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Briefing Report to the Honorable Lloyd Bentsen, U.S. Senate

August 1988

TECHNOLOGY TRANSFER

U.S. and Foreign Participation in R&D at Federal Laboratories

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GAO

United States
General Accounting Office
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Resources, Community, and
Economic Development Division

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August 15, 1988

The Honorable Lloyd Bentsen
United States Senate

Dear Senator Bentsen:

You asked us to study foreign sponsorship of research and development in areas of commercial importance at federal laboratories. Early in our audit work, we found that federal laboratories receive relatively little funding from foreign sources. Accordingly, we agreed with your staff instead to provide you information on (1) the extent of direct foreign participation in research and development at laboratories in fiscal year 1986, (2) federal laboratories' policies regarding foreign access to research and development, (3) reciprocity between federal laboratory researchers and foreign researchers, and (4) the implications of these issues for U.S. policy on foreign access to federal research and development. To gather this information, we sent a questionnaire to federal laboratories, and we obtained the perceptions of research managers and administrators at several laboratories and agencies. To provide a perspective on the extent of foreign involvement, this report also presents data on U.S. participation in research and development at federal laboratories.

In summary, we found the following:

-- The principal mechanism for U.S. and foreign participation in research and development is through programs that bring researchers from outside organizations to work at the federal laboratories, typically for 6 months to 1 year. Foreigners comprised 30 percent of the outside researchers who worked during fiscal year 1986 at the 50 federal laboratories that we surveyed.

-- In general, the federal laboratories support open exchanges in areas of basic scientific research, but have varying degrees of restrictions on foreign access to technologies with commercial potential.

-- The research managers and administrators at the eight federal laboratories we visited stated that their researchers have not had difficulty getting access to foreign laboratories and that, except for some isolated instances, foreign researchers have readily exchanged information with federal laboratory researchers.

-- The research managers and administrators did not perceive a need for additional guidance or authority regarding foreign access to the federal laboratories.

EXTENT OF PARTICIPATION AND LABORATORIES' POLICIES

The 50 laboratories that responded to our questionnaire are among the largest federal laboratories and are more likely than other federal laboratories to conduct research and development in fields with commercial potential. They reported that in addition to their permanent laboratory employees, 13,092 U.S. and 5,677 foreign researchers conducted research and development at their facilities in fiscal year 1986. Specifically:

-- 4,657 U.S. and 3,597 foreign researchers worked at these federal laboratories through so-called guest and visiting researcher programs that are intended to attract senior scientists and engineers from governments, businesses, and universities. In addition, 1,879 U.S. and 1,319 foreign postdoctoral fellows worked at the laboratories as part of their training for research careers. The remaining outside researchers were faculty and students from universities and high schools who participated in research through educational programs.

-- The Department of Energy's energy research laboratories and the National Institutes of Health reported the most outside U.S. and foreign researchers, followed by the National Aeronautics and Space Administration's (NASA) laboratories and Energy's defense programs laboratories. These laboratories accounted for 75 percent of the outside U.S. researchers and 82 percent of the outside foreign researchers.

-- More than 80 percent of the outside U.S. and foreign researchers were affiliated with universities and other nonprofit organizations.

-- The largest number of foreigners conducting research and development at the surveyed federal laboratories were 758 researchers (13 percent) from Japan, followed by 448 researchers (8 percent) from the United Kingdom and 438 researchers (8 percent) from the People's Republic of China.

The federal laboratories' data show less outside involvement in research and development through other types of interactions, such as sponsorship of research, collaborative research agreements, and the use of the laboratories' specialized scientific facilities.

All of the surveyed laboratories require outside U.S. and foreign researchers to disclose any invention made at their laboratory. Only 1 laboratory was aware of an instance in which an outside researcher had failed to disclose an invention during the past 3 years. While federal laboratories typically rely on general agency policies and directives regarding foreign access, some agencies and federal laboratories are more restrictive than others in providing access to research results. For example, NASA laboratories restrict foreign access to research results that have significant commercial potential for 2 years through NASA's "For Early Domestic Distribution Program." However, NASA can enforce this program only by removing an organization that distributes information to foreign groups from its distribution list.

RECIPROCITY AND FEDERAL POLICY ON FOREIGN ACCESS

Research managers and administrators at the eight federal laboratories that we visited stated that reciprocity has not been a problem for their laboratories either in getting access to foreign laboratories or in exchanging information with foreign researchers at their laboratories. Overall, they stated, the federal laboratories and the United States benefited more than foreign researchers and their countries through the collaboration on research and development. Because information is not available on whether U.S. businesses and universities have been denied access to foreign laboratories, the Department of Commerce published a public notice in the Federal Register in April 1988

requesting such information. As of July 28, Commerce had received only two responses.

Regarding federal policy on foreign access to federal laboratories, the research managers and administrators noted the following:

-- They distinguished between fundamental scientific research and research with commercial potential. While they supported open exchanges in basic scientific fields, managers and administrators at the National Bureau of Standards, Langley Research Center, Oak Ridge National Laboratory, and Sandia National Laboratories were more cautious about providing foreign researchers access to technologies with commercial potential.

-- They did not perceive a need for additional guidance or authority to require reciprocity or restrict foreign access to facilities or fields of research because of the commercial potential of the technology.

-- They did not favor formal restrictions on foreign access to federal laboratories. They believed that such restrictions would be counterproductive because the foreign researchers contribute to achieving the laboratories' mission. Instead, they stated, the preferred method of controlling foreign access is by stimulating U.S. participation. This is because the federal laboratories have staffing and space constraints that limit the number of outside researchers who can work at the laboratories. Overall, 24 of the 50 federal laboratories reported that they had started new programs since 1980 to encourage U.S. business-affiliated researchers to work at their laboratories.

SCOPE AND METHODOLOGY

To obtain information about the extent of U.S. and foreign participation and the laboratories' policies regarding foreign access, we sent a questionnaire to 52 laboratories in 7 federal agencies that we selected with the assistance of agency officials. The 50 responding laboratories employed 43,902 researchers and had a total research and development operating budget of $14.1 billion in fiscal year 1986, over 50 percent of the budget for federal laboratories in fiscal year 1986. We then visited eight laboratories in six of these agencies whose research and development results could have important commercial applications. We asked the laboratories' research managers

and administrators about their perceptions of foreign participation in research and development, including reciprocity and the need for any additional guidance or authority regarding foreign access to federal laboratories. We then discussed these perceptions with program officials at the six federal agencies and the Office of Science and Technology Policy.

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Section 1 of this briefing report provides background information and more details about our objectives, scope, and methodology. Sections 2, 3, 4, and 5 provide information about the extent of U.S. and foreign participation, federal laboratories' policies, reciprocity in the exchange of information, and the implications of these issues for U.S. policy on foreign access, respectively. Appendix I lists the federal laboratories that responded to our questionnaire. Appendix II contains a copy of the questionnaire. Appendix III lists the major contributors to this briefing report.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this briefing report until 21 days from the date of this letter. If you have further questions, please contact me at (202) 275-8545.

Sincerely yours,

Flora H. Milans

Flora H. Milans
Associate Director

CONTENTS

ABBREVIATIONS

DOD	Department of Defense
DOE	Department of Energy
FDA	Food and Drug Administration
GAO	General Accounting Office
IRTA	Intramural Research Training Award
NASA	National Aeronautics and Space Administration
NBS	National Bureau of Standards
NIH	National Institutes of Health
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanographic and Atmospheric Administration
R&D	research and development

SECTION 1

INTRODUCTION

In recent years concern has grown about the U.S. trade deficit and the ability of U.S. businesses to compete in world markets. In response to these concerns, the administration and the Congress have acted to strengthen the links between the nation's research and technology base and U.S. industry. One means of doing this is to increase U.S. industry's access to the technology of the federal laboratories, which obligated about $18 billion for research and development (R&D) in fiscal year 1986 and $20 billion in fiscal year 1987. The administration also is concerned about foreign access to federal laboratory technology and is reassessing the terms of scientific cooperation agreements with foreign countries that provide the basis for thousands of foreign researchers (scientists, engineers, and other research professionals) to work at federal laboratories each year. Its objective is to make the terms of such cooperations consistent with its domestic technology transfer efforts through intellectual property ownership clauses that protect U.S. taxpayer investment in federal R&D.

PARTICIPATION BY U.S. ORGANIZATIONS

Few federal laboratories have substantial programs for transferring their research results to U.S. businesses by stimulating U.S. industry participation in R&D. Examples of these efforts include the National Bureau of Standards' Industrial Research Associates Program and the National Aeronautics and Space Administration's (NASA) close relationship with the U.S. aeronautical industry. In general, however, unclassified research results have been publicly disseminated through publication in the scientific literature.

To encourage U.S. organizations, particularly businesses, to make better use of federal laboratories, the Federal Technology Transfer Act of 1986 (P.L. 99-502, Oct. 20, 1986) authorized federal agencies to permit their government-operated laboratories to collaborate on R&D with other organizations through cooperative R&D agreements. The intent of the act is to make entering into these agreements as easy as possible for the private sector participant, while protecting the legitimate concerns of the government. Under the act, a government-operated federal laboratory can grant a collaborator the right to (1) take title to or (2) license, on an exclusive or partially exclusive basis, any resulting inventions. However, if the collaborator takes title to an invention, the government retains a royalty-free license for its use by or on behalf of the government. The act also requires the directors of government-operated laboratories to give preference to U.S.-based businesses that agree to substantially manufacture in the United States any products embodying or produced through the use of any invention made under the cooperative R&D agreement. In

April 1987 President Reagan issued Executive Order 12591, Facilitating Access to Science and Technology. The order implements the Federal Technology Transfer Act by directing the heads of federal agencies to delegate authority to their government-operated laboratories to enter into cooperative R&D agreements and to license, assign, or waive rights to inventions, computer software, and other intellectual property.

In response to a request by the Chairman, House Committee on Science, Space and Technology, we issued a report in March 1988 that identified four constraints to transferring technology from federal laboratories to U.S. businesses.[1] We currently are assessing the implementation of the Federal Technology Transfer Act by federal agencies and laboratories for the Committee.

PARTICIPATION BY FOREIGN ORGANIZATIONS

For many years the United States has entered into scientific cooperation agreements with foreign governments that provide the opportunity for thousands of foreign researchers to work at federal laboratories. In recent years, in response to the U.S. trade deficit, the administration has reassessed its position on the terms of these scientific cooperation agreements. This change is best exemplified by the U.S.-Japan Agreement on Cooperation in Research and Development in Science and Technology, which was signed by President Reagan and Prime Minister Takeshita on June 20, 1988. The agreement addresses U.S. concerns about improving U.S. access to research facilities that are sponsored or supported by the Japanese government, protecting and distributing title rights to intellectual property arising from cooperative research, and protecting classified information. It also establishes a joint high level committee, which will meet at least annually to review matters of importance in the field of science and technology.

The United States has benefited from these scientific cooperation agreements with foreign governments through scientific and technological advances and the decision of many foreign researchers to stay and work in the United States. However, federal immigration laws require foreign nationals with educational visitor visas (either student or exchange visitor visas) to return to their countries for 2 years before they can become permanent resident aliens in the United States. This requirement can be waived if (1) the foreign national would be subject to persecution on account of race, religion, or political opinion, (2) the foreign national's departure would impose exceptional hardship on a wife or child who is a U.S. citizen or a lawfully resident alien, or (3) an interested U.S. agency states in writing that granting a waiver

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[1] Technology Transfer: Constraints Perceived by Federal Laboratory and Agency Officials (GAO/RCED-88-116BR, Mar. 4, 1988).

would be in the public interest and compliance with the 2-year home country physical presence requirement would be clearly detrimental to a program or activity of official interest to the agency. A waiver is more easily obtained if the home country states that it does not object.

The Federal Technology Transfer Act directs the heads of federal agencies, in determining whether to enter into a cooperative R&D agreement with an organization that is controlled by a foreign company or government, to consider whether the foreign government permits U.S. organizations to enter into cooperative R&D agreements and licensing arrangements. In implementing this section of the act, the April 1987 executive order requires federal agencies to consult with the U.S. Trade Representative in considering whether the foreign governments have policies to protect U.S. intellectual property rights and, for classified or sensitive research, whether the foreign government has adopted adequate measures to prevent the transfer of strategic technologies to destinations prohibited under U.S. national security export controls.

OBJECTIVES, SCOPE, AND METHODOLOGY

Senator Lloyd Bentsen asked that we assess the sponsorship of research in U.S. universities and the federal laboratories by foreign firms and governments. This is the second report in response to Senator Bentsen's request. The first report, which looked at research in U.S. universities, found that all foreign sources (governments, businesses, and nonprofit organizations) funded only 1 percent of the research that the 134 universities in our survey conducted in fiscal year 1986.[2]

Early in our review of foreign sponsorship of research at federal laboratories, we learned that foreign organizations also funded relatively little R&D at federal laboratories. Accordingly, with the concurrence of Senator Bentsen's staff, we modified the scope of our work to assess several mechanisms by which foreign organizations and researchers can participate in R&D at federal laboratories, including foreign researchers working at federal laboratories, the sponsorship of research, collaborative research agreements, and the use of the laboratories' specialized scientific equipment and facilities. Specifically, we agreed to evaluate the (1) extent of foreign participation in R&D at federal laboratories through these interactions, (2) laboratories' policies regarding foreign participation, (3) reciprocity in interactions between federal laboratory and foreign researchers, and (4) implications of these issues for federal policy on foreign access to federal R&D.

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[2]R&D Funding: Foreign Sponsorship of U.S. University Research (GAO/RCED-88-89BR, Mar. 4, 1988).

To provide a perspective on foreign participation in R&D, we also gathered data on the extent of U.S. participation in R&D at federal laboratories.

To gather information about the extent of U.S. and foreign participation and federal laboratories' policies regarding foreign participation, we sent a questionnaire to 52 laboratories in 7 federal agencies. These agencies accounted for about 95 percent of the funds obligated for R&D by government-operated and contractor-operated federal laboratories. With the assistance of agency officials, we selected federal laboratories that were (1) among each agency's largest laboratories and (2) more apt than other laboratories to conduct R&D in fields with commercial potential. For example, the Department of Defense (DOD) officials suggested that we exclude laboratories that primarily conducted test and evaluation work, as opposed to R&D, because this work normally is classified and has little likelihood of commercial, nondefense applications. We also did not send the questionnaire to some laboratories, such as the Department of Energy's (DOE) Fermi National Accelerator Laboratory, because their research involves basic science. We did not choose the federal laboratories randomly, and the results of our survey are not meant to be generalized to all federal laboratories with R&D activities.

The focus of our questionnaire was on U.S. and foreign researchers who worked at the laboratory for at least 1 consecutive week in fiscal year 1986.[3] For purposes of the questionnaire, we defined researchers as scientists in the physical or life sciences, engineers, and other professional researchers directly involved in the research. The questionnaire also requested fiscal year 1986 data on other interactions, including outside organizations' sponsorship of R&D, collaborative research agreements between the laboratory and outside organizations, the use of a laboratory's specialized scientific facilities (such as a wind tunnel or a synchrotron light source), and short-term visits to the laboratory to discuss research results and methodology. In addition, the questionnaire asked the laboratories to identify any formal or informal policies, in addition to agencywide policies, they may have instituted on foreign participation in R&D.

Fifty federal laboratories responded to the questionnaire. (See app. I for the participating laboratories and app. II for a copy of the questionnaire.) These laboratories employed 43,902 researchers, had a total R&D operating budget of $14.1 billion in

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[3]Federal agencies do not consistently treat U.S. permanent resident aliens as U.S. citizens or foreign nationals. We asked the federal laboratories to include any permanent resident aliens with U.S. citizens because they have demonstrated an intent to stay in the United States.

fiscal year 1986, and included the major federal laboratories involved in R&D with commercial potential. Many of the questions we asked were for data that the federal laboratories did not ordinarily use or track, requiring the laboratories to conduct manual file searches to respond. In particular, many laboratories could not readily identify (1) the institutional affiliation (government, industry, nonprofit organization, or other organization) of researchers who conducted R&D at the laboratory and (2) the purpose of a short-term visit, that is, whether industry representatives came to discuss research or whether, for example, they were repairmen or other service industry personnel.[4] As a result, many laboratories provided their best estimates while, for some answers, laboratories gave aggregate totals or stated that the information was not readily available.

To assess the reciprocity in interactions between federal laboratory researchers and foreign researchers and the implications for U.S. policy on foreign participation in federal laboratory R&D, we interviewed research managers and administrators at eight federal laboratories. (See table 1.1.) We selected the laboratories because (1) they are among the largest in each of six federal agencies, with a total operating R&D budget of $3.2 billion in fiscal year 1986, (2) they represented a mix of engineering and scientific laboratories as well as government-operated and contractor-operated laboratories, and (3) their R&D could have important commercial applications. At each laboratory, we talked with from 6 to 15 research managers and administrators. We then discussed their perceptions with program officials at each of the six federal agencies and with officials at the Office of Science and Technology Policy.

During the course of our audit work, several federal agency and laboratory officials expressed concern about foreign access to commercially sensitive technologies through interactions that were not included in our questionnaire. These include (1) access to federal laboratories' technical publications and computer software through the National Technical Information Service, the National Energy Software Center, and other federal information services; (2) presentations at international conferences and symposia; and (3) foreign organizations inviting U.S. researchers to teach at a university or discuss R&D results. As agreed with the requester's staff, we did not address foreign access to federal technical publications and computer software because of the extent of effort that would be needed. During our pretest of the questionnaire, the agency and laboratory officials who reviewed the questionnaire did not identify presentations at international conferences and foreign invitations to discuss R&D results as issues of comparable importance that we should include in our questionnaire.

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[4]We defined a short-term visit as lasting up to 5 days, although typically the visit was for 1 day or less.

Table 1.1: Federal Laboratories That We Visited

Laboratory	Federal agency	R&D operating budget in FY 1986 (dollars in millions)
Beltsville Agricultural Research Center	Agriculture	$ 71.6
National Bureau of Standards	Commerce	174.0
Lincoln Laboratory	Defense-Air Force	307.9
Naval Research Laboratory	Defense-Navy	400.7
Oak Ridge National Laboratory	Energy-energy research	455.0
Sandia National Laboratories	Energy-defense programs	1,000.0
National Institutes of Health	Health and Human Services	605.4
Langley Research Center	NASA	203.4

We conducted the audit work between April 1987 and March 1988. Our audit work was performed in accordance with generally accepted government auditing standards.

SECTION 2

EXTENT OF U.S. AND FOREIGN PARTICIPATION

Federal agencies offer a variety of programs at their laboratories through which U.S. and foreign governments, businesses, universities, and other nonprofit organizations can collaborate on or fund R&D. Our survey of 50 laboratories in 7 federal agencies showed that the principal mechanisms for interaction are through guest and visiting researcher programs and educational programs. Guest and visiting researcher programs provide a means for senior researchers from outside organizations to collaborate on a research project with a colleague at the laboratory.[1] Educational programs bring postdoctoral fellows, faculty, and students to the laboratories to gain experience and/or training in a research field. These programs expose the participants to the laboratory and serve to recruit new researchers. Through the guest, visiting, and educational programs, 13,092 U.S. and 5,677 foreign researchers conducted R&D at the 50 federal laboratories in fiscal year 1986.

The laboratories' data showed that most of the U.S. and foreign researchers (1) conducted R&D at the nine DOE energy research laboratories and the National Institutes of Health (NIH) and (2) were affiliated with universities and other nonprofit organizations. The data also showed that the largest number of foreign researchers came from Japan (758--13 percent of all foreign researchers), followed by the United Kingdom (448--8 percent) and the People's Republic of China (438--8 percent). Other opportunities for outside organizations to make use of federal laboratories' researchers and facilities are through sponsorship of R&D, collaborative R&D, and the use of a laboratory's specialized scientific facilities. The 50 laboratories reported that these mechanisms were predominantly used by U.S. organizations.

This section provides fiscal year 1986 data for each of these mechanisms for U.S. and foreign participation, including the institutional affiliation and country of origin of the researchers who participated in guest, visiting, and educational programs.

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[1]The distinction between a guest and a visiting researcher is whether the salary is paid by an outside sponsor or by the laboratory's agency. While almost all federal laboratories have only guest researcher programs through which the sponsoring organizations pay the researchers' salaries, the National Institutes of Health are authorized to pay the salaries of U.S. and foreign researchers who participate in the visiting scientist and associates programs.

U.S. AND FOREIGN RESEARCHERS WHO CONDUCTED R&D AT FEDERAL LABORATORIES

Research managers and administrators at several federal laboratories told us that the most effective mechanism for technology transfer is through "shoulder-to-shoulder contact" by federal laboratory researchers collaborating on R&D with outside researchers. This is because the collaborating researchers can readily exchange information about research techniques, technical data, and other know-how. Table 2.1 shows the number of outside U.S. and foreign researchers who worked at the 50 federal laboratories in fiscal year 1986.

- 13,092 U.S. (70 percent) and 5,677 foreign (30 percent) outside researchers conducted R&D at the 50 federal laboratories in fiscal year 1986. The high overall percentage of U.S. researchers reflected the high U.S. participation in educational programs. U.S. researchers comprised only 56 percent of the guest and visiting researchers.

Table 2.1: Total Outside U.S. and Foreign Researchers Who Conducted R&D at the Surveyed Federal Laboratories in FY 1986

Agency (number of surveyed labs)	Permanent lab researchers	Guest/visiting researchers	
		U.S.	Foreign
Agriculture (5)	1,045	110	120
Commerce			
NBS[a] (1)	1,537	467	312
NOAA[b] (6)	1,645	77	75
Defense			
Air Force (5)	4,393	241	38
Army (4)	2,479	306	23
Navy (5)	5,184	73	16
Energy			
Energy research (9)	7,820	1,817	1,243
Defense programs (3)	6,454	571	418
Health and Human Services			
FDA and NIOSH[c] (2)	962	34	49
NIH (1)	1,159	499	969
Interior/Geological Survey (3)	1,568	61	82
NASA (6)	9,656	401	252
Total	43,902	4,657	3,597

[a]National Bureau of Standards.
[b]National Oceanic and Atmospheric Administration.

- 41 percent of the U.S. outside researchers worked at DOE's energy research laboratories, 13 percent worked at NIH, 12 percent worked at NASA's laboratories, and 9 percent worked at DOE's defense programs laboratories.

- 34 percent of the outside foreign researchers worked at NIH, 32 percent worked at DOE's energy research laboratories, 9 percent worked at DOE's defense programs laboratories, and 8 percent worked at NASA's laboratories.

- NIH and Geological Survey had more foreign than U.S. outside researchers at their laboratories.

- Several laboratories relied on outside U.S. and foreign researchers to supplement their staff of permanent researchers. For example, 2,059 of the 2,215 U.S. and foreign researchers participating in R&D at NIH through educational programs were postdoctoral fellows who received training for careers in medical research. Only about 10 percent of the fellows receive full-time positions at NIH. National Bureau of Standards research managers stated that the Bureau's industrial research associates program, which is open only to U.S. researchers, leveraged the permanent staff because the parent companies paid their researchers' salaries and enabled the Bureau to accomplish more.

Researchers participating in educational programs		Total outside researchers			
		U.S.		Foreign	
U.S.	Foreign	Number	Percent	Number	Percent
356	44	466	4	164	3
257	52	724	6	364	6
194	22	271	2	97	2
306	26	547	4	64	1
350	0	656	5	23	0
240	2	313	2	18	0
3,566	548	5,383	41	1,791	32
647	75	1,218	9	493	9
112	22	146	1	71	1
1,250	965	1,749	13	1,934	34
46	113	107	1	195	4
1,111	211	1,512	12	463	8
8,435	2,080	13,092	100	5,677	100

[c]Food and Drug Administration and National Institute of Occupational Safety and Health.

Country of Origin of the Foreign Researchers

Table 2.2 shows the country of origin of the 5,677 foreign researchers who conducted R&D at the 50 federal laboratories in fiscal year 1986.

- 758 Japanese researchers conducted R&D. Of these, 394 (52 percent) worked at NIH, and 191 (25 percent) worked at DOE's energy research laboratories.
- 448 United Kingdom researchers conducted R&D. Of these, 147 (33 percent) worked at NIH, and 115 (26 percent) worked at DOE's energy research laboratories.
- 438 People's Republic of China researchers conducted R&D. Of these, 178 (41 percent) worked at DOE's energy research

Table 2.2: Country of Origin of All Foreign Researchers Who Conducted R&D at the Surveyed Federal Laboratories in FY 1986

Agency	Canada	Japan	People's Republic of China	United Kingdom
Agriculture	8	2	10	13
Commerce				
NBS	5	39	65	32
NOAA	7	10	11	6
Defense				
Air Force	2	2	0	11
Army	1	4	1	4
Navy	2	0	0	3
Energy				
Energy research	85	191	178	115
Defense programs	30	54	7	53
Health and Human Services				
FDA and NIOSH	2	4	8	3
NIH	66	394	130	147
Interior/Geological Survey	4	10	24	5
NASA	27	48	4	56
Total (Percent)	239 (4)	758 (13)	438 (8)	448 (8)

[a]Of the 2,549 researchers from other countries, 457 (8 percent) came from other Far East countries (such as South Korea and Taiwan); 1,291 (23 percent) came from other Western European countries (such as France

laboratories, 130 (30 percent) worked at NIH, and 65 (15 percent) worked at the National Bureau of Standards.

- 403 West German researchers conducted R&D. Of these, 170 (42 percent) worked at DOE's energy research laboratories, 95 (24 percent) worked at NIH, and 43 (11 percent) worked at NASA's laboratories.

- 366 researchers from India conducted R&D. Of these, 154 (42 percent) worked at NIH, 99 (27 percent) worked at DOE's energy research laboratories, and 45 (12 percent) worked at NASA's laboratories.

- 211 researchers from the Soviet Union and other Eastern European countries conducted R&D. Of these, 82 (39 percent) worked at DOE's energy research laboratories, and 71 (34 percent) worked at NIH.

West Germany	Israel	India	Eastern European countries	Other	Total
5	21	13	11	81	169
15	34	13	18	143	364
2	8	4	4	45	97
4	4	11	0	30	64
2	0	0	0	11	23
1	3	3	0	6	18
170	40	99	82	831	1,791
62	30	15	5	237	493
1	5	5	3	40	71
95	95	154	71	782	1,934
3	2	4	16	127	195
43	23	45	1	216	463
403 (7)	265 (5)	366 (6)	211 (4)	2,549[a] (45)	5,677

and Italy); 199 (3 percent) came from other Middle East countries (such as Egypt); and 602 (11 percent) came from countries in South America and Africa, Australia, etc.

Institutional Affiliation of Guest and Visiting Researchers

Guest and visiting researchers are senior scientists and engineers from outside organizations who contribute to federal laboratories' missions through their subject matter expertise. They also benefit by getting access to the laboratories' researchers, facilities, know-how, and sample materials. Table 2.3 shows the institutional affiliation of 3,917 U.S. and 2,953 foreign guest and visiting researchers who conducted R&D at 47 federal laboratories in fiscal year 1986. (Three laboratories could not provide these data.)

- 50 percent of the U.S. and 57 percent of the foreign guest and visiting researchers were affiliated with universities and other nonprofit organizations.
- 869 U.S. and 118 foreign guest and visiting researchers were affiliated with businesses. For the most part, researchers affiliated with businesses were guest researchers. The parent companies or sponsoring professional organizations/trade associations paid the researchers' salary, housing, and other costs.

Table 2.3: Institutional Affiliation of the Guest and Visiting Researchers Who Conducted R&D at the Surveyed Federal Laboratories in FY 1986

	U.S.			
Agency	Government	Business	Nonprofit	Other[a]
Agriculture	17	2	79	12
Commerce				
NBS	76	291	31	69
NOAA	10	0	66	1
Defense				
Air Force	39	36	101	65
Army	54	4	248	0
Navy	32	5	36	0
Energy				
Energy research[c]	226	366	582	8
Defense programs[d]	63	25	269	120
Health and Human Services				
FDA and NIOSH	17	1	16	0
NIH	85	47	309	58
Interior/Geological Survey	0	2	11	48
NASA[f]	67	90	230	3
Total (Percent)	686 (18)	869 (22)	1,978 (50)	384 (10)

[a]Other U.S. researchers mainly include retirees and researchers from federal contractor-operated laboratories. In addition, some researchers whose affiliation could not be determined are included.
[b]Other foreign researchers mainly include researchers whose affiliation could not be determined.
[c]Does not include Lawrence Berkeley, which could not provide the institutional affiliation of 635 U.S. and 371 foreign researchers.
[d]Does not include Lawrence Livermore, which could not provide the institutional

- Of the 869 U.S. guest and visiting researchers affiliated with businesses, 291 (33 percent) conducted R&D at the National Bureau of Standards, mainly through its Industrial Research Associates Program.

- 366 (42 percent) of the U.S. researchers affiliated with businesses conducted R&D at DOE's energy research laboratories, including 284 researchers at Oak Ridge National Laboratory. In 1985 DOE instituted the Industry-Laboratory Technology Exchange Program, which is open to a limited number of researchers from U.S. companies. According to a DOE program official, DOE is assisting 25 business-affiliated researchers in fiscal year 1988, typically at a cost of $20,000 to $25,000 for travel, housing, and other per diem costs associated with working at a DOE laboratory.

In addition to collaborating with the researchers who conducted R&D through guest and visiting researcher programs, federal laboratories' researchers frequently worked with their agencies' contractors on a research project. The 40 laboratories that could provide data reported 6,151 U.S. and 508 foreign researchers who were employed by a federal contractor conducted R&D at the laboratories to fulfill the contract terms. NASA's laboratories reported that 3,089 U.S. and 334 foreign researchers worked as contractor personnel in fiscal year 1986.

	Foreign		
Government	Business	Nonprofit	Other[b]
42	1	71	6
170	19	118	5
45	2	28	0
18	1	17	2
10	0	13	0
8	0	8	0
196	46	628	2
78	12	89	82
22	1	24	2
73	17	577	302[e]
55	0	27	0
23	19	94	0
740 (25)	118 (4)	1,694 (57)	401 (14)

affiliation of the 94 U.S. and 157 foreign researchers.

[e]Affiliation unidentified or listed as institutes, centers, and hospitals that cannot be identified as government, business, or nonprofit.

[f]Does not include the Jet Propulsion Lab, which could not provide the institutional affiliation of 11 U.S. and 116 foreign researchers.

Country of Origin of the Foreign Guest and Visiting Researchers

Table 2.4 shows the countries or regions of origin of the 3,597 foreign guest and visiting researchers who conducted R&D at the 50 federal laboratories in fiscal year 1986.

- o 452 (13 percent) of the foreign researchers came from Japan. Of these, 147 (33 percent) worked at NIH, and 163 (36 percent) worked at DOE's 9 energy research laboratories. Brookhaven and Lawrence Berkeley accounted for 91 of the 163 Japanese researchers at the energy research laboratories.

Table 2.4: Country of Origin of the Foreign Guest and Visiting Researchers

Agency	Canada	Japan	People's Republic of China	United Kingdom
Agriculture	7	2	5	11
Commerce				
NBS	3	38	56	28
NOAA	4	10	10	5
Defense				
Air Force	2	1	0	9
Army	1	4	1	4
Navy	1	0	0	3
Energy				
Energy research	62	163	131	92
Defense programs	26	46	7	48
Health and Human Services				
FDA and NIOSH	2	4	8	1
NIH	54	147	48	65
Interior/Geological Survey	0	8	17	5
NASA	17	29	0	43
Total (Percent)[a]	179 (5)	452 (13)	283 (8)	314 (9)

[a]Percentages do not add up due to rounding.
[b]Of the 1,572 guest and visiting researchers from other countries, 230 came from other Far East countries (such as South Korea and Taiwan); 904 came from other Western European countries (such as France and Italy);

- 314 (9 percent) of the foreign researchers came from the United Kingdom, 306 (8 percent) came from West Germany, and 904 (25 percent) came from other Western European countries. Overall, 403 Western European researchers worked at NIH, 489 worked at DOE's energy research laboratories, 263 worked at DOE's defense programs laboratories, 145 worked at NASA's laboratories, and 224 worked at the other surveyed laboratories.

- 283 (8 percent) of the foreign researchers came from the People's Republic of China. Of these, 131 worked at DOE's energy research laboratories, 56 worked at the National Bureau of Standards, and 48 worked at NIH. Brookhaven and Lawrence Berkeley accounted for 110 of the 131 Chinese researchers at the energy research laboratories.

West Germany	Israel	India	Eastern European countries	Other
4	18	5	10	58
15	33	6	17	116
2	5	0	4	35
3	2	3	0	18
2	0	0	0	11
1	3	3	0	5
132	32	58	51	522
52	23	8	4	204
1	4	1	3	25
58	60	74	31	432
3	1	1	15	32
33	6	9	1	114
306 (9)	187 (5)	168 (5)	136 (4)	1,572[b] (44)

73 came from other Middle East countries (such as Egypt); and 365 came from countries in South America and Africa, Australia, etc.

Institutional Affiliation of Guest and Visiting Researchers From Four Countries

Table 2.5 shows the institutional affiliation of 902 guest and visiting researchers from 4 selected countries--the United Kingdom, West Germany, Japan, and Israel--that have varying degrees of participation in R&D at 46 of the laboratories. (Four laboratories could not provide any data and 1 laboratory provided incomplete data so that the institutional affiliations 90 British, 98 West German, 140 Japanese, and 29 Israeli researchers were not identified.)

Table 2.5: Institutional Affiliation of Guest and Visiting Researchers From Four Selected Countries

	U.K.			West Germany		
Agency	Government	Business	Nonprofit	Government	Business	Nonprofit
Agriculture	3	0	8	1	0	3
Commerce						
NBS	4	2	22	6	1	8
NOAA	3	1	1	2	0	0
Defense						
Air Force	1	0	8	3	0	0
Army	2	0	2	2	0	0
Navy	2	0	1	0	0	1
Energy						
Energy research[a]	7	9	48	15	12	44
Defense programs[b]	11	2	16	11	2	26
Health and Human Services						
FDA and NIOSH	1	0	0	0	0	1
NIH[c]	2	1	44	2	1	41
Interior/Geological Survey	2	0	3	2	0	1
NASA[d]	6	2	10	0	4	19
Total (Percent)[e]	44 (20)	17 (8)	163 (73)	44 (21)	20 (10)	144 (69)

[a]Data not available for Lawrence Berkeley and Oak Ridge National Laboratories.
[b]Data not available for Lawrence Livermore National Laboratory.
[c]NIH could not identify the institutional affiliation of an additional 18 British, 14 West German,

- Overall, 598 (66 percent) of the researchers from these 4 countries were affiliated with universities and other nonprofit organizations, 235 (26 percent) were affiliated with government, and 69 (8 percent) were affiliated with businesses.

- These 4 countries accounted for more than one-half of the 118 foreign researchers affiliated with businesses, as shown in table 2.3--17 were from the United Kingdom, 20 were from West Germany, 27 were from Japan, and 5 were from Israel.

Japan			Israel		
Government	Business	Nonprofit	Government	Business	Nonprofit
1	1	0	3	0	15
12	7	19	26	0	7
9	0	1	2	0	3
1	0	0	0	1	1
2	0	2	0	0	0
0	0	0	2	0	1
35	6	48	6	2	14
17	1	9	12	0	8
2	0	2	2	0	2
5	7	99	1	2	43
6	0	2	1	0	0
2	5	11	0	0	4
92 (29)	27 (9)	193 (62)	55 (35)	5 (3)	98 (62)

36 Japanese, and 14 Israeli researchers.
[d]Data not available for Jet Propulsion Laboratory.
[e]Percentages for the United Kingdom do not add up due to rounding.

Researchers Conducting R&D Through Educational Programs

Table 2.6 shows the educational level of researchers who conducted R&D at the 50 federal laboratories through educational programs in fiscal year 1986.

- 6,521 (90 percent) of the 7,282 university faculty, graduate students, undergraduate students, high school students, and high school teachers who worked at federal laboratories were U.S. citizens, while 761 (10 percent) were foreign nationals.
- Only 1,914 (59 percent) of the 3,233 postdoctoral fellows were U.S. citizens.
- 1,094 (57 percent) of the U.S. and 965 (73 percent) of the foreign postdoctoral fellows worked at NIH. In 1986 NIH established an Intramural Research Training Award (IRTA) program on the basis of training authority in the Health

Table 2.6: Educational Level of Researchers Who Conducted R&D at the Surveyed Federal Laboratories Through Educational Programs

	U.S.			
Agency	University faculty	Postdoctoral fellows	Graduate students	Other[a]
Agriculture	0	67	25	264
Commerce				
NBS	110	57	40	50
NOAA	18	22	54	100
Defense				
Air Force	77	18	78	133
Army	12	0	38	300
Navy	101	81	14	44
Energy				
Energy research[b]	639	200	720	2,007
Defense programs	111	167	197	172
Health and Human Services				
FDA and NIOSH	13	21	49	29
NIH	64	1,094	50	42
Interior/Geological Survey	9	12	16	9
NASA	305	175	262	369
Total	1,459	1,914	1,543	3,519

[a]Other includes undergraduate students, high school students, and high school teachers.
[b]Oak Ridge National Laboratory could not provide a breakout of the 397 U.S. and 40 foreign graduate, undergraduate, and high school students and high school teachers.

Research Extension Act of 1985. The program is open only to U.S. postdoctoral fellows and provides a stipend of $24,000. Similar to the foreign visiting fellows, IRTA fellows do not count against NIH's staffing ceiling. NIH officials stated that the IRTA program had 103 U.S. postdoctoral fellows in fiscal year 1987 and 161 fellows as of June 1988. They aspire to have an equal number of IRTA and foreign postdoctoral fellows at NIH in future years.

The length of stay and the relevance of the research experience for technology transfer varied by educational level. For example, postdoctoral fellows typically have conducted R&D at a federal laboratory for 1 to 3 years, while university and high school students were likely to work at a federal laboratory for a summer or a semester. Because of their training and the duration of their stay, postdoctoral fellows are given a great degree of responsibility for the conduct of the research. In contrast, one of the principal reasons for bringing in graduate and undergraduate students is to interest them in a research career and expose them to a potential research career at a federal laboratory.

	Foreign		
University faculty	Postdoctoral fellows	Graduate students	Other[a]
14	19	11	0
19	0	33	0
2	11	7	2
7	11	7	1
0	0	0	0
2	0	0	0
129	111	143	165
2	59	13	1
4	9	6	3
0	965	0	0
3	3	65	42
40	131	33	7
222	1,319	318	221

Consequently, we distributed these numbers between the "graduate student" and "other" columns on the basis of proportions of the other DOE energy research laboratories.

Country of Origin of Foreign Researchers Who Participated in Educational Programs

Table 2.7 shows the countries and regions of origin of the 2,080 foreign researchers who conducted R&D at the 50 federal laboratories in fiscal year 1986 through participation in an educational program.

- 306 (15 percent) of the foreign researchers participating in educational programs came from Japan; 198 (10 percent) came from India.
- Several of the research managers and administrators at the eight federal laboratories we visited noted that the

Table 2.7: Country of Origin of the Foreign Researchers Who Conducted R&D Through Educational Programs

Agency	Canada	Japan	People's Republic of China	United Kingdom
Agriculture	1	0	5	2
Commerce				
NBS	2	1	9	4
NOAA	3	0	1	1
Defense				
Air Force	0	1	0	2
Army	0	0	0	0
Navy	1	0	0	0
Energy				
Energy research	23	28	47	23
Defense programs	4	8	0	5
Health and Human Services				
FDA and NIOSH	0	0	0	2
NIH	12	247	82	82
Interior/Geological Survey	4	2	7	0
NASA	10	19	4	13
Total (Percent)[a]	60 (3)	306 (15)	155 (7)	134 (6)

[a]Percentages do not add up due to rounding.
[b]Of the 977 foreign researchers from other countries, 227 came from other Far East countries (such as South Korea and Taiwan); 387 came from other Western European countries (such as France and Italy); 126 came from

likelihood of whether a foreign researcher participating in an educational program would seek U.S. citizenship varied by nationality. They said that Japanese researchers typically will return to Japan, while a higher percentage of researchers from India, for example, will seek U.S. citizenship.

In addition to programs that the agencies sponsored directly, such as NIH's visiting fellows program for foreign postdoctoral fellows, many laboratories participate in the National Research Council's resident research associateship program. The National Research Council is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities.

West Germany	Israel	India	Eastern European countries	Other
1	3	8	1	23
0	1	7	1	27
0	3	4	0	10
1	2	8	0	12
0	0	0	0	0
0	0	0	0	1
38	8	41	31	309
10	7	7	1	33
0	1	4	0	15
37	35	80	40	350
0	1	3	1	95
10	17	36	0	102
97 (5)	78 (4)	198 (10)	75 (4)	977[b] (47)

other Middle East countries (such as Egypt); and 237 came from countries in South America and Africa, Australia, etc.

SPONSORSHIP OF R&D

Forty-five of the 50 federal laboratories reported that they conducted R&D for organizations outside their agencies in fiscal year 1986. Table 2.8 shows that $1.8 billion (95 percent) of the sponsored R&D was funded by federal agencies other than the agency responsible for the laboratory's budget appropriation. For example, DOD contracted with several DOE laboratories to perform Strategic Defense Initiative and other R&D in fiscal year 1986. Also, sponsored R&D for Air Force, Army, and Navy laboratories included funding from DOD departments other than the service responsible for the laboratory.

- 18 of the 50 federal laboratories conducted R&D for U.S. businesses and 5 laboratories conducted R&D for foreign businesses in fiscal year 1986.
- DOE's energy research and defense programs laboratories conducted 69 percent of the R&D funded by U.S. businesses ($20.4 million) and 67 percent of the R&D funded by U.S. nonprofit organizations ($14.1 million). The laboratories performed this work through DOE's "Work-for-Others" program, which stipulates that (1) the R&D is done on a fully reimbursable basis, (2) it fits the laboratory's mission, and (3) the laboratory has a unique capability

Table 2.8: Sponsorship of R&D at the Surveyed Federal Laboratories by Nonagency Organizations in FY 1986 (dollars in thousands)[a]

	U.S. sponsor				
Agency	Government[b]	Business	Nonprofit	Other[c]	Total
Agriculture	$3,399	$53	$172	$57	$3,681
Commerce					
NBS	68,597	537	3,860	39	73,033
NOAA	14,007	0	40	566	14,613
Defense					
Air Force	5,579	1,481	112	0	7,172
Army	79,054	22	29	685	79,790
Navy	404,544	3,355	0	0	407,899
Energy					
Energy research	319,774	18,799	13,089	1,366	353,028
Defense programs	432,038	1,612	1,057	722	435,429
Health and Human Services					
FDA and NIOSH	6,762	0	0	0	6,762
NIH	7,582	1,500	553	911	10,546
Interior/Geological Survey	34,667	0	347	1,320	36,334
NASA	397,350	2,191	1,765	0	401,306
Total (Percent)	$1,773,353(95)	$29,550 (2)	$21,024(1)	$5,666(0)	$1,829,593

[a]This is R&D that is performed by federal laboratory researchers under a contract with a nonagency organization.

that is not in competition with private research organizations.

- 50 percent of the $28.6 million of R&D sponsored by foreign governments was conducted by the Naval Weapons Center in association with foreign military sales.

- Japan funded $5.9 million in R&D, including $2.9 million at NASA's laboratories and $2.2 million at DOE's energy research laboratories. This includes $1.8 million from Japanese businesses for Oak Ridge National Laboratory to conduct R&D on breeder-reactor fuel reprocessing technology, a field that the United States currently is not pursuing.

- Arab countries in the Middle East funded $7.2 million in R&D. Saudi Arabia funded most of this R&D through its long-term contract with Geological Survey for mapping the geology of Saudi Arabia, assessing its mineral potential, and training its staff of geologists.

- In fiscal year 1986, U.S. businesses funded $29.5 million in R&D at the 45 federal laboratories, mostly through relatively small contracts. Of the 772 total contracts, 102 were for $500,000 or more. By comparison, foreign organizations had 206 contracts in effect in fiscal year 1986, of which only 8 were for $500,000 or more.

Foreign sponsor				International	
Government	Business	Nonprofit	Total	organizations	Total
$277	0	0	$277	$7	$3,965
165	0	0	165	0	73,198
288	0	0	288	23	14,924
111	0	0	111	0	7,283
1	0	0	1	1	79,792
14,400	0	0	14,400	0	422,299
1,034	1,866	306	3,206	485	356,719
1,961	0	0	1,961	162	437,552
0	0	0	0	0	6,762
187	43	283	513	0	11,059
6,644	0	0	6,644	0	42,978
3,506	47	3	3,556	154	405,016
$28,574 (2)	$1,956 (0)	$592 (0)	$31,122	$832(0)	$1,861,547

[b]Federal agencies other than the agency that is responsible for the laboratory.
[c]State and local governments.

COLLABORATIVE R&D AGREEMENTS

Table 2.9 shows the number of collaborative agreements that the 50 federal laboratories entered into with other U.S. and foreign organizations in fiscal year 1986.

- The National Bureau of Standards and NIH accounted for almost two-thirds of all of the collaborative agreements with U.S. and foreign organizations and 76 percent of the agreements with U.S. businesses.

- DOE has not delegated authority to enter into cooperative agreements to most of its laboratories because they are operated by contractors and thus are not covered by the Federal Technology Transfer Act. Technology transfer officials at Sandia, Lawrence Livermore, and Brookhaven National Laboratories told us that DOE's review of proposed collaborative agreements caused delays and in many cases

Table 2.9: Number of Collaborative R&D Agreements With Nonagency Organizations in FY 1986

	U.S. collaborator			
Agency	Government	Business	Nonprofit	Total
Agriculture	25	29	76	130
Commerce				
NBS	61	252	258	571
NOAA	20	3	8	31
Defense				
Air Force	58	3	2	63
Army	10	4	10	24
Navy	10	0	4	14
Energy[a]				
Energy research[b]	1	2	3	6
Defense programs	5	6	8	19
Health and Human Services				
FDA and NIOSH	18	2	31	51
NIH	211	37	160	408
Interior/Geological Survey	1	0	1	2
NASA	82	42	77	201
Total (Percent)	502 (33)	380 (25)	638 (42)	1,520

[a]DOE program officials believe that DOE laboratories underreported the number of collaborative agreements. They stated that DOE currently has 75 active agreements with foreign organizations and that DOE's fossil, renewable, and

did not take into account the special needs of the collaborator. They proposed that DOE establish a threshold below which the laboratories or the local DOE operations office could authorize an agreement without DOE headquarters' review and approval. DOE opposes giving this authority directly to the laboratories because a contractor would then be authorized to spend government funds without a federal agency's review and approval. DOE program officials stated that DOE is developing a streamlined approval process to eliminate any delays.

The Federal Technology Transfer Act of 1986, which was enacted in October 1986, authorizes federal agencies to delegate authority to their government-operated laboratories to enter into cooperative R&D agreements, with the objective of making the process simpler and faster. Because the act became effective in fiscal year 1987, the data in table 2.9 would not reflect its impact but can provide a baseline for subsequently measuring the impact of the act.

	Foreign collaborator		
Government	Business	Nonprofit	Total
9	3	20	32
63	31	154	248
4	0	0	4
18	0	0	18
13	0	1	14
5	0	2	7
6	4	2	12
18	2	6	26
13	0	9	22
105	14	106	225
29	0	0	29
51	3	19	73
334 (47)	57 (8)	319 (45)	710

conservation groups have 70 currently active.
[b]Data not available for Brookhaven National Laboratory.

SPECIALIZED SCIENTIFIC USER FACILITIES

Forty-four of the 50 federal laboratories reported that they have specialized scientific facilities that can be used by outside organizations. Table 2.10 shows the number of times in fiscal year 1986 that U.S. and foreign organizations used these facilities, which include (1) NASA's and Air Force's wind tunnels; (2) Brookhaven's synchrotron light source, which provides continuous sources of x-ray and ultraviolet radiation for R&D in areas such as the analysis of the composition of materials, solid-state physics, and x-ray lithography; and (3) Los Alamos' meson physics facility, which provides a high-intensity proton beam for research in areas such as nuclear physics, solid-state physics, and nuclear chemistry.

- U.S. organizations used the laboratories' specialized scientific facilities 3,091 times, accounting for 81 percent of the use by outside organizations.

Table 2.10: Use of Specialized Scientific Facilities at the Surveyed Federal Laboratories by U.S. and Foreign Organizations in FY 1986

	U.S.			
Agency	Government	Business	Nonprofit	Total
Agriculture[a]	12	32	50	94
Commerce				
NBS	13	14	26	53
NOAA	25	10	33	68
Defense				
Air Force	65	53	47	165
Army[b]	36	2	20	58
Navy	66	212	22	300
Energy				
Energy research	129	185	382	696
Defense programs	256	74	489	819
Health and Human Services				
FDA and NIOSH	21	5	15	41
NIH	4	2	26	32
Interior/Geological Survey	1	1	5	7
NASA	207	124	427	758
Total (Percent)	835 (27)	714 (23)	1,542 (50)	3,091

[a]Data not available for the Northern Regional Research Center.

- 74 percent of the U.S. and foreign organizations used specialized scientific facilities at DOE and NASA laboratories.

The 44 laboratories also reported that 93 percent of the researchers who used the specialized facilities were from U.S. organizations. Researchers from U.S. businesses comprised 1,345 of the 1,395 business researchers.

In addition to specialized scientific facilities that were available in fiscal year 1986, Oak Ridge National Laboratory opened its high temperature materials laboratory in April 1987. In addition, the National Bureau of Standards is constructing a cold neutron facility, which is expected to become operational in early 1990, for the study and characterization of ceramics, polymers, advanced alloys, and other materials. Officials at both laboratories stated that both facilities will be used extensively by U.S. businesses, and the laboratories will carefully screen foreign requests to use the facilities.

	Foreign		
Government	Business	Nonprofit	Total
8	8	28	44
5	0	11	16
9	1	4	14
8	5	3	16
1	0	5	6
5	6	4	15
75	20	185	280
39	8	128	175
5	0	2	7
0	0	19	19
32	0	12	44
26	13	34	73
213 (30)	61 (9)	435 (61)	709

[b] Data not available for the Army Chemical Research, Development and Engineering Center.

SECTION 3

FEDERAL LABORATORIES' POLICIES REGARDING FOREIGN ACCESS TO R&D

Foreign researchers and organizations can get access to federal laboratories' facilities and research results through a wide variety of interactions. In addition to foreign researchers' conducting R&D and foreign organizations' funding or collaborating on R&D at federal laboratories, representatives of foreign organizations make lab visits, attend scientific conferences, and request reprints of articles in scientific publications, computer software, and other technical data.

In commenting on foreign access to federal laboratory R&D, research managers and administrators distinguished between fundamental scientific research and research with commercial potential. While the distinctions have become blurred in fields such as biotechnology, the research managers and administrators supported open exchanges in the basic scientific fields as the best way to advance scientific knowledge. However, managers and administrators at the National Bureau of Standards, Langley Research Center, Oak Ridge National Laboratory, and Sandia National Laboratories were concerned about providing foreign researchers and organizations access to technologies with commercial potential. They stated that they gave preference to U.S. researchers and organizations and carefully reviewed requests for access by foreign researchers and organizations for fields of research with commercial potential. Managers and administrators at NIH and the Beltsville Agricultural Research Center stated that historically they have sought the best quality research to achieve their respective missions to improve health and agricultural production. Managers and administrators at the Naval Research Laboratory and Lincoln Laboratory stated that they have had little interaction with either U.S. or foreign businesses other than DOD contractors because of national security concerns.

U.S. PREFERENCE

Federal agencies have a large number of programs that bring U.S. and foreign researchers to their laboratories to conduct R&D. In recent years the agencies have established or expanded programs that are specifically intended to attract researchers from U.S. businesses. Similarly, federal agencies have limited some of their educational programs to U.S. researchers, or in some cases they screen the field of research in which foreign researchers can work.

Businesses

In recent years, federal legislation and agency initiatives have encouraged the federal laboratories to interact more with U.S. organizations and give a preference to U.S.-based businesses. The

Patent and Trademark Amendments of 1980 (P.L. 96-517) direct federal agencies normally to license a federal invention to companies that agree that any products embodying the invention or produced through the use of the invention will be manufactured substantially in the United States. The Federal Technology Transfer Act of 1986 similarly directs government-operated laboratories to give preference to U.S.-based organizations in entering into cooperative R&D agreements.

Twenty-four of the 50 federal laboratories we surveyed have started new programs since 1980 to encourage U.S. business-affiliated researchers to work at their laboratories. For example, the National Bureau of Standards decided in 1981 to double the size of its Industrial Research Associates Program, which is only open to U.S. businesses; Geological Survey instituted a cooperative research program in 1983 and an Industrial Research Associates Program in 1984; and DOE initiated an Industry-Laboratory Technology Exchange Program in 1985.

Research managers at the Beltsville Agricultural Research Center stated that the Federal Technology Transfer Act has fundamentally changed the Center's relationship with U.S. businesses. Prior to the act, the Center would conduct research tests for U.S. businesses, but few, if any, business-affiliated researchers conducted R&D at the Center. With the passage of the act, the Agricultural Research Service has established an office for cooperative interactions and has negotiated 30 cooperative R&D agreements with U.S. businesses.

NIH's relationship with U.S. industry similarly has changed with the enactment of the Federal Technology Transfer Act. NIH created a patent policy board to establish policies and procedures for collaborations with outside organizations. The board is responsible for developing model cooperative R&D agreements and for reviewing all agreements for their acceptability and appropriateness. NIH also is in the process of creating an office of invention development consisting of five staff members to coordinate the implementation of the act.

Research managers at the Naval Research Laboratory and Sandia National Laboratories stated that they are interested in collaborating with U.S. businesses; however, they are constrained by the need for security clearances. Naval Research Laboratory officials stated that outside researchers need at least a secret clearance to conduct R&D at the laboratory. Sandia, because it is a DOE-defense programs laboratory, requires researchers working inside its security fence to have a top secret clearance, which security officials noted takes 9 months on average to process. Sandia officials stated that several opportunities to collaborate have been lost because of the time required to obtain security clearances. They added that moving laboratory facilities outside the security fence would impose a burden on Sandia's researchers

because they would not have as ready access to central computers or the library.

Educational Programs

Several of the educational programs that bring postdoctoral fellows, university students and faculty, and high school students and teachers to the federal laboratories give preference or are limited to U.S. citizens. Programs limited to U.S. citizens include the Army's Summer Faculty Research and Engineering Program, the Navy's Postdoctoral Fellowship Program, DOE's University/DOE Laboratory Cooperative Program, NASA's Summer Faculty Fellowships, and NIH's Intramural Training Awards Program.

Several agencies participate in the National Research Council's Resident Research Associateships Program for bringing postdoctoral fellows and some senior university researchers to their laboratories. According to the director of the associateship program, the agencies and laboratories generally make the program open to both U.S. and foreign postdoctoral fellows. However, NASA screens the fields of research for the foreign associateship candidates and the National Bureau of Standards restricts its program to U.S. fellows, as both are concerned about the commercial potential of the technology. In addition, the Naval Research Laboratory restricts the associateship program to U.S. fellows because of national security constraints. NIH joined the associateship program in 1986 with the goal of attracting 145 (primarily U.S.) postdoctoral fellows per year.

FOREIGN PARTICIPATION IN R&D

The federal laboratories have differed in their receptivity to foreign researchers participating in R&D. In general, DOD laboratories have been most restrictive in providing access to foreign researchers, primarily because of national security concerns. Table 2.1 in section 2 shows that the 14 DOD laboratories that responded to our questionnaire reported that 105 foreign researchers conducted R&D at their laboratories in fiscal year 1986. By contrast, 1,934 foreign researchers worked at NIH and 1,791 foreign researchers worked at 9 DOE-energy research laboratories in fiscal year 1986.

Research managers and administrators at the National Bureau of Standards, Langley Research Center, Sandia National Laboratories, and Oak Ridge National Laboratories told us that they do not have formal polices that exclude foreign researchers. However, the managers and administrators stated that, because they are concerned about providing foreign researchers access to fields of research or laboratory facilities with commercial potential, they carefully screen foreign proposals to collaborate in these areas. The managers and administrators also noted that because they give preference to U.S. researchers and because of their laboratories'

staffing and space constraints, the access of foreign researchers to R&D with commercial potential is limited in many cases.

Research managers and administrators at NIH and the Beltsville Agricultural Research Center noted that theirs are scientific laboratories with goals of improving health and agricultural production. The managers and administrators told us that historically they have pursued the best scientific research, regardless of the nationality of the collaborating researchers. Several NIH research managers expressed concern about any effort to restrict the number of foreign postdoctoral fellows who spend 1 to 3 years at NIH because they are intelligent and industrious and because NIH is facing increased competition for the best U.S. postdoctoral fellows from medical schools and biotechnology and pharmaceutical companies.

RIGHTS TO INTELLECTUAL PROPERTY DEVELOPED AT FEDERAL LABORATORIES

All of the 50 laboratories we surveyed reported that they require the outside U.S. and foreign researchers to disclose any inventions they make while working at the laboratory. During fiscal year 1986 outside U.S. researchers reported 208 inventions and outside foreign researchers reported 35. The laboratories stated that few, if any, outside researchers during the past 3 years had failed to disclose inventions. Only one laboratory, Agriculture's Northern Regional Research Center, reported an instance in which an outside researcher did not disclose an invention.

Forty-eight of the laboratories reported that title to any inventions, computer software, and other technical data that an outside researcher makes while at the laboratory belongs to the federal agency or is determined on a case-by-case basis. However, the Army's Harry Diamond Laboratories and NASA's Goddard Space Flight Center reported that an outside foreign researcher has title rights to inventions, computer software, and other technical data that the researcher makes at the laboratory.[1] In cases in which an outside foreign researcher is given title rights to an invention, computer software, or other technical data, the federal agency is required to retain a royalty-free license for its use by or on behalf of the government.

Seven of the eight laboratories we visited stated they require guest or visiting researchers to sign an agreement in advance that provides a statement of work, stipulates that the outside researcher will disclose any inventions made at the laboratory, and

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[1]Harry Diamond officials noted that only one or two outside foreign researchers typically conduct R&D at the laboratories in a fiscal year.

specifies the title rights to intellectual property developed at the federal laboratory. Langley Research Center was not using a guest agreement, but Langley's patent counsel subsequently stated that the laboratory is developing an agreement form for future use. We also interviewed patent counsels at NASA headquarters and at the other five NASA laboratories that responded to our questionnaire. The patent counsels noted that most, if not all, of the foreign researchers come to their laboratories through the National Research Council's Residential Research Associateship program. They stated that under the Patent and Trademark Amendments of 1980 (35 U.S.C. 200 et seq.) the Council as a nonprofit organization is entitled to retain title to any inventions made by any of the researchers who participated in the associateship program. They also noted that if the Council does not assert its right, then the researcher can retain title to the invention. In either case the government would retain a royalty-free license for the invention's use by or on behalf of the government.

Research managers and administrators at the eight federal laboratories we visited told us that they were not aware of any instances in which a foreign company commercialized their laboratory's technology on the basis of work that an outside foreign researcher conducted at the laboratory. However, several research managers cited instances of foreign companies' commercializing technology developed at their laboratories primarily by being more aggressive than U.S. businesses in pursuing the research results that were published in the scientific literature. Several Langley Research Center officials cited the "fly-by-wire" computerized flight-control system, supercritical air foils, and a glass cockpit as technologies that were developed at Langley, other NASA, and/or Air Force aeronautical laboratories, but which were first introduced in commercial jets by Airbus Industrie (the European consortium). The Langley officials stated that Airbus Industrie introduced the technologies in large part because a gap has been created in the United States in moving aircraft technology from R&D to commercialization. Major U.S. air frame manufacturers were unwilling to introduce sophisticated technologies based on wind tunnel test data; however, the manufacturers did not fund the next step in commercialization--demonstrating the technologies on test aircraft--because of the high cost. In each of the cited cases, the federal laboratory research managers stated, the foreign company was within its rights.

FOREIGN VISITS TO FEDERAL LABORATORIES

The federal laboratories' policies regarding short-term visits (from less than 1 day up to 5 days) by representatives of foreign organizations vary by agency. For example, NASA and DOE require their researchers to obtain advance approval of foreign visits either by agency headquarters or by senior laboratory management. In contrast, NIH's Fogarty International Center is notified of and

coordinates visits only for official foreign delegations. NIH requires no central approval for informal visits by foreign research colleagues or other foreign visitors.

Table 3.1 shows the number of visits in fiscal year 1986 by representatives of foreign organizations to the 40 federal laboratories that could provide data. Five of these laboratories could provide only aggregated visit data without identifying the institutional affiliation of the foreign representatives. Many laboratories had difficulty providing this information because (1) no centralized data are kept; (2) visit data are not kept in computer files, thus requiring manual searches of security logs; and/or (3) the institutional affiliation and purpose of the visit were not normally recorded. Research managers and administrators at several federal laboratories also pointed out that the visit data are not a reliable indicator of technology transfer because the data do not address the degree of access provided during the visits. Several of the laboratory officials stated, for example, that they have tended to give official delegations from foreign countries a broad overview of the laboratory's mission and R&D efforts, with little specific information about individual research projects.

As table 3.1 shows, the visits were relatively evenly distributed among representatives of foreign governments, businesses, and universities and other nonprofit organizations. Ten of the laboratories that could identify the institutional affiliation of their foreign visitors reported more than 100 visits by representatives of foreign businesses. The largest number of these visits were to the Naval Research Laboratory, Oak Ridge National Laboratory, Pacific Northwest Laboratories, the Solar Energy Research Institute, Wright Aeronautical Laboratories, and Lincoln Laboratory. The table shows that DOE, NASA, and Navy laboratories accounted for 76 percent of the reported visits. The largest number of visits to DOE's energy research and defense programs laboratories were by representatives of Japanese organizations, followed by United Kingdom representatives. The largest number of visits to NASA laboratories were by United Kingdom representatives followed by Japanese representatives. The Army, Navy, and Air Force laboratories reported that foreign visits were principally by representatives of North Atlantic Treaty Organization members.

Five of the 50 laboratories reported that they had formal policies and 6 reported that they had informal policies regarding reciprocity that expanded on their agencies' policies on foreign visits. In general, these policies direct the laboratories' researchers to ensure that a reciprocal exchange of information occurs. Only the Jet Propulsion Laboratory reported that it had changed its policy regarding reciprocity for foreign visits since 1980 so it could more closely monitor the value of foreign visits.

Table 3.1: Number of Visits to the Surveyed Federal Laboratories by Representatives of Foreign Organizations in FY 1986[a]

Agency	Government	Business	Nonprofit
Agriculture[b]	121	54	139
Commerce			
NBS	155	53	65
NOAA	156	110	16
Defense			
Air Force[c]	319	399	183
Army	174	208	67
Navy[d]	481	469	369
Energy			
Energy research[e]	821	989	953
Defense programs[f]	126	157	177
Health and Human Services			
FDA and NIOSH	128	16	48
NIH[g]	54	35	105
Interior/Geological Survey[h]	--	--	--
NASA	388	284	241
Total	2,923	2,774	2,363

[a]We defined a visit as lasting up to 5 days. Typically, however, the visits lasted 1 day or less.
[b]Data not available for the Northern Regional Research Center.
[c]Data not available for the Geophysics Laboratory.
[d]Data not available for the Naval Surface Weapons Center.
[e]Data not available for Argonne National Laboratory and Lawrence Berkeley National Laboratory.

Mixed delegation	Total	
	Number	Percent
24	338	3
24	297	2
14	296	2
18	919	7
303	752	6
731	2,050	16
421	3,184	25
1,549	2,009	16
9	201	2
19	213	2
--	--	--
1,531	2,444	19
4,643	12,703	100

[f]Data not available for Sandia National Laboratories.
[g]Totals only include formal visits that arranged through NIH's Fogarty International Center.
[h]Data not available for U.S. Geological Survey.

FOREIGN REQUESTS FOR TECHNICAL DATA

Foreign requests for technical data are controlled under the Export Administration Regulations (15 CFR Part 379), which implement the Export Administration Act of 1979 (50 U.S.C. App. 2401-2420), and the International Traffic in Arms Regulations (22 CFR Subchapter M), which implement the Arms Export Control Act (22 U.S.C. 2751 et. seq.). The Export Administration Regulations apply to unclassified technical data that can be used, or adapted for use, in the design, production, manufacture, utilization, or reconstruction of articles or materials. The regulations require exporters of technical data to get a license from the Department of Commerce, but they provide an exemption for generally available data, including scientific publications, scientific and educational data, and patent applications. The International Traffic in Arms Regulations apply to classified information relating to defense articles and services; information covered by an invention secrecy order; or information not classified pursuant to U.S. law and regulation but which is directly related to the design, engineering, development, production, processing, manufacture, operation, overhaul, repair, maintenance, or reconstruction of defense articles.

In addition to these governmentwide regulations, NASA restricts foreign access to its laboratories' R&D results that have significant potential for domestic benefit through commercial or government use. NASA's "For Early Domestic Dissemination Program" is intended for R&D results applicable to commercial products or processes that would be brought to market within a reasonable time. Under this program foreign organizations normally cannot receive documents for 2 years. Researchers and research managers at Langley Research Center noted that the "For Early Domestic Dissemination Program" does not have an enforcement mechanism and questioned the extent to which the program successfully keeps information from foreign competitors. NASA also has a "Limited Distribution Program" for the distribution of documents related to a proof-of-concept or a major breakthrough that would allow a major technological improvement that could be applied in a commercial or governmental aerospace system or subsystem within 5 years. Under this program, documents are made available only to U.S. organizations, and publication of R&D results typically is delayed for 2 years.

Twenty-eight of the 50 federal laboratories reported that, in addition to government or agencywide policies, they have policies on providing technical data and/or sample materials to foreign requesters. Of the 28 laboratories, 8 reported that they have changed their policies since 1980 to tighten the criteria or strengthen review and approval procedures for providing technical data and/or sample materials to foreign requesters. Nine laboratories provided copies of instructions that they issued to

implement agency directives, and four laboratories provided informal criteria and procedures that they use.

The National Institute for Occupational Safety and Health, Geological Survey, and the National Oceanic and Atmospheric Administration reported that their informal policy is to make technical data and/or sample materials available to any requester. In contrast, two DOD laboratories have an informal policy not to provide technical data and/or sample materials to foreign requesters. Sandia's policy is that information generally will not be released to foreign nationals or multinational companies (1) if the net effect on the U.S. economy is judged to be negative and (2) unless information of comparable value is received in return. One criterion Sandia uses to determine the net effect on the U.S. economy is whether the company receiving the information would predominantly utilize it for U.S. operations in manufacturing, software, services, or other enterprises.

SECTION 4

RECIPROCITY IN THE EXCHANGE OF INFORMATION

Concern in the administration and the Congress has grown in recent years about reciprocity in the exchange between U.S. and foreign researchers. While large numbers of foreign researchers work at U.S. laboratories, relatively small numbers of U.S. researchers conduct R&D in foreign countries. Also, administration officials have pointed out that the United States has a strong basic and applied research program at universities and federal laboratories that is generally open to foreign researchers. In contrast, Japan, for example, has a weak basic and applied research program, and the best research is conducted in corporate laboratories that are not as readily accessible to U.S. researchers. Administration officials also are concerned that, by providing access to large numbers of foreign researchers, the federal laboratories transfer technology and skills to the foreign researchers without getting comparable benefits in return.

FEDERAL LABORATORY RESEARCHERS WHO CONDUCTED R&D IN FOREIGN COUNTRIES

Table 4.1 shows that 1,679 researchers from the 50 federal laboratories conducted R&D in a foreign country in fiscal year 1986. More than half of these researchers worked for Geological Survey. According to a Geological Survey official, the researchers primarily (1) provided technical assistance to a foreign government, (2) attended a conference or a meeting in a foreign country and then extended the visit to work in the field or conduct R&D in a laboratory, or (3) responded to a major earthquake in a foreign country as a part of the Department of State's foreign disaster assistance program.

Table 2.3 in section 2 shows that 740 foreign government researchers conducted R&D at the 50 federal laboratories in fiscal year 1986, including 55 at Geological Survey. If the Geological Survey data are excluded because many of the researchers were providing technical and disaster assistance to foreign countries, then 766 federal laboratory researchers conducted R&D in foreign laboratories, as compared with 687 foreign government researchers who worked at the 50 federal laboratories.

Research managers and administrators at the eight federal laboratories that we visited stated that their laboratories' researchers have obtained access to the foreign researchers and laboratories with whom they want to collaborate on R&D. However, the research managers and administrators identified several personal and organizational disincentives, unrelated to access, that discourage their researchers from conducting R&D in foreign countries. These include (1) language and cultural barriers,

(2) family dislocations, (3) the agency's travel budget constraints, (4) a perception in many fields that the best R&D is being performed in the United States so federal researchers gain little by working in foreign laboratories, (5) no positive recognition in performance appraisals at the laboratory for a researcher who conducted R&D in a foreign country, and (6) the possibility that laboratory space may be reassigned during the researcher's absence.

Information is not available about the number of researchers from U.S. businesses, universities, and other nonprofit organizations who have conducted R&D at foreign laboratories in recent years. On April 21, 1988, the Department of Commerce published a public notice in the Federal Register requesting information about the access of U.S. scientists to foreign research facilities. Specifically, Commerce asked about (1) denials by foreign governments of opportunities to do research in foreign facilities or to enter into formal cooperative relationships and (2) effects of current policies governing foreign access to federal laboratories on private sector willingness to enter into cooperative R&D agreements with such laboratories. Because it had received only two responses to its notice by July 28, Commerce now is making a direct mailing to U.S. industry trade associations to solicit information.

RECIPROCITY AMONG RESEARCHERS AT FEDERAL LABORATORIES

Research managers and administrators at the eight federal laboratories we visited stated that their laboratories have experienced only minor, isolated problems in the exchange of information among their laboratories' researchers and foreign guest researchers. The research managers stated that, while their laboratories do not have formal policies regarding reciprocity, they have informal expectations that the foreign researchers will work closely with their federal laboratory colleagues and share ideas about the research. In particular, federal laboratory researchers and researchers from developed countries generally arrange collaborations in advance and the colleagues work closely together. In addition to the specific collaboration, many of the laboratory managers stated that the foreign researchers participate in a laboratory unit's informal meeting about research, including discussions about R&D at their home institutions, and may deliver formal presentations about their R&D at a conference and symposium.

Overall, research managers and administrators at all of the eight federal laboratories believed that the federal laboratories and the United States benefited more than foreign researchers and countries through foreign researchers collaborating on R&D at federal laboratories. The research managers and administrators stated that, in general, researchers from Western Europe and Japan are experienced scientists and engineers who are not being trained

Table 4.1: Researchers from the Surveyed Federal Laboratories Who Conducted R&D in Foreign Countries in FY 1986

Agency	Canada	Japan	People's Republic of China	United Kingdom
Agriculture	3	0	0	9
Commerce				
NBS	0	2	0	1
NOAA	6	5	3	2
Defense				
Air Force	0	1	0	1
Army	0	0	0	3
Navy	11	2	0	13
Energy				
Energy research	0	13	5	23
Defense programs	0	7	1	27
Health and Human Services				
FDA and NIOSH	1	2	1	0
NIH	2	13	6	12
Interior/Geological Survey	143	24	49	63
NASA	6	3	0	12
Total	172	72	65	166

[a]Of these federal laboratory researchers, 87 worked in other Far East countries (such as South Korea and Taiwan); 389 work in other Western European countries (such as France and Italy); 39 worked in other Middle East countries (such as Egypt); 294 worked in countries in South America

West Germany	Israel	India	Eastern European countries	Other	Total Number	Total Percent
2	1	4	9	41	69	4
13	0	0	0	11	27	2
6	0	0	0	26	48	3
2	0	0	0	5	9	1
5	0	0	0	8	16	1
1	0	0	0	5	32	2
38	3	2	0	110	194	12
28	1	1	1	141	207	12
1	0	0	2	4	11	1
7	12	6	2	20	80	5
26	1	15	41	551	913	54
5	1	0	3	43	73	4
134	19	28	58	965[a]	1,679	101[b]

or Africa, Australia, etc; and 156 worked for an international agency in a foreign country.

[b]Percentages do not add up due to rounding.

during their stay at a federal laboratory. Also, several research managers said that the benefit to the federal laboratory of a foreign researcher increases as the duration of the stay increases. The managers stated that, as a general rule, the federal laboratory receives little benefit if an outside researcher stays for 6 months or less. However, the research managers noted that senior foreign researchers have difficulty justifying a stay of more than 1 year to their home institutions.

None of the research managers and administrators at the eight federal laboratories we visited identified an instance in which a foreign researcher or business improperly made use of the laboratory's technology. While several research managers cited examples of federal laboratory technology that was commercialized first by foreign businesses, they typically stated that this was because the research was published in the scientific literature. One research manager cited a case of a foreign business' commercializing a product that was based in part on the results of a collaboration between a foreign researcher and a federal laboratory researcher. The manager noted that no U.S. business was actively pursuing this field of research and suggested that federal laboratories generally should not collaborate in R&D in which only a foreign business could benefit.

SECTION 5

IMPLICATIONS FOR U.S. POLICY ON FOREIGN ACCESS TO FEDERAL R&D

Research managers and administrators at the eight federal laboratories we visited did not perceive a need for an overall federal policy on foreign access to R&D at federal laboratories. They stated that the laboratories did not need additional authority and/or guidelines regarding reciprocity or restricting foreign access to certain laboratory facilities or fields of research because of the commercial potential of the technology. In general, the research managers and administrators stated that their laboratories have sufficient authority to control foreign researchers' access to their laboratories through their agencies' organic acts and other legislation. They also believed that they are in the best position to determine whether to collaborate on R&D based on the circumstances of each proposed collaboration.

Some of the research managers noted that section 2 of the Federal Technology Transfer Act and section 4(a) of Executive Order 12591, Facilitating Access to Science and Technology, require federal laboratory directors, in negotiating cooperative R&D agreements with a business or other organization that is subject to the control of a foreign company or government, to take into consideration whether or not the foreign government permits U.S. organizations to enter into cooperative R&D agreements and licensing agreements. The Interagency Committee on Federal Laboratory Technology Transfer is developing draft guidelines to implement the act and the order that require the federal agency to coordinate with the U.S. Trade Representative's office to assess foreign reciprocity before entering into an agreement.

The managers and administrators at the eight federal laboratories we visited opposed establishing a governmentwide policy that restricts or excludes access of foreign researchers to fields of research or facilities because of the commercial potential of the technology. The research managers and administrators stated that their laboratories have sufficient authority to control foreign access and/or the policy runs counter to the scientific principle of free and open access and discussions among researchers seeking to advance scientific knowledge. Several of the managers and administrators added that if a policy were developed, it should be in the form of an overall objective, leaving the federal laboratories the flexibility to implement the policy.

Many managers told us that restricting foreign access would be counterproductive. They stated that overall the federal laboratories benefit more from collaborations than the foreign researchers and their countries. National Bureau of Standards officials cited several examples of collaborations with foreign

researchers and businesses in high technology fields that were particularly beneficial to the Bureau and U.S. industry. In one instance, while working at the Bureau, an Israeli university researcher discovered a new material that reversed scientific thought about crystallization. In another instance, the Bureau, through its involvement in the Center for Advanced Research in Biotechnology, analyzed the molecular structure of a $1-million sample of interluken-2(beta), a biologically engineered compound that may be used to treat cancer, for Otsuka Pharmaceutical, Ltd., a Japanese company. Under the terms of the agreement, the results will be published in the U.S. scientific literature so that U.S. researchers will have access to the data. The Bureau's officials also noted that foreign companies and governments would likely be able to find ways around any written policy.

According to several research managers and administrators, the best way to control foreign participation in R&D is to stimulate U.S. participation. This is because the federal laboratories have staffing and space constraints that limit the number of outside researchers who can conduct R&D at the laboratories. By giving preference to U.S. researchers, the federal laboratories would be able to limit foreign involvement to collaborations that are particularly useful.

As table 2.3 shows, the National Bureau of Standards and Oak Ridge National Laboratory reported that 291 and 284 researchers affiliated with U.S. businesses conducted R&D in fiscal year 1986, respectively, while most of the other federal laboratories reported few, if any, business-affiliated researchers. According to research managers and administrators at the Bureau and Oak Ridge, they had large numbers of business-affiliated researchers because their R&D programs are intended to address related industry needs and encourage industry participation. For example, each year industry advisory boards review Oak Ridge's R&D programs. (Research managers at Langley Research Center similarly reported that Langley's senior management meets each year with several major U.S. airframe manufacturers to review its R&D program.) In addition, the National Bureau of Standards' Industrial Research Associates Program is intended to minimize the amount of paperwork and review needed to approve a collaboration by, for example, delegating authority to approve the collaboration from the Bureau's director to a laboratory chief.

The intent of the Federal Technology Transfer Act is to strengthen the link between the federal laboratories' research and technology base and U.S. industry by providing clear authority for federal laboratories to collaborate on R&D with U.S. businesses and other organizations. Several federal agencies and laboratories are still in the early stages of implementing the act. For example, the Navy and the Air Force are in the process of delegating authority to their laboratory directors to enter into cooperative R&D agreements, and many laboratories are in the process of

developing a model cooperative R&D agreement that will serve as a basis for negotiations.

Program officials at DOE, NASA, and the Department of Health and Human Services noted that one of the principal reasons for the large number of foreign students and postdoctoral fellows working at federal laboratories through educational programs is that foreigners comprise 55 percent of the doctoral candidates at U.S. universities. They stated that the federal laboratories are dependent on graduate school programs in the sciences and engineering for their future researchers, and they believed that the United States needs to stimulate U.S. high school and university students to pursue science and engineering careers. In a report on foreign engineers in the United States, the National Research Council addressed this concern by recommending, among other things, that major efforts are needed to improve the scientific and mathematical content and standards of precollege education for a larger portion of the population.[1]

DOD and NASA program officials stated that, in addition to direct foreign access to R&D at federal laboratories, they were concerned about other ways that foreign organizations can get access to federally funded R&D results. DOD officials cited access through (1) agreements between U.S. professional societies and foreign organizations, mentioning as an example an agreement that the American Society of Mechanical Engineers and the Soviet Union's Academy of Sciences entered into in November 1987; (2) researchers' addressing international conferences and symposia; or (3) a foreign organization's inviting U.S. researchers to teach at a university or discuss R&D results during a visit. (According to an American Society of Mechanical Engineers official, the society is sensitive to DOD's concerns and initial cooperation will be on conferences that are open to the public, such as a planned joint international meeting on applied mechanics.) NASA officials particularly were concerned that foreigners can get access to federally funded R&D results through requests under the Freedom of Information Act (5 U.S.C. 552).

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[1]National Research Council, Foreign and Foreign-Born Engineers in the United States: Infusing Talent, Raising Issues, 1988.

FEDERAL LABORATORIES PARTICIPATING IN OUR SURVEY

Agency	Federal laboratory	Number of permanent researchers	R&D operating budget in FY 1986 (dollars in millions)
Agriculture	Beltsville Agricultural Research Center	424	$71.6
	Eastern Regional Research Center	184	13.6
	Northern Regional Research Center	160	16.2
	Southern Regional Research Center	178	15.5
	Western Regional Research Center	99	11.9
Commerce	National Bureau of Standards	1,537	174.0
Commerce	National Oceanic and Atmospheric Administration[a] -- Environmental Research Laboratories -- National Meteorological Center -- Northeast Fisheries Center and Woods Hole Laboratory -- Northwest and Alaska Fisheries Center and Associated Laboratories -- Southeast Fisheries Center and Miami Laboratory -- Southwest Fisheries Center and LaJolla Laboratory	1,645	52.4
Defense-Air Force	Armament Laboratory	310	121.0
	Geophysics Laboratory	446	112.0
	Lincoln Laboratory	1,281	307.9
	Rome Air Development Center	679	449.0
	Wright Aeronautical Laboratories	1,677	944.9

APPENDIX I

Agency	Federal laboratory	Number of permanent researchers	R&D operating budget in FY 1986 (dollars in millions)
Defense-Army	Chemical Research, Development and Engineering Center	679	201.1
	Corps of Engineers Waterways Experiment Station	1,114	162.7
	Harry Diamond Laboratories	417	122.8
	Night Vision and Electro-Optics Laboratory	269	84.2
Defense-Navy	Naval Ocean R&D Activity	168	18.2
	Naval Ocean Systems Center	1,403	478.0
	Naval Research Laboratory	1,384	400.7
	Naval Surface Weapons Center	342	48.0
	Naval Weapons Center	1,887	608.7
Energy-energy research	Argonne National Laboratory	1,364	241.9
	Brookhaven National Laboratory	1,065	201.6
	Idaho National Engineering Laboratory	1,478	166.8
	Lawrence Berkeley Laboratory	785	152.9
	Morgantown Energy Technology Center	67	14.5
	Oak Ridge National Laboratory	1,352	455.0
	Pacific Northwest Laboratories	1,304	207.2
	Pittsburgh Energy Technology Center	170	12.9

Agency	Federal laboratory	Number of permanent researchers	R&D operating budget in FY 1986 (dollars in millions)
	Solar Energy Research Institute	235	63.5
Energy-defense programs	Lawrence Livermore National Laboratory	3,426	821.5
	Los Alamos National Laboratory	1,915	750.0
	Sandia National Laboratories	1,113	1,000.0
Health and Human Services	Food and Drug Administration[b]	701	79.0
	National Institute of Occupational Safety and Health	261	18.6
	National Institutes of Health	1,159	605.4
Interior	Geological Survey -- Reston, Virginia -- Denver, Colorado -- Menlo Park, California	1,568	218.6
NASA	Ames Research Center	1,125	242.0
	George C. Marshall Space Flight Center	1,617	1,780.5
	Goddard Space Flight Center	1,902	1,156.8
	Jet Propulsion Laboratory	2,709	821.3
	Langley Research Center	1,082	203.4
	Lewis Research Center	1,221	712.0

[a]NOAA provided aggregate data for all of its laboratories, including regional service centers in the National Weather Service.
[b]FDA provided data for all of its research facilities, including the National Center for Toxicological Research.

QUESTIONNAIRE SENT TO FEDERAL LABORATORIES

U.S. GENERAL ACCOUNTING OFFICE
Foreign Participation in Federal Laboratory Research and Development

INTRODUCTION

In response to a congressional request, the U.S. General Accounting Office (GAO) is collecting information about foreign participation in research and development at federal laboratories. As a first step in gathering this information, we are sending this questionnaire to 50 of the largest federal laboratories in order to: 1) obtain fiscal year 1986 data on the extent of U.S. and foreign participation in R&D at each laboratory, and 2) identify each laboratory's relevant policies. The questionnaire is divided into the following parts:

Parts I and II:	US and foreign researchers who worked at your lab
Part III:	Lab researchers who worked at foreign laboratories
Part IV:	Intellectual property rights
Part V:	Foreign access to sample materials and technical data
Part VI:	Visits to your laboratory
Part VII:	Use of specialized equipment and facilities
Part VIII:	Sponsored research
Part IX:	Background

Your cooperation in completing this questionnaire is vital to our study. The information collected will be included in our report to the Congress. Please return your completed questionnaire in the enclosed self-addressed envelope by August 4, 1987, if possible.

Before completing Part I, please call Ric Cheston at FTS 634-4925. In the event that the envelope is misplaced, return your questionnaire to:

U.S. General Accounting Office
Mr. Ric Cheston
Room 4476
441 G Street, N.W.
Washington, D.C. 20548

ID (1-3)
C01(4-5)

APPENDIX II

PART I

RESEARCH STAFF IN PHYSICAL SCIENCE, LIFE SCIENCE OR ENGINEERING

On page 3 is a chart we would like you to complete. We are interested in obtaining information about research professionals in the physical or life sciences or engineering who worked at your laboratory in FY 1986. By 'research professional' we mean any scientist, engineer or other professional researcher involved in the direct support of research (i.e., not in administrative positions). Please carefully read the instructions for each block entry in the chart before completing it since we may use certain terms or classifications differently than is done at your laboratory.

INSTRUCTIONS: Please be sure to count any individual **only one time**, i.e. if a researcher at your lab appears to fit into more than one of the categories listed below, pick the most appropriate category. Also be sure to **enter the number zero** if you have no researchers who fall into the category described for one of the block entries.

BLOCK 1: Please enter the number of **US citizen or permanent resident** research professionals who were permanent employees of your laboratory in FY 1986. Do not include researchers who participated in R&D through educational programs or visiting/guest researcher programs.

BLOCK 2: Please enter the number of **foreign national** research professionals (i.e. citizens of a foreign country) who were permanent employees of your laboratory in FY 1986. Do not include researchers who participated in R&D through educational programs or visiting/guest researcher programs.

BLOCK 3: Please enter the number of **US citizen and permanent resident** researchers who were not permanent employees of your laboratory, but who worked at your laboratory in FY 1986 through participation in a program sponsored by your lab for high school, university, or graduate students, or post-docs or faculty of US educational institutions.

BLOCK 4: Please enter the number of **foreign national** researchers who were not permanent employees of your laboratory, but who worked at your laboratory in FY 1986 through participation in a program sponsored by your lab for high school, university, or graduate students, or post-docs or faculty of US educational institutions.

APPENDIX II

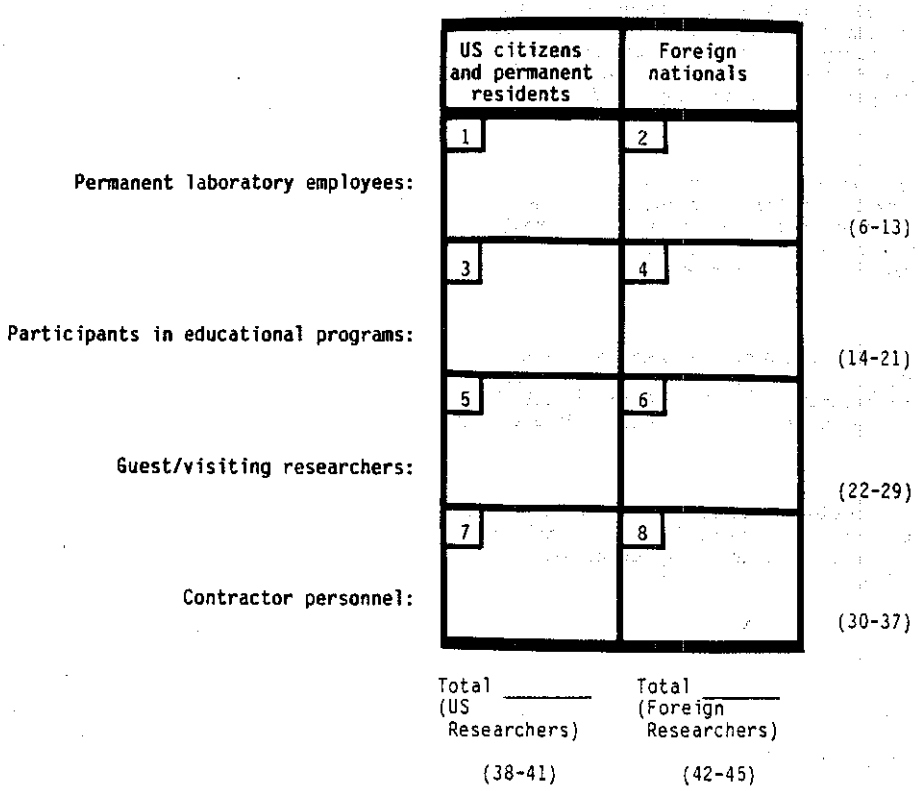
BLOCK 5: Please enter the number of **US citizen and permanent residents** who conducted research at your laboratory for at least 1 consecutive week in FY 1986 through participation in a visiting or guest researcher program. Please do not include any researchers who were counted in Block 3 as participants in programs for educational institutions.

BLOCK 6: Please enter the number of **foreign nationals** who conducted research at your laboratory for at least 1 consecutive week in FY 1986 through multilateral or bilateral agreements with foreign countries. Please do not include any researchers who were counted in Block 4 as participants in programs for educational institutions.

BLOCK 7: Please enter the number of US **citizen or permanent resident** researchers who were employed by a federal contractor and who conducted research at your laboratory in FY 1986 to fulfill the contract terms. (If data are not available, please indicate with N/A.)

BLOCK 8: Please enter the number of **foreign national** researchers who were employed by a federal contractor and who conducted research at your laboratory in FY 1986 to fulfill the contract terms. (If data are not available, please indicate with N/A.)

APPENDIX II



3

APPENDIX II

PART II

In Part II we would like to obtain some more detailed information about the researchers identified in the Chart in Part I. Each section heading identifies the Block in Part I where you entered the data for the researchers we are interested in. Please answer the questions in each section for **only** those researchers who you counted in the Block entry in Part I.

Block 2
Foreign Laboratory Employees

A. How many of the researchers identified in **Block 2** came from each of the following countries or regions? (**See Attachment 1 for list of countries and regions.**)

USE **EITHER** NUMBER COLUMN **OR** PERCENT COLUMN
(If none, enter zero.)
(Percents should add to 100%)

ID (1-3)
CD2(4-5)

	FOREIGN SOURCES (46-93)	**NUMBER**	or	**PERCENT**	(6-41)
a.	Canada			%	
b.	Japan			%	
c.	People's Republic of China			%	
d.	Other Far East countries (including Taiwan, South Korea)			%	
e.	United Kingdom			%	
f.	West Germany			%	
g.	Other Western European countries			%	
h.	Israel			%	
i.	Other Middle Eastern countries (including Egypt)			%	
j.	India			%	
k.	Eastern European countries (including the Soviet Union)			%	
l.	Other (SPECIFY) _____			%	
				100%	

APPENDIX II

Blocks 3 and 4
Researchers Who Are Participants in Programs for US Educational Institutions

B. Of the individuals identified in **Blocks 3 and 4** who worked at your laboratory in FY 1986 through programs sponsored by your lab for US educational institutions, how many were in each of the following categories?

	ENTER NUMBER (If none, enter zero)		
	U.S. Citizens and Permanent Resident Researchers	Foreign National Researchers	
Faculty	_____	_____	(42-47)
Post-docs	_____	_____	(48-53)
Graduate students	_____	_____	(54-59)
Undergraduate students	_____	_____	(60-65)
High School teachers	_____	_____	(66-71)
High School students	_____	_____	(72-77)
			ID (1-3)
			CD3(4-5)

5

APPENDIX II

C. How many of the researchers identified in **Block 4** came from each of the following countries or regions?

USE **EITHER** NUMBER COLUMN **OR** PERCENT COLUMN
(If none, enter zero.)
(Percents should add to 100%)

	FOREIGN SOURCES	NUMBER (6-53)	PERCENT (54-89)
a.	Canada		%
b.	Japan		%
c.	People's Republic of China		%
d.	Other Far East countries (including Taiwan, South Korea)		%
e.	United Kingdom		%
f.	West Germany		%
g.	Other Western European countries		%
h.	Israel		%
i.	Other Middle Eastern countries (including Egypt)		%
j.	India		%
k.	Eastern European countries (including the Soviet Union)		%
l.	Other (SPECIFY) _____		%
			100%

D. In addition to any existing agency wide policies, does your laboratory have a policy for its programs for educational institutions which specifies criteria for accepting researchers who are U.S. citizens or permanent residents vs. foreign nationals? (Check one)

(90)

1. [__] Formal, written policy ---> Please attach a copy of the policy.

2. [__] Informal policy ---> Briefly describe the policy.

3. [__] No policy

APPENDIX II

Blocks 5 and 6
Visiting/Guest Researchers

E. Approximately how many of the **visiting or guest** researchers identified in **Blocks 5 and 6** who worked at your laboratory in FY 1986 had primary affiliations with each type of U.S. and foreign organization listed below?

ENTER NUMBER
(If none, enter zero.)

	US Citizens and Permanent Resident RESEARCHERS	Foreign National RESEARCHERS	
Government	____	____	(91-96)
Business	____	____	(97-102)
University/other nonprofits	____	____	(103-108)
Other _____ (Please specify)	____	____	(109-114)

F. Has your laboratory started any new programs since 1980 to encourage researchers from U.S. businesses to work at your laboratory?

(115)

1. [__] No ---> Skip to Question H.

ID (1-3)

CD4(4-5)

2. [__] Yes

G. For each new program identified in Question F, please identify:
(Please use separate sheet and attach to questionnaire.)

The program's name

When the program started

Number of researchers from US businesses who worked at your laboratory in FY 1986 through the program

Whether the program is open to foreign businesses

APPENDIX II

H. Approximately how many of the **visiting** researchers identified in **Block 6** came from each of the following countries or regions?

USE **EITHER** NUMBER COLUMN **OR** PERCENT COLUMN
(If none, enter zero.)
(Percents should add to 100%)

	FOREIGN SOURCES	NUMBER (6-53)	PERCENT (54-89)
a.	Canada		%
b.	Japan		%
c.	People's Republic of China		%
d.	Other Far East countries (including Taiwan, South Korea)		%
e.	United Kingdom		%
f.	West Germany		%
g.	Other Western European countries		%
h.	Israel		%
i.	Other Middle Eastern countries (including Egypt)		%
j.	India		%
k.	Eastern European countries (including the Soviet Union)		%
l.	Other (SPECIFY) _____		%
			100%

ID (1-3)
CD5(4-5)

I. Approximately how many of the **visiting** researchers in **Block 6** from the United Kingdom, West Germany, Japan, and Israel had primary affiliation with the types of organizations listed below?

REPORT NUMBER
(If none, enter zero.)

	UNITED KINGDOM	WEST GERMANY	JAPAN	ISRAEL	
Government					(6-17)
Business					(18-29)
University/nonprofits					(30-41)
Other_____					(42-53)

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APPENDIX II

PART III LAB RESEARCHERS WHO WORKED AT FOREIGN LABS

In this section we are interested in the access of your laboratory's researchers (identified in Blocks 1 and 2) to laboratories in foreign countries.

A. Approximately how many of your laboratory's researchers (identified in **Blocks 1 and 2**) worked at a laboratory(s) in each of the following countries or regions in FY 1986?

ENTER NUMBER
PLEASE INDICATE WHETHER NUMBER IS ACTUAL OR ESTIMATE
(If none, enter zero.)

	FOREIGN SOURCES	NUMBER	(54-92)	CHECK ONE ACTUAL (1)	ESTIMATE (2)	(93-105)
a.	Canada					
b.	Japan					
c.	People's Republic of China					
d.	Other Far East countries (including Taiwan, South Korea)					
e.	United Kingdom					
f.	West Germany					
g.	Other Western European countries					
h.	Israel					
i.	Other Middle Eastern countries (including Egypt)					
j.	India					
k.	Eastern European countries (including the Soviet Union)					
l.	International agencies (e.g. WHO, IAEA, etc.)					
m.	Other (SPECIFY) _____					

PART IV INTELLECTUAL PROPERTY RIGHTS

In this section we are interested in your laboratory's disclosure and title rights policies for inventions and computer software that a researcher identified in Blocks 3, 4, 5, or 6 may develop while working at your laboratory. (Please do not include contractor personnel or scientific facility users.) (Check one)

A. Are all U.S. and foreign visiting researchers required to disclose any inventions they make while working at your laboratory? (106)

1. [__] No ---> Briefly describe your invention disclosure policy.

2. [__] Yes

B. How many inventions did U.S. and foreign visiting researchers disclose in FY 1986? (Enter number. If none, enter zero.)

Disclosures by U.S. visiting researchers _____ (107-108)

Disclosures by foreign visiting researchers _____ (109-110)

C. Are you aware of any cases during the past 3 years in which a U.S. or foreign visiting researcher failed to disclose inventions made while working at your laboratory? (Check one) (111)

1. [__] No

2. [__] Yes ---> How many cases? _____ (112-113)

D. In your opinion, how much of a problem, if any, has your laboratory had during the past 3 years with U.S. or foreign visiting researchers failing to disclose inventions made while working at your laboratory?

1. [__] Little or no problem (114)

2. [__] Some problem

3. [__] Major problem ---> Please explain why.

E. Generally, who has title rights to inventions that visiting foreign researchers make at your laboratory? (Check one) (115)

1. [__] The federal agency (or the operating contractor)

2. [__] The foreign researcher

3. [__] Determined on a case-by-case basis

APPENDIX II

F. Generally, who has title rights to computer software or technical data that visiting foreign researchers develop at your laboratory?

(116)

1. [__] The federal agency (or the operating contractor)
2. [__] The foreign researcher
3. [__] Determined on a case-by-case basis

ID (1-3)
CD6(4-5)

PART V FOREIGN ACCESS TO SAMPLE MATERIALS AND TECHNICAL DATA

In this section we are interested in requests by foreign researchers for sample materials and/or technical data that is not in the scientific literature.

A. In addition to any existing agency wide policies, does your laboratory have a formal or informal policy on providing sample materials to foreign requesters? (Check one)

(6)

1. [__] Formal (written) policy ---> Please attach a copy.
2. [__] Informal policy ---> Briefly describe.
3. [__] No policy
4. [__] Not applicable

B. In addition to any existing agency wide policies, does your laboratory have a formal or informal policy on providing technical information to foreign requesters? (Check one)

(7)

1. [__] Formal (written) policy ---> Please attach a copy.
2. [__] Informal policy ---> Briefly describe.
3. [__] No policy
4. [__] Not applicable

C. Has your laboratory changed its policy since 1980 on providing sample materials or technical data to foreign requesters? (Check one)

(8)

1. [__] No
2. [__] Yes ---> How has it changed?

APPENDIX II

PART VI VISITS TO YOUR LABORATORY

In this section, we are interested in visits to your laboratory, of one day or more, by representatives of U.S. or foreign organizations.

A. How many visits were made to your laboratory in FY 1986 by representatives of each of the following types of US or foreign organizations? (If data are not available, please indicate with N/A.)

	US	FOREIGN	
Government	____	____	(9-16)
Business	____	____	(17-24)
University/other nonprofit	____	____	(25-32)
Mixed delegation	____	____	(33-40)

B. How many visit requests did your laboratory receive from organizations from the following countries in FY 1986, and how many of these were approved?

	Visit requests		Requests approved	
Canada	____	(41-61)	____	(62-82)
Japan	____		____	
People's Republic of China	____		____	
United Kingdom	____		____	
West Germany	____		____	
Israel	____		____	
India	____		____	

C. In addition to any existing agency wide policy, does your laboratory have a policy on visits that addresses reciprocity in access (i.e., receiving access to foreign laboratories and/or obtaining information from visitors during the visit to your laboratory)? (Check one) (83)

1. [__] Formal (written) policy ---> Please attach a copy.
2. [__] Informal policy ---> Briefly describe.
3. [__] No policy
4. [__] Not applicable

APPENDIX II

D. Has your laboratory changed its policy related to reciprocity for visits since 1980? (Check one) (84)

1. [__] No

2. [__] Yes ---> How has it changed?

PART VII USE OF SPECIALIZED EQUIPMENT/FACILITIES

In this section we are interested in the use of your laboratory's specialized scientific equipment or facilities (such as wind tunnels, accelerators, measurement equipment, etc.) by outside organizations for which the laboratory may or may not be reimbursed.

A. Does your laboratory have specialized equipment or facilities that outside organizations can use? (Check one) (85)

1. [__] No ---> Skip to PART VIII

2. [__] Yes

B. How many U.S. or foreign government, business, or nonprofit organizations used your laboratory's specialized equipment or facilities in FY 1986?

	U.S.	Foreign	
Government	____	____	(86-91)
Business	____	____	(92-97)
University/other nonprofit	____	____	(98-103)

C. For each category of organizations identified in the question above, how many outside researchers participated in the research. (If data are not available, please indicate with N/A.)

	U.S.	Foreign	
Government	____	____	(104-109)
Business	____	____	(110-115)
University/other nonprofit	____	____	(116-121)

ID (1-3)
CD7(4-5)

APPENDIX II

PART VIII SPONSORED RESEARCH

In this section we are interested in research at your laboratory that is funded by sources outside your agency, or that is jointly conducted with an outside organization through a cooperative agreement.

A. Did your laboratory receive funding to conduct R&D from any sources outside your federal agency in FY 1986? (Check one) (6)

1. [__] No ---> Skip to Question E
2. [__] Yes

B. Approximately how much funding did your laboratory receive in total and for each of the following groups and subgroups in FY 1986? (Do not include any reimbursement for the use of specialized equipment or facilities discussed in Part VII.) (**ROUND TO NEAREST THOUSAND**)

	AMOUNT (IN THOUSANDS)	
1. Total from US sources	$_____	(7-10)
a. Other federal agencies	$_____	(11-14)
b. State and local governments	$_____	(15-18)
c. Businesses	$_____	(19-22)
d. Universities/other nonprofits	$_____	(23-26)
2. Total from foreign sources	$_____	(27-30)
a. Governments	$_____	(31-34)
b. Businesses	$_____	(35-38)
c. Other foreign organizations	$_____	(39-42)
3. Total from international organizations	$_____	(43-46)
TOTAL OUTSIDE FUNDING	$_____	(47-50)

APPENDIX II

C. If your laboratory received funding from foreign sources for R&D in FY 1986, approximately how much funding from **all foreign sources** (governments, businesses, and other organizations) and specifically from foreign businesses came from each of the following countries or regions?

ENTER AMOUNT
(ROUND TO NEAREST THOUSAND)
(If none, enter zero.)

ID (1-3)
CD8(4-5)

		ALL FOREIGN SOURCES	FOREIGN BUSINESSES	
	(51-94)			(6-49)
a.	Canada	$	$	
b.	Japan			
c.	People's Republic of China			
d.	Other Far East countries (including Taiwan, South Korea)			
e.	United Kingdom			
f.	West Germany			
g.	Other Western European countries			
h.	Israel			
i.	Other Middle Eastern countries (including Egypt)			
j.	Multinational businesses (country uncertain)			
k.	Other (SPECIFY REGION(S))			

D. How many of the R&D contracts **in effect** during FY 1986 with US businesses or foreign sources (governments, businesses, and other organizations) were for:

ENTER NUMBER FOR EACH
(If none, enter zero)

	US Business	Foreign Sources	
a. Less than $500,000			(50-53)
b. $500,000 or more			(54-57)

APPENDIX II

E. How many collaborative agreements (joint research projects in which no money is exchanged) did your laboratory enter into with each of the following categories of U.S. and foreign organizations in FY 1986?

ENTER NUMBER
(If none, enter zero)

	US	FOREIGN	
Government	_____	_____	(58-61)
Business	_____	_____	(62-65)
University/other nonprofits	_____	_____	(66-69)

F. In your opinion, do foreign businesses typically seek to negotiate different contract terms for R&D than US businesses? (Check one) (70)

1. [__] No
2. [__] Yes ----> Briefly describe
3. [__] Don't know/No basis to judge

G. In addition to any existing agency wide policies, does your laboratory have a written or informal policy regarding foreign sponsorship of research at your laboratory? (Check one) (71)

1. [__] Formal (written) policy ---> Please attach a copy.
2. [__] Informal policy ---> Briefly describe.
3. [__] No policy
4. [__] Not applicable

H. Has your laboratory developed and/or changed its policy on foreign sponsorship of research since 1980? (Check one) (72)

1. [__] No
2. [__] Yes, policy has been developed.
3. [__] Yes, policy has changed. ---> Briefly describe.

APPENDIX II

PART IX BACKGROUND

A. Which of the following categorizes your laboratory?

(73)

1. [__] Government-operated laboratory
2. [__] Government-owned, contractor-operated laboratory (GOCO)
3. [__] Federally funded research and development center (FFRDC)

B. What was your laboratory's total R&D operating budget for FY 1986?

Enter Amount $_____ (in thousands) (74-79)

C. Did your laboratory report any invention disclosures in FY 1986? (Check one)

(80)

1. [__] No
2. [__] Yes ---> How many? _____ (81-83)

D. Did your agency apply for any US patents in FY 1986 for inventions that were made at your laboratory? (Check one)

(84)

1. [__] No
2. [__] Yes ---> How many? _____ (85-87)

E. Please provide the name, title, and phone number of an individual who will be the central point of contact if we need to clarify any response or need additional information.

NAME: _____

TITLE: _____

PHONE: ( ) _____

F. Thank you for your cooperation in completing the questionnaire. Please remember to attach any written policies that you identified in the preceding questions. Also, please attach any additional comments regarding any of the topics covered please enter them below.

(88)

APPENDIX II

ATTACHMENT I

Region List

In several questions we ask that you identify the country of origin of visiting scientists, requests for visits or data, etc. For each of these questions, if the country is not listed separately in the chart, please use the list below to identify the region under which we have classified the country in order to standardize the responses.

Other Far East countries:	Taiwan, South Korea, the Philippines Indonesia, Hong Kong, Singapore, Malaysia, Thailand.
Other Western European countries:	France, Italy, Ireland, the Netherlands, Belgium, Luxembourg, Spain, Portugal, Denmark, Sweden, Norway, Finland, Austria, Greece, Switzerland.
Other Middle East countries:	Egypt, Saudi Arabia, Turkey, Jordan, Dubai, United Arab Emirates, Yemen, Algeria, Tunisia, Sudan, Morocco, Lebanon, Syria, Iraq, Libya.
Eastern European countries:	Soviet Union, Poland, East Germany, Hungary, Rumania, Bulgaria, Czechoslovakia, Yugoslavia.
Other regions:	South America, Central America and the Caribbean, Australia and New Zealand, Africa excluding Middle East countries, Central Asia excluding India.

APPENDIX III

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