselor/Attache system, along the lines of the study described in Chapter 1.

- The Department of State (OES) should continue to work closely with the Foreign Service Institute (FSI) to insure that the syllabus of FSI's course on International Environment, Science and Technology Issues and American Foreign Policy is as germane to U.S. interests and as practically helpful to the students as possible. The course should be given more often than the present once a year.

- Orientation for EST officers should include more extensive presentations by the principal U.S. departments and agencies of their international programs and interests.

- As an integral part of EST training, the State Department (OES) should make every effort to continue the practice of an annual conference in Washington for Embassy EST officers, including enlisting support from and active participation by other interested U.S. Government departments, technical agencies and Congressional members and staff.

2. Continuation and Broadening of Present Science and Technology Agreements and Activities

The U.S. has been the source of much technical progress in other countries through generous sharing of scientific and engineering discoveries. The U.S. still leads in many respects, but is now also increasingly on the receiving end. The preceding chapters have detailed international scientific and technological interactions and benefits deriving from a significant range of U.S. international S&T agreements and activities.

Recommendations

- U.S. Government agencies should continue to maintain and broaden U.S. EST interactions and cooperation with the rest of the world.

- The USG should continue to work to insure that countries where new discoveries are being made continue to operate their laboratories and distribute their scientific literature in an open manner. Protection of intellectual property rights (IPR) arising from S&T cooperative activities should be pursued with all partners.

- Executive agencies should continue to negotiate science and technology agreements with due consideration for factors such as effective provisions on equitable access and intellectual property rights.

- Executive agencies should be attentive to the possibilities for negotiating appropriate new science and technology agreements with counterparts emerging in the newly independent states in the territory of the former Soviet Union.

3. Funding

The President's budget sets forth funding proposals, by Department, for support of S&T programs of the U.S. Government. This report discusses selected program funding, for example in Poland, Hungary, Yugoslavia, Israel and India.

Recommendations

- The Committee on International Science, Engineering and Technology (CISET) should continue to encourage transparency and consistency by technical agencies in providing funding data on cooperative S&T activities for inclusion in this report (particularly for the database).

- Technical agencies and the Executive departments should continue to participate in identified and specific joint efforts to prioritize and coordinate S&T activities, for example, through the FCCSET/CISET mechanism.

4. Plans for Future Routine Evaluation of Science and Technology Agreements and Activities

The intent of this and future Title V reports is to be the central annual U.S. Government reference on USG international activities and agreements on science and technology. With that in mind, the overall approach of this year's Title V report has been to:

- Review a number of currently important international science and technology subjects and themes;

- Illustrate where and how U.S. Government international S&T activities and agreements were involved with these subjects and themes; and

- Provide an extensive database of U.S. Government international S&T agreements by country and by agency.

Recommendations

- Future Title V reports should continue to improve the quality and usability of the data provided, in order to constitute the principal annual body of information for understanding the interaction with U.S. interests of international environment, science and technology matters, and for reviewing the scientific and technological benefits deriving from U.S. Government international science and technology activities and agreements.

- The Congress and other users are requested to provide information on the usefulness of this report.

5. Equity of Access

Consistent with recommendations in last year's report, technical agencies have continued to help assure equitable access to facilities and resources of overseas partners. While not explicit in most framework agreements for cooperation, access provisions are a major feature of implementing arrangements in which specific provisions between collaborators are spelled out in greater detail.

During FY-1991, U.S. cooperative activities were monitored closely and no significant problems of access were identified for either U.S. public or private entities working with their foreign counterparts. In fact, the year was characterized by reported improvements in opportunities to work in Japan, always an important collaborative partner, and an unprecedented level of access to former Communist research facilities, particularly and including institutions of the former Soviet Union which performed, in part or in toto, defense-related research and development in the past. This unusual development could increase rapidly over the next few years as former Communist states evolve politically and economically.

Equity of access has special aspects in respect to emerging technologies. The challenge for U.S. policy makers is threefold: first, to encourage collaboration in advanced R&D in technologies where there is mutual interest; second, to continue to support a market-based policy framework in this country that is conducive not only to the development but also to the commercialization of new technologies; and, lastly, to cooperate with our partners to ensure greater transparency and improved understanding of the international effects of their R&D support policies. Progress on all will be important if we are to capture the full benefit of these technologies which hold such promise for improving the standard of living of future generations.

Recommendations

- Continue to assure equitable access to foreign research facilities and programs through negotiated provisions in U.S. agreements and implementing arrangements.

- Continue to monitor closely agreements and activities with respect to access opportunities, through more systematic reporting from EST officers overseas, focused surveys by technical agencies, and selected briefings before such interagency fora as the CISET and FCCSET.