Technology Transfer to the United States: The MIT-Japan Science and Technology Program

April 1989

NTIS order #PB89-224711

TECHNOLOGY TRANSFER TO THE UNITED STATES: THE MIT-JAPAN SCIENCE AND TECHNOLOGY PROGRAM

A Background Paper of
OTA's Assessment on
Technology, Innovation, and U.S. Trade

April 1989

Office of Technology Assessment
Congress of the United States
Washington, D.C.

Technology, Innovationand U.S. Trade

Advisory Rinel

Lewis Branscomb, *Chairman*
Harvard University

Michael Aho
Council on Foreign Relations

Ralph Gomory
IBM

Joseph Grunwald
The Institute of the Americas

Thomas Hout
Boston Consulting Group

Ramchandran Jaikumar
Hamard Business School

Franklin P. Johnson, Jr.
Asset Management Company

Lester C. Krogh
3M

Paul R. Krugman
Bureau of Economic Research

Alvin P. Lehnerd
Northwestern University

Ann Markusen
Northwestern University

Ray Marshall
University of Texas

Regis McKenna
Regis McKenna, Inc.

Paula Stern
The Stem Group

Brian Turner
AFL-CIO

Gus Tyler
International Ladies Garment Workers Union

Lewis C. Veraldi
Ford Motor Company

Ezra F. Vogel
Harvard University

OTA Project Staff- Technology Transfer to the United States: the MIT-Japan Science and Technology Program

Lionel S. Johns, Assistant Director *OTA*
Energy Materials, and International Security Division

Audrey Buyrn
Industry, Technology, and Employment Program Manager

Julie Fox Gorte, *Project Director*

Katherine Gillman, *Deputy Project Director*

Brenda Brockman, Analyst
Carol Henriques, *Research Assistant*
Philip Shapira, Analyst

Administrative Staff

Christopher N. Clary, *Admininistrative Assistant*
Diane D. *White, Administrative Secretary*

Contents

INTRODUCTION

On September 13,1988, the Office of Technology Assessment (OTA) and the Massachusetts Institute of Technology (MIT) Japan Science and Technology Program (JSTP) held a one-day workshop to discuss MIT's Japan Science and Technology Program's internship program and its technical language workshop. The internship program provides MIT engineering and science students with Japanese language skills, cultural education, and placements in Japanese industry, government, and university research facilities. These interns get first-hand experience of Japanese methods of research, technology development, and manufacturing. The MIT technical language workshop provides advanced training in reading technical documents in a specific field of science or technology for people who already have some background in Japanese.

OTA co-sponsored the workshop as part of the research for its assessment Technology, Innovation, and U. S. Trade. One part of this study examines the contribution of technology to U.S. manufacturing performance in an increasingly competitive world economy. The workshop helped OTA to understand Japanese approaches to technology development and manufacturing, contrast these with U.S. practices, study MIT's experience in combining an engineering and science background with the ability to speak and read Japanese, and assess the value of such programs to U.S. corporations. Participants at the workshop included current and graduated interns, graduates of the technical language workshop, corporate sponsors of the JSTP, the faculty director and staff of the program, and OTA-staff members.

This document gives a brief description of the MIT-Japan Science and Technology Program. It then reports the principal themes and issues raised at the workshop.

The MIT-Japan Science and Technology Program

Established in 1981, the MIT-Japan Science and Technology Program has three components: education, research, and public service. Educational activities include the internship program and the development of an interdisciplinary curriculum in Japanese language, science, society, economics, politics, and history at MIT. Research supported by members of the program includes a five-year interdisciplinary project to investigate technology and its diffusion. Among its public service offerings, MIT-JSTP sponsors meetings on Japanese science and technology developments and U.S.-Japan policy issues. Another such service is the workshop in technical Japanese for scientists and engineers, first held in the summer of 1988 and scheduled to be repeated in 1989.

The internship program arranges the placement of MIT science and engineering students in Japan and provides orientation seminars before they go. About 15 to *20* students are placed each year, but participation is increasing steadily. Private Japanese firms that have accepted students include Toshiba, NEC, Matsushita, NTT, Nippon Steel, Mitsubishi, Shimizu and Hitachi. Students have also been placed in Tokyo and Kyoto Universities, the Tokyo Institute of Technology, and Japan's National Laboratories. Before going to Japan, each student studies Japanese for two years (usually *4-5* class hours a week), and is required to take courses on Japan and its culture. The program encourages students to work collaboratively with Japanese researchers throughout their careers.

The MIT technical Japanese workshop helps participants improve their ability to read Japanese technical materials in their area of expertise. Participants in the first workshop were required to have a knowledge of computers, electrical engineering, or related subjects and be able to understand appropriate technical documents in English. A basic command of the Japanese language is also a prerequisite: this means being able to converse in Japanese and read Japanese at the high school level (equivalent to knowing 800-1000 kanji). The intensive eight-week course covers reading, recognition of kanji used in technical documents, use of reference tools, and use of on-line and off-line data sources.

The MIT-JSTP's` core financial support comes from thirteen U.S. corporate sponsors: AT&T, Dow Chemical, Dow Corning, Eastman Kodak, Ford, General Electric, IBM, Monsanto, Motorola, PPG Industries, Proctor and Gamble, Teradyne, and United Technologies. Additional funding to support student interns comes from the Starr Foundation and the Japan-U.S. Friendship Commission. The Japanese companies providing placements contribute by paying interns' salary and travel costs. The technical Japanese workshop obtains support from the National Science Foundation, the Hitachi Foundation, the Japan Foundation, and the Japan-U.S. Friendship Commission.

THE CORPORATE SPONSORS: EXPECTATIONS AND REALITIES

Reasons for participating

Corporate sponsors participate in the JSTP internship program for several reasons. First, the program provides opportunities to learn about the Japanese research environment. For example, discussions with interns have given Motorola insights about Japan as a source and user of technology, according to David Metz, formerly the Motorola Corporate Director of University Relations. Sponsors see the program as a way for American engineers and scientists to learn about research and manufacturing processes and then communicate this to corporate management. "Working at IBM-Japan helps Americans understand how the Japanese operate, for example, how they obtain high quality control," said James McGroddy, Vice-President at IBM's General Technology Division, White Plains, NY. In addition, these interns build networks in their specialized areas.

Corporate sponsors also valued other JSTP program activities, such as seminars on Japanese culture and technology at MIT and at company sites. Leonard Morgan, Technical Resources General Manager at General Electric's Bridgeport, CT, Corporate Engineering and Manufacturing Group, said that ten years ago the company's concern about the inroads made by Japanese manufacturers led it to start a program called "Impact," for manufacturing managers. GE managers toured Japanese factories and discussed approaches to managing people and technology - a process which got GE interested in the MIT program. MIT-run workshops have helped prepare GE people going to Japan, and the JSTP research reports are disseminated throughout the company. Morgan remarked that the MIT program had "fully met expectations as an added source of information on Japan."

Hiring of interns

Program Director Richard Samuels emphasized that MIT does not, and will not, ask U.S. companies to sponsor specific individuals. "We keep an arm's-length relationship with the [Japanese] host companies. If an intern is in a private corporate Japanese lab, contacts between U.S. firms and the intern are not encouraged during the intern's work in Japan." Samuels noted that contacts with U.S. firms are encouraged if the intern is at a Japanese government or university lab. It is important for the program and for future interns that MIT remain a neutral actor, serving only as a broker between Japanese and American industry.

Information about returnees is made available to the corporate sponsors, who can hire the interns upon completion of their project. Of the 50-60 returned interns, 8-10 have been hired by the corporate sponsors. "IBM has tried to hire interns, but without success," said James McGroddy. General Electric has hired three interns. Motorola has made several offers, but employs only one program participant, who is now working in Scotland. Teradyne and Proctor and Gamble have hired one each.

There are several reasons for the low hiring rate. The program is still new and many of the interns returning from Japan go back to school for graduate work, some entering law or business schools. These interns have not yet entered the job market. General Electric's Morgan and IBM's McGroddy remarked that some interns want to go back to Japan to work which presents problems. McGroddy said that it now costs up to **$500,000** a year to maintain an American IBM employee in Japan at **U.S.** living standards, and that it is IBM policy to so maintain its U.S. employees in Japan. Moreover, McGroddy stressed that new employees have to work in the United States initially, not only to absorb IBM's own corporate culture, but also to show they can perform technically. He implied that speaking Japanese and having Japanese research experience are not significant assets in the intern's first job, though these skills could be useful afterwards. Other corporate sponsors agreed that interns have to "get their heads down" and show they can produce in the United States first. Most of the MIT interns are interested in research but many only have a B.S. , which does not meet usual hiring requirements for researchers in U.S. corporations.

One corporate sponsor described a successful case of intern employment. General Electric hired an intern, Gontran Kenwood, who worked at Hitachi on a product that GE licenses from the Japanese firm. Larry Morgan stressed that GE pays for and abides by the terms of its license, but added that "it is very useful for GE to have someone who has spent time working on the same product at another firm, since engineers never write everything down." Kenwood was brought directly into GE's corporate staff - an unusual step. His ability to speak Japanese has been helpful to General Electric in their negotiations with Japanese partners, especially Hitachi where his network with former colleagues has been very useful to both firms.

In most cases, the corporate sponsors do not differentiate between the interns and other new graduates of MIT science or engineering programs in their hiring policies. Interns are expected to fit into existing corporate behavior patterns and reward structures. Although Motorola's David Metz felt that the MIT interns and others like them would emerge as corporate leaders in twenty-five years, little evidence was given that the corporate sponsors were taking steps now to use and develop the Japanese skills and experience of the program's engineers and scientists.

Comparing American and Japanese practice

The corporate sponsors agreed that Japanese industry had progressed rapidly -- without necessarily conceding that their own companies had fallen behind. Thus, while the corporate sponsors praised the continuous workforce training (including English language instruction) in larger Japanese firms, they also noted the significant effort their own companies were now putting into training. Motorola's David Metz said his company managers spend about 1.5 percent of their budgets on ongoing employee training. But this level of investment in training is still below Japan's, Metz said, which emphasizes training young professionals by rotating them through a series of jobs in their first 8-10 years with a company.

One area where almost all of the sponsors saw problems was training mid-career engineers and scientists in Japanese and offering them work experience in Japan. General Electric's Morgan said that mid-career people can spend time in Japan if they want to, but “many feel that it will do damage to their careers.” The problem, observed David Metz of Motorola is that “success is defined as becoming the head of a division or business, which means staying on the job. Moreover, managers do not see it as being in their own interest to let people go, particularly if they are good people.” Robert Gonzalez, also from Motorola added that he was skeptical that mid-career people would be able to make the commitment to language training.

A key area in U.S.-East Asian competition is manufacturing technology. McGroddy said that Japanese manufacturing facilities are organized differently than in the United States. “In Japan, things are done in manufacturing plants which would be seen as development in the United States and which would take place in labs.” Corporate sponsors also compared the United States to other East Asian countries, specifically Korea and Taiwan. “The things to be learned from these other countries are not about technology, where the U.S. is still the leader - especially in design. The competition is in manufacturing,” McGroddy said.

THE INTERNS: EXPERIENCES IN JAPAN AND RETURN TO THE UNITED STATES

Placements in Japan

Interns were placed with some of Japan's leading private company, government and university research laboratories. MIT's international reputation was useful in obtaining good placements since prestige is particularly important in Japan. The program uses personal contacts developed between MIT faculty and Japanese researchers and links with MIT's Japanese alumni. "When prospective interns first approach the program, I send them back to their MIT professors to get names of Japanese contacts," said Patricia Gercik, the program's Assistant Director. It was felt that MIT's success might not be easily repeated by less well-known or less prestigious institutions. One suggestion was a Congressional Japanese Fellowship Program which would provide an appropriate imprimatur.

In Japan, the interns were treated like other Japanese employees - living in dorms or company housing and participating in social occasions with their Japanese colleagues. The program has produced a "guide to hosting MIT students" that helps to convince Japanese firms that these students ought not to be segregated and treated specially. The object is to integrate them into the life of the laboratory. Shari Yokota, who worked two years at NEC's Central Lab researching diamond thin films, said that it took the first year to find her way around. 'The second year was the most productive."

Access to information and facilities

Japanese sponsors placed no special limits on interns' access to information and facilities. Gontran Kenwood, an industrial automation engineer, was the first foreigner in his Hitachi lab and was involved in all meetings with no special restrictions on information. At the same time, the interns had to conform to Japanese practices. For instance, while Mark Holzbach was working on holographic technology at the Tokyo Institute of Technology, he wanted to do an experiment using special equipment at a private company, Dai Nippon Printing. However, even though Dai Nippon had invited him, Holzbach could not do work there because the university lab had a longstanding relationship with another company, Toppan Printing.

Interns who had worked in universities noted that Japanese university labs often had meager equipment. Different research groups within the laboratory did not readily share equipment. In contrast, the equipment and facilities at private corporate labs were generally very good.

Technology transfer

Interns cited cases where they learned something about specific technologies used in Japan. Peter Whitney spoke about a Japanese method of dealing with impurities in semiconductor materials. The usual American approach is to remove impurities, which is difficult and expensive. In Japan, he learned about techniques to add other impurities to cancel out the original impurities. 'The Japanese solution is not elegant, but it works," said Whitney.

However, in general, the interns did not bring back any technologies unknown in the

United States. This was not seen as a problem. The interns believed that learning about the process of Japanese technology development was more important than gaining information about individual technologies. This is consistent with the program's philosophy. As mechanical engineer Michael Caine remarked: "Soaking up specific technology is not the point, since the technology can become obsolete very quickly." He emphasized the importance of learning the process by which technology is developed and how it is used in Japan and in making contacts which will be important throughout his career. At Toshiba where Caine worked on developing image processing software, he saw how research was driven by the needs of manufacturing plants. "I learned respect for the Japanese approach."

Materials scientist Peter Whitney said his experience at NTT's Musashino Laboratory showed him how Japanese research was managed. He concluded that "much of the conventional wisdom about Japan is true." There was a high degree of research collaboration within his group, with individual researchers working on parts of a problem which built on the work of colleagues. At the same time, he saw little interaction between different research groups in the company. Whitney reported that his colleagues at NTT frequently sought his views on ways to tackle research problems. His experience with basic research was in great demand by NTT, as it seemed to be an area where the Japanese lack experience and creativity. Other American engineers had similar experiences.

Engineer Gontran Kenwood worked on a new color image processing project at Hitachi's industrial engineering laboratory. The lab's work was funded by factories, which meant he had to make plant visits. "This encourages researchers to develop products suitable for manufacturing," observed Kenwood. "In the U.S., credit is given to engineers who fix machines and keep them running; in Japan the aim is to design products which can be easily manufactured." He also suggested that the Japanese concentrate on trying to avoid problems which might arise in manufacturing, while the American engineers tend to solve problems after they occur.

The importance of knowing Japanese

The interns emphasized that learning to speak read, and write Japanese took a considerable commitment. They felt that their two years of preparation was the minimum needed--more would have been helpful. But Samuels, drawing on the Chinese analogy of letting a hundred flowers bloom, discussed other ways of gaining Japanese experience, including Stanford's approach of sending engineers and scientists to Japan for shorter periods with less language training. Cornell's intensive nine-week language program is another option for learning Japanese.

The interns repeatedly stressed the benefits of being able to communicate in Japanese. Vince McNeil, an electrical engineer who had spent a year at the Tokyo Institute of Technology, said that to fully interact with Japanese colleagues, "you have to speak the language and you need to know the nuances of the language, including the cultural nuances." McNeil added that being able to read kanji is important to handle dangerous chemicals safely in the labs.

Chris Mizumoto, an intern with Hitachi now placed at Yokogawa Medical Systems, a joint venture with General Electric, communicates in Japanese as much as possible and writes reports in Japanese. As a result, he is aware of technical changes unknown to GE joint-venture engineers in the U.S., because the Japanese engineers do not always communicate the changes to the GE engineers in English. Japanese engineers and scientists may have had English training in school, but instruction is often not geared to conversation, and their English grows rusty through disuse. Consequently many Japanese feel uncomfortable using English.

Return to the United States

Interns looking for employment on their return to the United States mostly felt that their experience was an asset. ‘The program has given me a premium in the job market,” said GE’s Gontran Kenwood. Added Peter Whitney, “It was a hot topic, which took up 10 to 50 percent of the time in job interviews.” Taking part in the program showed he could take the initiative and master a challenge, Whitney said. When he looked for jobs in the United States, the MIT program responded rapidly to help him make connections with the corporate sponsors, but there were delays in reaching the specific people responsible for hiring. He ultimately took a job with a small firm, Lasertron, rather than with a corporate sponsor.

Overall, the interns’ comments confirmed the impression from the corporate sponsors’ remarks: while employers take a positive view of the program, they are not always interested in making immediate use of the interns’ Japanese experience, or able to do so. Peter Whitney said that he is not using the results of any particular projects he worked on at NTT, although he may do in the future. Shari Yokota on returning from working at NEC’s labs, took a job with Crystallume, a new California start-up firm, principally because this small company allowed her to conduct research even though she had only a B.S. degree. At Crystallume, Yokota works on diamond thin films, using a different approach from the one used at NEC’s lab. Yokota occasionally translates Japanese technical papers.

The interns hope to encourage their companies to make use of their experience. Peter Whitney remarked that he would try to convince the head of his company of the importance of maintaining contacts with Japan. Peter Schindler, now at MIT after returning from IBM-Japan, felt that while his Japanese may not be useful now, it may be in the future. He hopes to return to work in Japan.

One of the MIT program’s aims is to give scientists and engineers the opportunity to develop lifelong contacts with Japanese researchers. It is still too early to evaluate the program’s success in this. There was some indication that interns had begun to establish strong links with Japanese colleagues. For example, Peter Whitney maintains a network with NIT researchers and exchanges papers. He can use these contacts to widen his circle to other Japanese contacts.

ACCESSING JAPANESE TECHNICAL LITERATURE

Value of Japanese technical literature

Japan produces a mass of technical literature, much of which is available only in Japanese. Madeline Dovale, a graduate of the Program's Technical Japanese Workshop, described how this literature is used by a major consortium of U.S. computer firms, the Microelectronics and Computer Technology Corporation (MCC), Austin, TX. A Japanese-language studies graduate, Dovale tracked technical developments for MCC researchers by scanning Japanese technology journals, translating titles and abstracts, monitoring conferences and proceedings, and using on-line Japanese databases. "Researchers look for very specific information," noted Dovale, "so it is not always necessary to do full translations." When MCC researchers requested a full translation, outside professional translators were used. Approximately 10 translations were done per month; these were available only to MCC member companies.

In 1988, University Microfilms (UMI), Ann Arbor, Michigan, closed down its Japanese technical literature translation service, citing lack of demand. However, Dovale commented, UMI's real problem was that its services were not timely, nor were they on-line. There was a three month time lag in the distribution of title lists and abstracts, and articles that researchers wanted to read then had to be translated--an expensive and lengthy process if done by UMI. At MCC, Dovale was able to get translated articles to researchers within a month of publication in Japanese. Some of the corporate sponsors added that UMI was superfluous because they have their own professional translators versed in technical fields in Japan and America. However, electrical engineer Vince McNeil commented that translation services which use non-technical specialists to translate often lose important nuances.

Andy Howard, a Hewlett-Packard (H-P) engineer and former fellow of another Japan internship program, sponsored by the American Electronics Association, took the MIT summer workshop to improve his technical Japanese. Few people at H-P know Japanese, Howard said, and few feel the need. His colleagues think that useful information will be published in English. Howard, himself, reads Japanese technical articles to learn about new developments in Japan. Hewlett-Packard does not use his Japanese beyond translating occasional messages, but he hopes it will in the future. H-P partially supported his participation in the workshop, giving him a two-month leave of absence at half-salary. This was supplemented by an NSF Fellowship. Mark Holzbach, a former intern who also took the summer technical language workshop, said he was now able to read Japanese technical manuals - an important aid to his startup consulting business selling software services to Japanese customers. Holzbach also uses his technical Japanese to translate articles on a freelance basis.

Japanese "gray" technical information

IBM's McGroddy talked about the "gray" literature - information on Japanese technology development which is not proprietary but which is not published in journals. Such information is hard for American companies to acquire, but has great value if obtained in a timely manner. McGroddy gave three examples of gray information: discussions between friends indifferent companies, discussions about standards, and discussions between vendors and customers. These discussions frequently occur in industry and trade group meetings, for which unpublished documents sometimes exist but are difficult to obtain. However, it is not impossible to get gray literature. Madeline Dovale noted that MCC has developed a range of personal contacts within Japanese companies, and is often able to get information others cannot. This example shows the value to an American company of a technically literate and well-connected Japanese speaking staff. It is necessary to have someone who is more than a translator of documents.

THE CHALLENGE OF ASYMMETRY

The success of the MIT-Japan internship needs to be evaluated in light of what Richard Samuels, the Program's Director, called "the asymmetries between Japanese students coming to the United States and American students going to Japan." First, the students are different. Japanese students in the United States usually come from firms, and have jobs and defined career paths to return to - all of which helps them focus on specific questions or technologies to explore while in the United States. American students in Japan usually come from universities, are recent undergraduates, are not going from or returning to companies, and are usually seeking a broader experience. Generally, the Japanese students have spent more years (perhaps ten) studying English than the Americans have spent studying Japanese (two years in the MIT case). Even though conversational English is not a strong point in Japan, most professionals have a good reading knowledge of English and a good vocabulary. Second, the sources of technology are different. In the United States, Japanese researchers can get access to manufacturing research and technology in universities; in Japan, most of the best research and development is done in private corporations. Thus, American students need to go to Japanese companies, which is harder to arrange than for a Japanese person to enter an American university.

The MIT program has established a good model for exposing young scientists and engineers to Japanese research, development, and manufacturing methods. Several departments at MIT send some of their best students through the program, and the numbers are growing. In the first five years, 1983-88, thirty-three interns went through the program; twenty took part in 1988-89, and forty were accepted as candidates for the following year, 1989-90. That MIT-JSTP has also been successful in reaching industry is shown by the fact that thirteen corporations sponsor the program, and that company requests for seminar programs on Japanese culture are numerous. The internship program seems to be well-received in the Japanese laboratories, as more students are finding places in the Japanese research system. The program is still new but its reputation as well as its size is growing. It is premature to assess the effect of the interns in American companies because there have not been very many so far, a good half go on for further schooling rather than to work, and the experience of those who have taken jobs is brief. When the interns have had more experience in American industry, the benefits of speaking Japanese and exposure to Japanese research methods can be better evaluated.

POTENTIAL AREAS OF CONGRESSIONAL INTEREST

U.S. interest in promoting the flow of scientific and technical information from Japan to the United States is growing. Up to now, most of the flow has been the other way. For example, in 1988 there were roughly 7,000 Japanese scientists and engineers working in U.S. government and university facilities. The number of Americans working in Japanese labs was probably no more than **500.**[1]

Several factors led to this lack of balance. First, U.S. engineers and scientists have not been particularly eager to work in Japan. Not many speak Japanese and until quite recently, few were interested in learning it. Moreover, very few American companies or institutions have wanted to send technical people to Japanese laboratories for extended stays; nor do they especially reward people with experience in Japan. Even now, despite the growing interest in closer interchanges with Japan the traditional reluctance to go outside one's own country--even one's own company--for technical knowledge remains strong in American 'industry (the "not-invented-here" syndrome). For those engineers and scientists who do want temporary assignments in Japan, high living costs and the difficulty of finding jobs for spouses remain big obstacles.

The nature of Japanese institutions also deters U.S. researchers from doing work there. Most R&D in Japan--including some of the best--takes place in private industry, and since a good deal of this work is proprietary, acceptance of outsiders in corporate labs can be difficult. In government and university labs, the quality of basic research has been uneven, very good in some fields but less so in others; furthermore, foreign researchers' access to government labs was rather limited until recently. In the United States, university and government labs have the reputation for consistently high quality work. Positions there interest foreign researchers, and foreigners are generally welcome. Japanese scientists win many of these positions on merit, often drawing stipends from the U.S. government.

Since 1962, the United States and Japan have had bilateral exchange programs in the field of science and technology. The U. S.-Japan Cooperative Science Program, established by executive agreement that year, has supported hundreds of joint seminars and short-term cooperative research projects ever since. In the past year or so, emphasis in these bilateral exchanges has shifted to longer term projects and more research by American scientists and engineers in Japan. Anew agreement signed in 1988 reflects this changed emphasis.[3]

One goal of the U.S. negotiators in the new agreement was "equitable contributions and comparable access to each Government research and development systems."[4] Accordingly, Prime Minister Takeshita arranged for a gift of $4.8 million to enable U.S. inves-

1 E. Lachica, "U.S. Japanese Negotiators Deadlocked on Tapping Each Others' Technology," Wall Street Journal, Jan. 22, 1988, cited in U.S. Congress, Office of Technology Assessment, Commercializing High Temperature Superconductivity, OTA-ITE-388 (Washington, DC: U.S. Government Printing Office, 1988), p. 116.

2 For example, 327 Japanese did research at the National Institutes of Health in 1986437, compared to 72 West Germans and 68 French. Stipends for five out of six Japanese were paid by the NIH, at a cost of $6.8 million; fewer than half of the Germans and two-thirds of the French got NIH stipends. See Marjorie Sun, "Strains in U.S.-Japan Exchanges," Science, July 31, 1987.

3 The Agreement Between the United States of America and Japan on Cooperation in Research and Development in Science and Technology, first signed in 1980 and revised in 1988.

4 Letter from the Honorable George P. Shultz, Secretary of State of the United States of America, to His Excellency, Sousuke Uno, Minister for Foreign Affairs of Japan, June 20, 1988; letter from Mr. Uno to Mr. Shultz, June 20, 1988.

tigators to do research in Japan.[5] In addition, the Japanese government established two new award programs to bring as many as 100 young post-doctoral or master-degree American scientists and engineers to Japan each year, for cooperative research projects lasting 6 to 24 months. Placements will be mainly in university and government laboratories, some of which rank as world leaders; for example, the Institute for High Energy Physics at Tsukuba The awards pay for airfare to Japan, travel in Japan, a stipend, housing and family allowances, medical insurance, and Japanese language instruction.

The National Science Foundation coordinates the Japanese-sponsored programs on the U.S. side and nominates some of the candidates. In its Japan Initiative, which got underway in 1988, NSF offers more awards of the same kind. It provides funds (mostly drawn from the Japanese gift) for U.S. scientists and engineers to work in Japanese corporate labs, as well as government and university facilities, for 6 to 18 months. NSF has arranged with the Japanese Ministry of International Trade and Industry (MITI) to offer U.S. applicants up to 30 research spots per year in the 16 laboratories directed by MITI's Agency of Industrial Science and Technology. MITI has also agreed to place up to three U.S. researchers per year in Japan's fifth generation computer project.

NSF's Japan Initiative also provides tuition, fees, and a stipend for researchers to undertake intensive studies in the Japanese language. The program is primarily for graduate or post-doctoral scientists and engineers, but is also open to senior researchers, including people in industry. Altogether, NSF set aside $800,000 for its Japan Initiative in fiscal year 1988 and $725,000 in FY 1989.

A spokesman for NSF said in late winter 1989 that the Japanese language programs, first announced in April 1988, were now oversubscribed; they are "flooded with applicants." Also, NSF is supporting programs at four universities to improve the teaching of Japanese. The NSF official expected that at least one of the programs for U.S. research in Japan would be fully booked (with 50 U.S. researchers) by May 1989, about a year after it was announced. This program offers posts in university labs under the authority of the Ministry of Education, Science, and Culture, and is administered by the Japan Society for the Promotion of Science; the Society has been NSF's opposite number in the Japan-U.S. Cooperative Science Program since it was established 27 years ago. The other Japanese-sponsored program is administered by the Science and Technology Agency (STA), a new partner for NSF; this one was moving along more slowly. And, surprisingly to NSF, only one applicant so far had asked for a posting to a Japanese corporate lab.

Besides these NSF and Japanese programs, several universities and one trade association, the American Electronics Association (AEA), sponsor placement of U.S. engineers and scientists in Japan.[6] From the beginning of its program in 1984 till September 1988, AEA sponsored 41 fellows from 20 American graduate schools, placing them for 9 months' to a year's work in Japanese electronics companies. Interest in the program has risen each year; in 1988,55 applicants competed for 11 spots.

5 This was a one-time gift, not a yearly contribution.

6 The AEA's program is cofunded by NSF.

The EAGLE Consortium (Engineering Alliances for Global Education), composed of eleven universities,[9] is offering a new program in 1989. It plans to enroll 250 undergraduates and graduate students in a summer course of intensive Japanese language study, followed by a year of academic study and language maintenance, after which the students will be placed in Pacific rim branches of U.S. companies for 8 to 12 months. Some 40 companies have expressed interest in placing EAGLE Consortium students.

The government-sponsored programs described above were established by executive action. Congress has not enacted any law that explicitly encourages U.S. researchers to work in Japan, but did include in the Trade Act an admonition to U.S. negotiators to ensure that "access to research and development opportunities and facilities, and the flow of scientific and technological information, are, to the maximum extent practicable, equitable and reciprocal."[8] This is happening. *The* NSF and Japanese programs to support U.S. researchers in Japan are not yet fully subscribed, but the reason may be that the programs are new, and individual applicants must make rather complicated arrangements with the Japanese institutions they want to work in. The AEA and MIT fellowships are older, and also make more of the placement arrangements for the fellows. Both programs started slowly but now have more applicants than positions. Congress might wish to monitor the progress of the government-sponsored programs, to determine whether, at some point, they ought to be expanded. If the number of qualified applicants continues to grow and an expansion is needed, one option might be to establish a Congressional U.S.-Japanese Fellowship Program, which would have the advantage of prestige due to the backing of Congress. Meanwhile, a useful government function, which NSF might undertake, would be to bring together in one place information on all the programs, public and private, that offer U.S. researchers the chance to work in Japan.

One area that might profit from increased congressional attention is Japanese language studies and translations of technical papers. The language barrier is obviously a major impediment to flows of technological knowledge from Japan to the United States, both through the exchange of people and through published literature.

Congress has passed legislation to encourage the flow of published information from Japan to this country. In the Japanese Technical Literature Act of 1986, it directed the Department of Commerce to keep abreast of new technical developments in Japan, translate technical documents on request (at the requester's expense), and publish lists of important documents translated from Japanese and a directory of translation services. The office that was set up to do these jobs is small, with a staff of two and a budget of less than half a million dollars, reprogrammed from other Department funds. In the beginning, the office arranged translations, but it does so no longer because the translations cost so much ($60 a page) and take so much time that there were few customers. According to the office staff, what people really need is abstracts of Japanese technical literature and forecasts of trends in technology.

Several possibilities are open if Congress wishes to do more to break through the lan-

7 The University of California at Berkeley, Cornell University, the Georgia Institute of Technology, the Rose Hulman Institute of Technology, the University of Illinois, Lehigh University, North Carolina State University, the University of Texas at Austin, Texas A&M University, the State University of New York at Buffalo, and the University of Wisconsin.

8 Public Law 100-418, Part II, Sec. 5171 (a).

guage barrier. One is to appropriate funds specifically for the Office of Japanese Technical Literature, enabling it to bring results of Japanese research and technology development to American users more effectively. Possibly, the Office could collaborate with private services that offer abstracts and evaluations of Japanese technical information and on demand, translations.[9] Such services are very expensive. And they are unfamiliar; even customers who could afford them may be unaware of their possible benefits. One role for the Office might be to provide partial or temporary subsidies for distributing these reports and services to NSF grantees or to industrial subscribers. Considering the national interest in encouraging the flow of technical information from Japan to the United States, this might bean appropriate role for government.

More fundamentally, Congress might wish to support the teaching of Japanese to more Americans. The NSF language courses for scientists and engineers are now getting an eager response, but the number of people involved is small--50 or so a year. The best way to broaden knowledge of Japanese among many Americans is to start language instruction early. Japanese school children get 10 years of instruction in English, from the elementary grades through high school. (Granted, the instruction is not very strong in conversational skills, yet many Japanese professionals can read English.) It is the rare American high school that offers any Japanese courses; most that do are in Hawaii, with a few more on the West Coast.

Congress has already demonstrated its concern for foreign language instruction in the public schools. The education act passed in 1988 contains a section that authorizes Federal grants of as much as $20 million a year, to contribute to the cost of model foreign language programs for children in public and private schools.[10] The program supports instruction in "critical foreign languages," as defined by the Secretary of Education. A logical first step to expand the teaching of Japanese to more Americans is for Congress to oversee the progress of this program and evaluate whether it gives adequate support to the study of Japanese.

In addition, Congress might wish to support programs to encourage Japanese language studies at the undergraduate level in colleges and universities. (The EAGLE consortium program which includes Japanese language studies, is open to undergraduates as well as graduates, but NSF's current Japanese language program is aimed at graduate engineers and scientists.) One possibility is to provide NSF fellowships for engineering undergraduates who want to study Japanese.

9 An example is the Japan Technology Information and Evaluation Service (J-TIES), a private service that provides a monthly report of scientific and technical advances in Japan, as selected and evaluated by an advisory committee of University of Tokyo professors. Another example is the Japanese Technical Information Service.

10 August F. Hawkins-Robert T. Stafford Elementary and Secondary School Improvement Amendments of 1988, Public Law 100-297, Title II, Part B.

Appendix: Workshop Participants

Corporate Sponsors

Robert Gonzalez, Motorola

Jan *P. Herring The* Futures Group

John Korzec, United Technologies

David Metz, Motorola

James McGroddy, IBM

Leonard Morgan, General Electric

Jan A. Notion, AT&T - Bell Labs

Interns/Technical Japanese Program Participants

Michael *Caine*, MIT. M.S. Mechanical Engineering. (Toshiba Manufacturing Engineering Laboratory, one year and one summer)

Madeline Dovale, Intel. (MIT Technical Japanese Workshop, summer 1988)

Andy *Howard* Hewlett-Packard. (MIT Technical Japanese Workshop, summer 1988; American Electronics Association Japan Fellow).

Mark Holzbach, Private Consultant. M.S. Physics Holographic Media Technology. *(Tokyo* Institute of Technology, one year; MIT Technical Japanese Workshop, summer 1988)

Gontran Kenwood General Electric. M.S. Mechanical Engineering. (Hitachi Production Engineering Research Laboratory, one year)

Chris Mizumoto Yokogawa Medical Systems/General Electric. M.S. Applied Radiation Physics, Ph.D. Nuclear Magnetic Spectrography. (Hitachi Central Research Laboratory, one year)

Vince McNeil, MIT. M.S. Electrical Engineering. (Tokyo Institute of Technology, one year)

Peter Schindler, MIT. M.S. Electrical Engineering. (IBM Japan, one summer plus nine months)

Peter Whitney, Lasertron. Ph.D. Material Science. (NIT Musashino Laboratory, two years)

Shari Yokota, Crystallume. B.S. Material Sciences and East Asian Studies. (NEC Central Research Laboratory, two years)

MIT-Japan Science and Technology Program

Richard Samuels, Director

Patricia Gercik, Assistant Director

Susan *Sherwood,* Technical Japanese Project Administrator