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Washington, D.C. 20505

DIRECTORATE OF INTELLIGENCE

30 SEP 1986

MEMORANDUM FOR: [redacted] 25X1
Assistant Director for International Affairs
Office of Science and Technology Policy

FROM: [redacted] 25X1
Chief, Technology and Industrial Competitiveness Division
Office of Global Issues

SUBJECT: New Directions in Japanese Science and Technology Policy: Opportunities for U.S. Participation [redacted] 25X1

The attached report, prepared by members of my staff, is in response to the request from the Committee on International Science, Engineering and Technology (CISET) for information on opportunities for US researchers to participate in Japanese government funded research. Changes in Japanese science and technology policy--particularly an increased stress on fundamental research--open opportunities for increased Japan-US joint research. This report describes some of these opportunities. If you or members of your staff have questions concerning the report, please call [redacted] 25X1

[redacted] 25X1

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Attachment:
New Directions in Japanese Science and Technology Policy: Opportunities for U.S. Participation [redacted] 25X1
GI M-20232, September 1986, [redacted] 25X1

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SUBJECT: New Directions in Japanese Science and Technology Policy: Opportunities for U.S. Participation

OGI/TICD/CF/ (30 Sept 86) 25X1

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Central Intelligence Agency

Washington, D.C. 20505
DIRECTORATE OF INTELLIGENCE

1 October 1986

New Directions in Japanese Science and Technology Policy: Opportunities for U.S. Participation

Summary

An evolutionary shift in Tokyo's science and technology policy from encouraging short-term, development-oriented work to sponsoring more fundamental research offers increased opportunities for United States researchers to cooperate on research in Japan. Recent government White Papers stress that government agencies should conduct more fundamental--or "non-proprietary"--research to provide support for industries of the 21st Century. As agencies such as MITI, STA and MPT undertake more fundamental research, we believe they will be less concerned about protecting proprietary results and more open to foreign cooperation than in the past. Moreover, Japan admires the US basic research system and, we believe, will seek help from foreign researchers in establishing an R&D infrastructure. Areas where fundamental research is being encouraged are: new materials, electronics, biotechnology, and robotics. We believe that the programs offering the most opportunity for cooperation at this time are fundamental research projects at the large agencies, and the new projects designed to encourage foreign participation. Fundamental research projects are now being sponsored by almost all the S&T ministries and agencies of the Japanese government. Moreover, the Ministry of International Trade and Industry has recently established three programs that specifically seek foreign cooperation in Japanese research: Key TEC Research Center; Human Frontiers Program; and the Centers for Cooperative Research. [redacted] 25X1

This paper was prepared by [redacted] 25X1
Competitive Factors Branch, Technology and Industrial Competitiveness Division, Office of Global Issues with research assistance [redacted] 25X1
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Chief, Competitive Factors Branch [redacted] 25X1

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New Directions in Japanese Science and Technology Policy: Opportunities for U.S. Participation

TOKYO BUILDS AN R&D INFRASTRUCTURE

Recent action on the part of Japan's ministries to encourage more fundamental research afford an opportunity for increased US-Japan cooperation in science and technology activities. The move towards "fundamental" -- or non-proprietary -- research reflects Tokyo's belief that its R&D infrastructure must be strengthened if Japan is to maintain state-of-the-art technology. Moreover, Tokyo feels that its position as a world economic power brings responsibility to advance human knowledge. The Council for Science and Technology (CST) -- Japan's panel of experts to oversee major directions in S&T policy (see Figure 1.) -- recently recommended an increase in government funding dedicated to fundamental research, an increase in the "creativity" of research, and an effort to break down barriers to cooperation among sectors of the Japanese S&T community. As agencies such as MITI, STA and MPT undertake more fundamental research, we believe they will be less concerned about protecting proprietary results and more open to foreign cooperation than in the past. [redacted]

All the S&T ministries and agencies are taking part in the new push to conduct more fundamental research, but the shift is most significant in the agencies that have traditionally been closed to foreign participation -- such as MITI and MPT. Both ministries have excellent labs conducting advanced research that would be very attractive to US scientists and engineers. Moreover, we believe that science and technology will continue to receive priority funding in a time of budget austerity. (See Figure 2.) [redacted] 25X1 25X1

The major players in Japan's S&T scene are:

- The Ministry of International Trade and Industry has traditionally concentrated on commercial development by funding and coordinating joint goverment-industry product development efforts, but more recently shifted its activities to include fundamental research.

- The Science and Technology Agency's major efforts are large-scale development projects which are not commercially attractive in space, nuclear energy, marine science and the environment.

- The Ministry of Education, Science and Culture (MOE) funds "basic" research in a broad range of scientific disciplines at the national, regional and private universities. [redacted] 25X1 25X1

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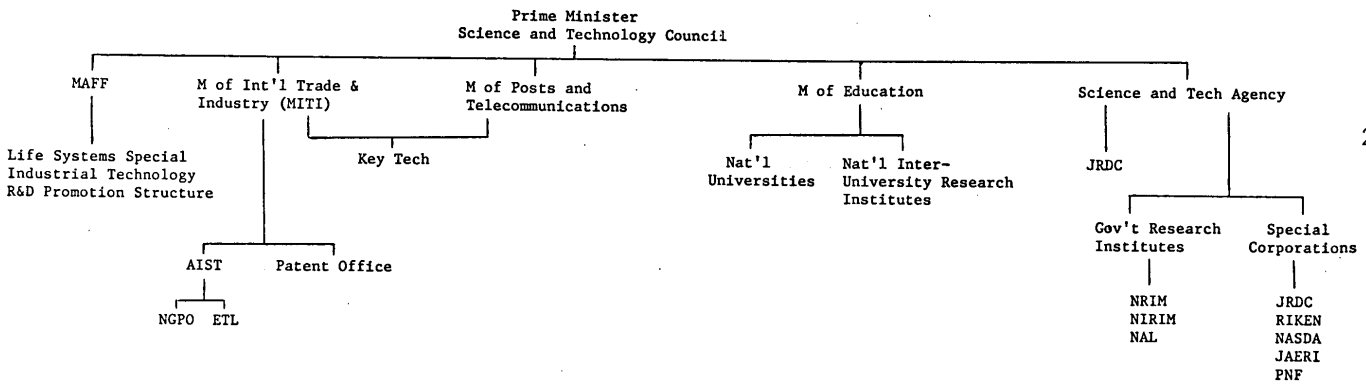
Figure 1

Selected Japanese Science and Technology Agencies



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AIST	Agency for Science and Technology
ETL	Electrotechnical Laboratories
JAERI	Japan Atomic Energy Research Institute
JRDC	Japan Research Development Corporation
MAFF	Agriculture, Forestry and Fisheries
NAL	National Aerospace Laboratory
NASDA	National Space Development Agency
NGPO	Next Generation Planning Office
NIRIM	National Institute for Research in Inorganic Materials
NRIM	National Research Institute for Metals
NTT	Nippon Telegraph and Telephone
PNF	Power Reactor and Nuclear Fuel Development Corporation
RIKEN	Institute of Physical and Chemical Research

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Figure 2

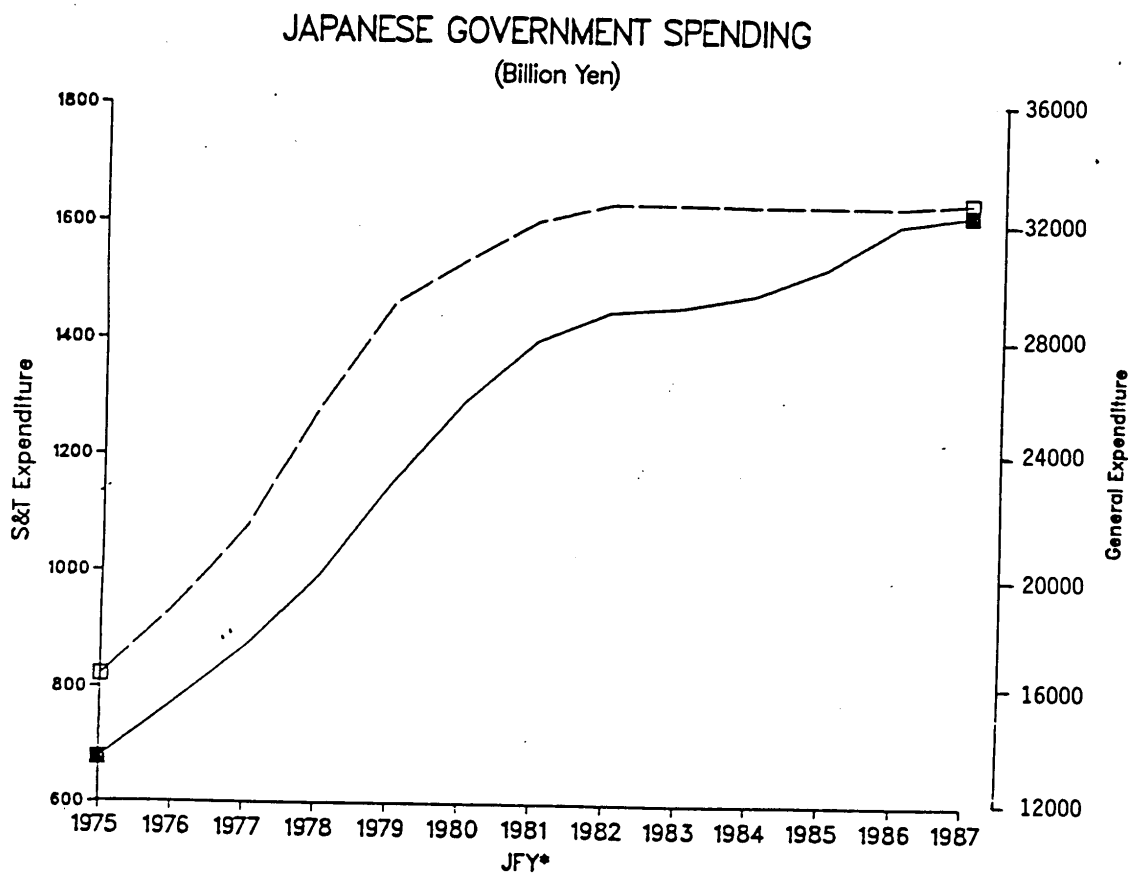

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Figure 2A

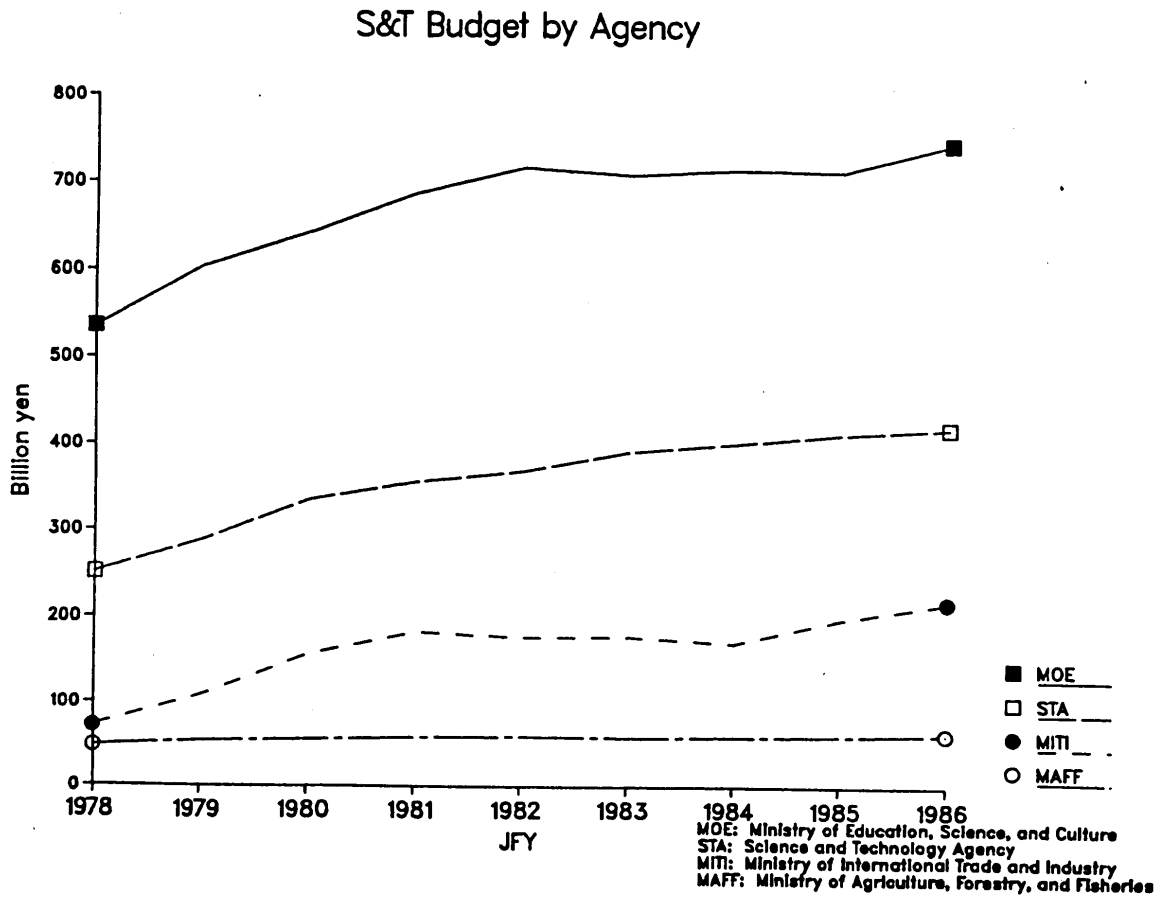

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Figure 3

MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY'S
"MAP" OF TECHNOLOGICAL DEVELOPMENT

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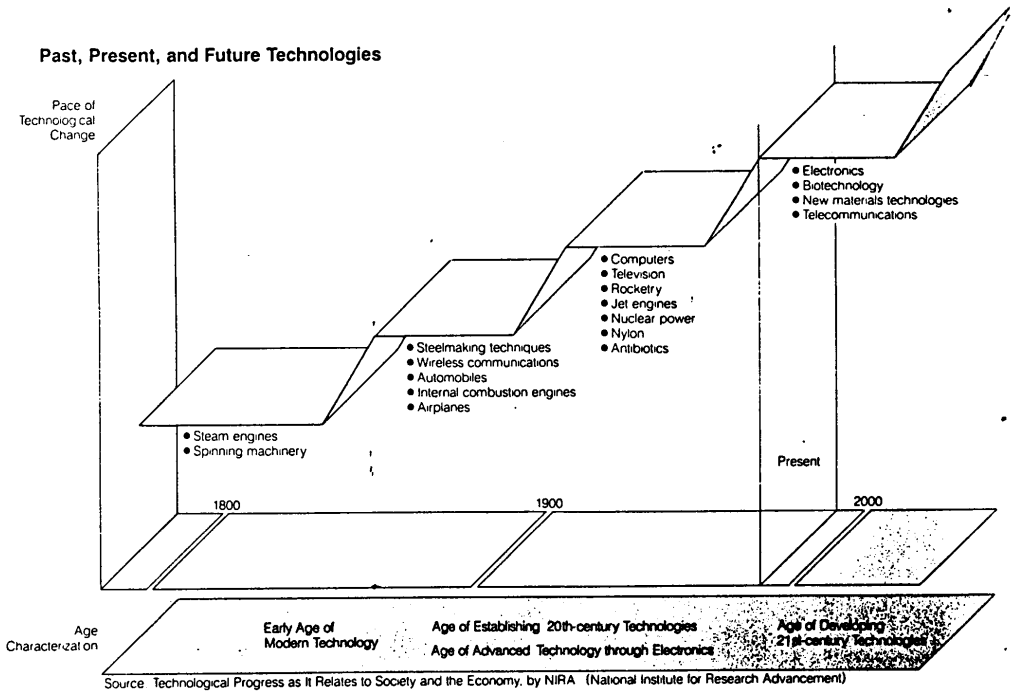

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Other ministries with much more limited mandates and budgets operate research labs and fund R&D:

- The Ministry of Posts and Telecommunications (MPT) has increased responsibility for communications R&D in the wake of the privatization of Nippon Telegraph and Telephone (NTT).

- The Ministry of Agriculture, Forestry and Fisheries (MAFF) is increasing funds to biotechnology.

MITI SHIFTS ITS SUPPORT POLICY

The Ministry of International Trade and Industry (MITI) has historically conducted large scale industrial development projects aimed at developing and commercializing state-of-the-art products. As the industries that MITI has promoted have become competitive, MITI has begun to shift its support to encourage fundamental research in areas that it sees as key to industries of the 21st Century: electronics, biotechnology, new materials and robotics. (See Figure 3.) MITI's extensive network of contacts with business, its international outlook, its 16 laboratories, and its influential position in the Japanese government make it an excellent agency to approach for the purposes of international cooperative research in areas within MITI's jurisdiction. In addition to sponsoring increasing amounts of fundamental research, MITI has recently announced the establishment of three programs that will specifically seek foreign researchers to work on MITI's new fundamental research projects. [redacted] 25X1

International Programs. In FY86, for the first time, MITI opened its research centers to foreign participation, setting aside about $2 million* to bring foreign researchers to Japan. Although the foreign research fund is still very small, we believe that MITI has a genuine interest in incorporating foreign researchers into its operations. This offers a good opportunity for the United States to tap into MITI's extensive R&D capabilities. (See box on current international efforts.) The new international programs are:

- The Key TEC Center.
- The Human Frontiers Program.
- The Centers for Cooperative Research.

Key TEC. The Key Technology Center (Key TEC) -- a Center dedicated to cooperative, long-term R&D in the technologies of the 21st century -- is a joint MITI - Ministry of Posts and Telecommunications (MPT) program.** Key TEC will:

* The exchange rate of 175 yen to the dollar was used throughout the paper.

** Key TEC was included in a package of measures to encourage more "fundamental" research in a 1985 "Law for the Facilitation

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- o Contribute funds and make loans at favorable interest rates for R&D conducted on the fundamental key technologies by private industry.
- o Facilitate joint research between private industry and government laboratories.
- o Conduct research on behalf of private industries.
- o Invite and fund researchers from overseas to work in Japan.
- o Collect information on research results from 16 government labs and disseminate to private industry.

Key TEC will contribute up to 70 percent of the capital needed to conduct R&D in a "strategic, technical area."* While promoted originally as a "basic" research center, Key TEC literature states that projects are chosen on the basis of their long-term commercial or practical application. The Center has so far provided $11 million to 25 long-term research projects in electronics, biotechnology, optoelectronics and communications systems and software.** (See Appendix, Table 1 for list of projects.) [redacted] 25X1

The Japan Trust -- a joint government-business fund -- is Key TEC's program to fund foreign researchers with expertise in Key TEC technologies. (See Attachment 1.) Despite high level political commitment to the Trust, however, Embassy reporting indicates that corporate contributions have not been sufficient to support the 100 foreign researchers envisioned by the designers of the Trust. MITI is proposing a tax incentive to encourage corporate contributions, and has set aside $500,000 for an initial international technical exchange. [redacted] 25X1

Human Frontiers. In April, 1986, the Japanese government announced the impending formation of the MITI-sponsored "Human Frontiers Program," envisioned as an international center for research in the life sciences. The program was never formally proposed, however. Even so, MITI has already established two offices -- the Human Frontiers Program Promotion Center and the Human Frontiers Policy Office -- to manage the program. Accord-

* MITI has traditionally provided 50-percent of funding to R&D projects. We believe that the increase to 70-percent reflects MITI belief that the Key TEC projects will be more fundamental, and therefore less attractive to industry participation than past projects. [redacted] 25X1

** Under the new law creating Key TEC, businesses and individuals participating in cooperative research are allowed to use MITI patent and industrial rights without charge.

[redacted] 25X1

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ing to the Japanese press, MITI is collaborating on a formal proposal with STA and MOE and hopes to present it at the next Summit of Industrialized Nations in 1987. 25X1

Centers for Cooperative Research. A law was passed in 1985 authorizing MITI to establish a series of regional core R&D centers to bring together government, industry, academic and international researchers. A major objective of the Centers is to increase industry-university collaboration on long-term research with industrial applications. MITI has set aside $130 million for an international industrial technology research project, some of which will go to the development of the Cooperative Centers in FY86. The Centers have been strengthened by a 1986 law allocating money and creating incentives for industry to participate in the Cooperative Centers. 25X1 25X1

Domestic Programs. Of the 10 large-scale R&D projects currently funded by MITI, most are development-oriented and therefore unlikely to be open to foreign participation. (See Table 1.) The Next Generation Technology Research and Development Program, however, concentrates on medium- to long-term technology developments that are important for industries of the 21st Century. Its long-term orientation makes the Next Generation Program a good candidate for international cooperation. Moreover, it is receiving top funding priority -- a factor that makes it attractive to groups seeking cooperation with Japanese S&T operations. (See Figure 4.) (See Appendix, Tables 3, 4 and 5 for a full list of projects.) 25X1

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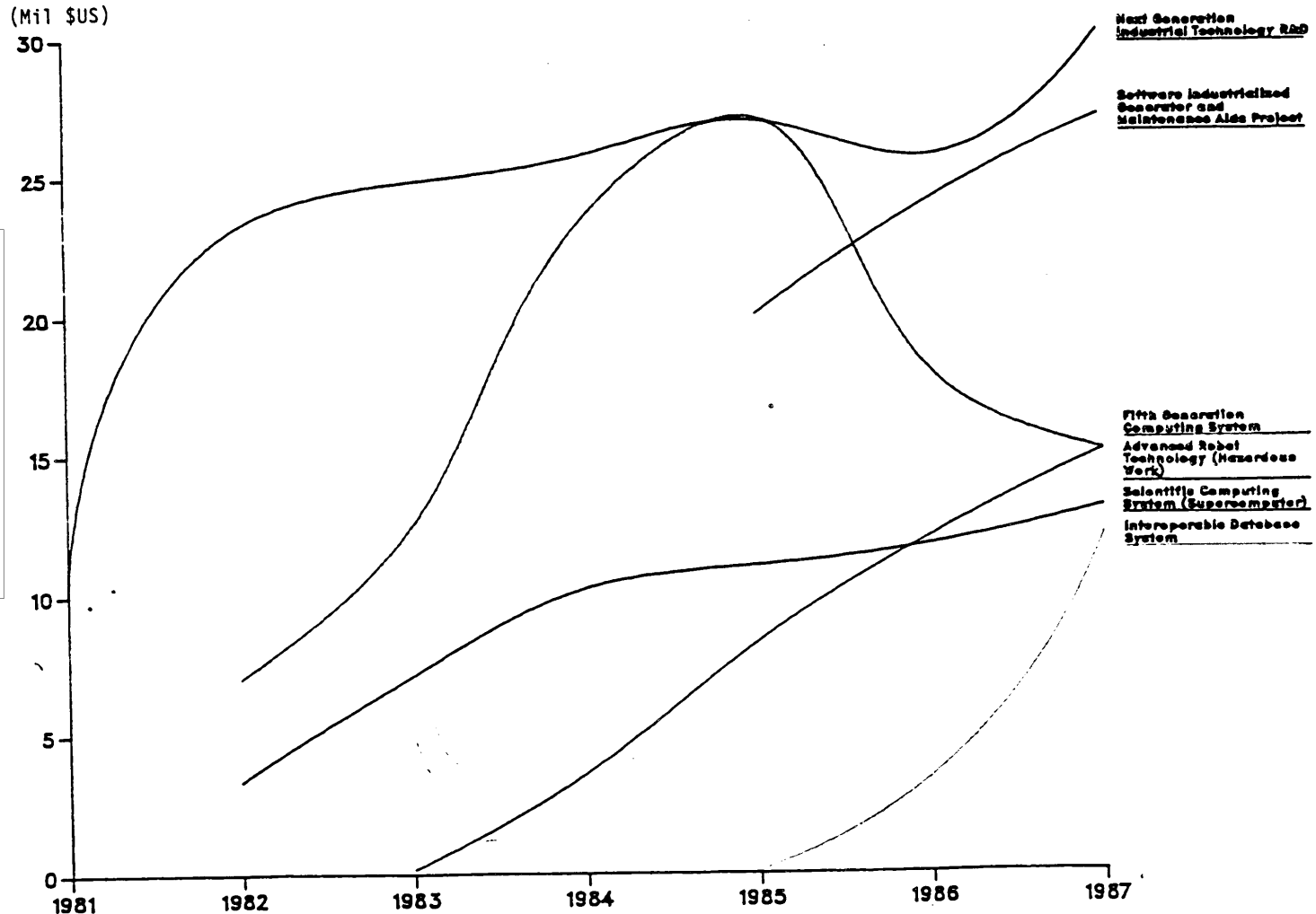
Table 1

Current MITI Sponsored Programs

Dates	Project Title	Total Funding	1981	1982	1983	1984	1985	1986	1987	Project Description
1980-1987	Monocarbon Molecule Chemical Technology	65	9.2	10.5	11.5	10.6	7.5			Research and development for a new production technology to produce such basic chemicals as ethylene glycol by use of catalytic agents and gas membrane separation techniques as a means of making radical changes in raw materials needs in the petrochemical industry.
1981-1989	Manganese Nodule Mining System	87	2	3.6	5.5	7.2	5.6	4.7	4[e]	Research and development of a hydrodynamic dredging system which will suction up nickel, copper, cobalt and other important metal-impregnated maganese nodules from ocean depths of 4,000-6,000 meters.
1981-1991	Next Generation Industrial Technology R&D	425	10	23.2	24.8	25.7	26.9	25.6	30[e]	Research and development into the basic technologies imperative for the industries that are expected to develop in the 1990s, in particular: new materials, biotechnology and new functional elements.
1982-1991	Scientific Computing System (Supercomputer)	150	-	3.3	7.1	10.2	11	11.7	13[e]	Research and development of a high-speed computer system using such high-speed elements as HEMT and parallel processing to undertake large volume scientific and technical calculations such as pictorial information data retrieved from satellites.
1982-1989	Automatic Sewing System	57	.008	.1	1.8	3.3	4	6		Research and development of an automatic sewing system which, by introducing mechatronics technology into the apparel industry, will enable it to efficiently produce products in small volume in a wide range of items.
1982-1990	Advanced Robot Technology (Hazardous Work)	80	-	-	.2	3.6	8.3	12	15[e]	Research and development of a robot with quick and precise response mechanically and having a wide spectrum of capabilities responsive to both direct and remote guidance for use in the nuclear and oceanographic sectors.
1982-1992	Fifth Generation Computing System	400	-	7	12.4	23.4	27	18	15[e]	Research and development into advanced artificial intelligence computer design and application, including R&D on gallium arsenide, high electron mobility and inference systems.
1985-1991	Interoperable Database System	60	-	-	-	-	.1	3.4	12[e]	Research and development of a computer technology that will be multicompatible in order to bring in to a common data base system widely dispersed information and to be able to respond to multimedia, voice, printing and graphics instructions.
1985-1990	Software Industrialized Generator and Maintenance Aids Project	103	-	-	-	-	20	24	27[e]	Research and development into automated production methods for software to increase productivity and efficiency of design.
1985-1991	Aqua Renaissance Project	56.6					6			Utilizing biotechnology and membrane separation technology, to research and develop a radically different general water recycling system from those in use as a response to the mid-to-long range social problem of decreasing water supplies.
1987-1990	Superprecision Processing Technology for Semiconductors									Not yet initiated.

e = estimate

Current MITI Sponsored Programs



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Current International Activities Sponsored By MITI

At the Summit of Industrialized Nations in 1985, Japan joined other advanced countries to sponsor international advanced technology research projects. Japan takes the lead on "Frontier Robots" -- a project to implement flexible manufacturing systems in areas of hazardous work -- along with Canada, West Germany, Italy, Britian, the US, the EC, and Austria. MITI has contributed $14 million to this project in fiscal year 1986. In addition to this project, MITI also contributes funding and manpower to the following international research cooperatives:

- o International Biotechnology Research.
- o New Materials and Their Standards.
- o Social Acceptability of New Technologies.
- o Bioscience.
- o High Energy Physics.
- o Probe Into the Solar System.
- o Remote Sensing from Space.

In 1985, Japan signed agreements to work on specific research projects with West European governments on the following topics:

- o Synthesis technology for VLSI.
- o Laser sensing technology.
- o Ceramic composites.
- o Micro gas sensor for robots. [redacted] 25X1

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[redacted] 25X1

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SCIENCE AND TECHNOLOGY AGENCY

The Science and Technology Agency (STA) is responsible for coordinating the Japanese government R&D activities and conducting R&D in "big science" projects. This coordinating role, coupled with its excellent research resources and openness to foreign participation, makes STA a very good agency to approach for cooperation. STA controls a large portion of the government's R&D budget (See Figure 2A) as well as access to a number of government labs. [redacted] 25X1

The largest proportion of STA's research budget (60 percent) is devoted to nuclear energy and space, and the remainder is spent on a range of R&D topics, notably life sciences and materials. STA is committed to improving cooperation among Japanese research sectors -- government, universities, industry -- and developing new methods of promoting fundamental research. Since 1980, STA's budget has grown most rapidly in fundamental research -- as funding for this sector grows, we believe new opportunities will open for US researchers. [redacted] 25X1

Opportunities for cooperation with STA-sponsored activities lie primarily within the Japan Research Development Corporation (JRDC) and the Institute for Physical and Chemical Research (RIKEN). Both organizations currently accept foreign researchers, and with STA's increasing emphasis on fundamental research, these two research centers offer significant possibilities for cooperation. The JRDC has been among the first in Japan to successfully organize the work of university, government and industry researchers under one program. The Exploratory Research for Advanced Technology Program (ERATO) has recruited foreign researchers in the past, and STA has proposed a new law to allow foreigners to hold senior positions in government laboratories. RIKEN has also traditionally favored hosting visiting foreign scientists. [redacted] 25X1

ERATO. The JRDC's fundamental research effort is mainly embodied in ERATO, conducting research in electronics, ceramic materials, biology and chemistry. In contrast to MITI's product-oriented development and the unfocused nature of Ministry of Education research, ERATO is charged with conducting "fundamental research." ERATO is awarding funding for projects through 1987, with the projects themselves running up until 1992. [redacted] 25X1

[redacted] ERATO has funded a project to aggressively recruit US researchers to work in their materials and biotechnology research programs. We believe that this offers an excellent opportunity for US researchers. (See Appendix, Table 6.) [redacted] 25X1

RIKEN. RIKEN is sponsoring the "Frontier Research Program" -- a program that we believe may be open and attractive to US researchers. RIKEN itself is a multidisciplinary institute with projects ranging from basic to development activities in the physical and biological sciences. RIKEN has traditionally sought foreign participation in its research programs but the number of

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foreigners at RIKEN has been small (about 5-10 a year). Efforts could be made to increase the number of researchers sponsored under the Frontier Research Program which has a rising research budget. [redacted] 25X1

RIKEN's Frontier Research Program started in 1985 as a 15-20 year fundamental research program in new materials and biology (See Appendix, Table 7 for list of projects.) Funds allocated for FY86 top $6 million and RIKEN is expected to spend about $200 million over the 20 year life of the project. In addition to providing research grants and contracts, the Frontier program is expected to have a staff of 35 full time researchers, with about one-third of these from abroad. RIKEN plans to build a housing project to accommodate foreign researchers. [redacted] 25X1

THE MINISTRY OF POSTS AND TELECOMMUNICATIONS TAKES ON RESEARCH

In the wake of the privatization of the Nippon Telephone and Telegraph Company (NTT), government-sponsored R&D in telecommunications and information has been decoupled from commercialization, with the Ministry of Posts and Telecommunications (MPT) assuming the role of guiding fundamental R&D. MPT's new role may offer opportunities for the United States to cooperate with Japan in information R&D -- a sector where Japan has conducted extensive research in the past. [redacted] 25X1 25X1

[redacted] the establishment of a new research center sponsored by Key TEC -- the Advanced Telecommunications Research Institute (ATR) -- dedicated research needed to advance telecommunications technology. Embassy sources report that a major component of the ATR research labs is the development of automatic interpreting telephone equipment. The US Embassy in Tokyo reports that at least two US firms are already working at the ATR. [redacted] 25X1 25X1

In addition to funding ATR, Key TEC will provide $86 million to R&D in telecommunications, offering potential cooperation in:

- Regional information services development.
- Basic telecommunications research.
- Communications for space-based use.
- Wide-band multiplexer systems.
- Highly functional wide area network systems.
- Intelligent communications technology. [redacted] 25X1

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MINISTRY OF EDUCATION: PROMOTING BASIC RESEARCH

Of the ministries supporting research, the Ministry of Education, Science and Culture (MOE) has the largest overall budget for the support of research, much of which is basic research. (See Figure 2A.) Most of the research that MOE funds is conducted at its network of laboratories and research institutes. The Ministry is emphasizing research in areas similar to the priorities of its sister ministries, although conducting more basic research in smaller scale projects. Research priorities include materials science, biology, chemistry, and electronics. (See Appendix, Table 8.)

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The MOE has been the ministry most open to international cooperation in the past. MOE has an International Cooperative Division for Science and International Affairs that processes and aids foreign researchers and manages international research projects such as the Middle Atmosphere Joint Observation Program. Moreover, MOE currently has agreements with the French and the West German governments to pay the salaries and expenses of researchers from these countries while they work in Japan.

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Although MOE has been open to foreign research participation in the past, US researchers have found it difficult to tap into MOE research in large part because of the language barrier. Moreover, under the Japanese university system of "chairs," a few professors control most research projects. Senior university staff hand-pick their associates, sometimes making it difficult for foreign researchers to break into the system. While academics from abroad are eligible as of 1982 for long-term positions with Japanese universities, by 1985, only five foreigners have accepted such positions in Japanese national universities. Moreover, according to press reports, foreign researchers feel isolated at Japanese universities. In addition, critics say that the "chair" system, coupled with the civil servant status of Japanese staff, stifles creativity by blocking contact and mobility across academic disciplines.

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MOE is changing to be more hospitable to foreign researchers and has stated that it will seek more foreign participation in the future. Tsukuba University, for example, has an on-going project to train foreign researchers in technical Japanese. To date, however, no US researchers have been trained under this program. This type of program offers an excellent opportunity to help US researchers over a major barrier to successful cooperation with the Japanese. Moreover, we believe that MOE is open to foreign participation in some of its short-term and special projects because its available work force of civil servants is not easily transferred for short periods of time.

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MINISTRY OF AGRICULTURE CULTIVATES BIOTECHNOLOGY

The Ministry of Agriculture, Forestry, and Fisheries (MAFF) -- traditionally the farmers' voice in Tokyo with little interest in fundamental research -- is becoming a leader in biotechnology R&D related to agriculture. Its interests center on the application of new techniques to plant and animal breeding, with secondary emphasis on food processing, production of agricultural chemicals, small-scale biomass conversion, and development of livestock pharmaceuticals. The MAFF is making three major changes that may provide opportunities for international cooperation:

- o Expanding fundamental research in its own central laboratories.
- o Attempting to improve cooperation with industry and the universities.
- o Establishing an agricultural biotechnology support center similar to MITI's Key-TEC program.

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The MAFF ranks a distant fourth in research spending among Japanese agencies (See Figure 2A). The bulk of this spending continues to be on regional research institutes supporting farmers, foresters, and fishermen. Cooperation between the private sector and the universities has generally been weak in these areas -- some 90 percent of the research budget has been spent in MAFF institutes. In an effort to expand fundamental research and improve contacts with other sectors, the MAFF has been reorganized to include a program of cooperative research with industry and universities. This program has been integrated with its system of 5 to 10-year projects (See Appendix, Table 9, Sections I and II.). The scale of this program is small -- approximately $.5 million for support of university research and $3.5 million for support of private research.

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MAFF recently established the Center for R&D on Bio-Industrial Technologies with $21 million funding for FY86, expanding possibilities for cooperative research. (See Appendix, Table 9, Section III.) Like MITI's Key-TEC Center, the bulk of the new funds is provided from the dividends of state enterprises (NTT and Japan Tobacco). For FY86, approximately $2.8 million will be available for financing, and $7 million for loans to groups undertaking agricultural research. The Center will also provide industry with access to gene banks, information on research in government laboratories, and information on opportunities for cooperation abroad. Projects proposed for financing through the center have generally been of a very practical nature

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The Ministry's principal fundamental research laboratory is the National Institute of Agro-Biological Resources (founded 1983) in Tsukuba Science City. With a budget of $8.5 million in FY85, the NIAR specializes in basic plant biology. According to

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press reports, the MAFF plans to expand the NIAR to enhance its role as the hub of MAFF biotechnology plans. The NIAR is also the Ministry's participant in international cooperative breeding research with the United States, West Germany, and France. [redacted] 25X1

OPPORTUNITIES FOR US INVOLVEMENT

We believe that opportunities for Japanese - US cooperation are expanding in the Japanese science and technology community because of an increased emphasis on fundamental research and a related interest in welcoming foreign researchers. Programs offering the most opportunity for cooperation at this time are:

1. Those designed to welcome foreign participation:
- o Human Frontiers.
- o The Japan Trust.
- o Cooperative Research Centers.
- o ERATO.
- o RIKEN's Frontier Research Program.

2. Domestic programs and centers conducting fundamental R&D:
- o Ministry of Education's international research programs and joint use laboratories.
- o RIKEN's laboratories.
- o MITI's Next Generation Research Program.
- o MAFF's Center for R&D in Bioindustrial Technologies.

Opportunities for cooperation will be greatest in areas where fundamental research is viewed as important to Japan: materials, electronics, life science, and robotics. Moreover, life sciences and materials have been identified as two areas of fundamental research in which Japanese would be attractive to US researchers at this time. [redacted] 25X1

Because of Japanese budget constraints, we believe the greatest opportunities for cooperation are in existing programs. Our research shows that budget constraints and turf battles among the ministries are likely to be obstacles in creating new cooperative projects or arranging a government-wide cooperative activity. Moreover, we believe that these obstacles within Japan will break down slowly. Ministry-specific, on-going projects, however, should be open to cooperation. [redacted] 25X1

Perhaps the greatest barrier to cooperative research is slowly being lowered -- in the past, ministries had no office to process foreign requests for cooperation. Prior to 1985, only MOE had such an office. With the recent push for fundamental research and cooperation, MITI and STA have added offices and facilities to process, and in the case of STA, to house foreign researchers. The existence of offices for international research cooperation will provide an excellent opportunity for joint Japanese - US research. [redacted] 25X1

[redacted] 25X1

APPENDIX

Table 1

Following is the list of the 25 projects and participating research organizations of the Key Technology Research Center:

1. Non-Oxide Glass
   Nippon Sheet Glass, Hoya Glass

2. Second Generation Optical ICs
   NEC, Oki Electric and 11 others

3. General R&D on Space Use
   Ishikawajima-Harima Heavy Industries, Toshiba and 4 others

4. Coherent Optical Communication Measuring Technology
   Yokogawa Hokutatsu Electric, Advan Test and 3 others

5. Gene Manipulation of Active Peptide, Manufacturing Process with Chemical Compounding and Active Screening Methods
   Meiji Confectionary, Daicel Chemical Industry

6. Protein Engineering
   Mitsubishi Chemical Industry, Kyowa Hakko plus 3 others

7. High-Level Information Processing-Type Image Information System
   Sumitomo Electric Industrial, Fujitsu plus One

8. Synchrotron Radiating Ray Use Technology
   Mitsubishi Electric, Toshiba plus 11 others

9. High-Performance Surface Metals
   Nippon Kokan, Kawasaki Steel plus 15 others

10. Language Processing Electronic Dictionary
    Fujitsu, Toshiba plus 6 others

11. Human Science Audio/Visual Structure International Advanced Telecommunications Technology
    Lab (ATR), NTT plus 39 others

12. Automatic Interpreting Telephones
    Same as above

13. Intelligent Communications
    KDD, Sony plus 41 others

14. Optical Wave Communications
    ATR, Toshiba plus 39 others

15. Integrated Information/Communication Systems for Buildings
    Fujitsu, Shimizu Construction, Taisei Construction

16. Voice Activating Associative-Type Information Storage Communication System Applicable to Minicomputers
    Carry Lab plus 3 others

17. Joint Backup Communications Structure
System Brain, Seibu Information Center plus 3 others

18. Industrial Park Information System
Gunma Bank plus 7 others

19. Kumamoto Prefecture Information System
Kumamoto Prefecture, City Offices plus 40 others

20. Regional Information System to Reinvigorate Hometown
Shimane Prefecture Office, Sanin Godo Bank plus 7 others

21. Integrated Information System for Greater Suwa Teletopia
Nagano Prefecture Office, Seiko Epson plus 31 others

22. Yamaguchi Triangle Teletopia Information System
Yamaguchi Prefecture, City Offices plus 17 others

23. INF Information System
NTT, Fukushima City plus 160 others

24. Kurume Teletopia Information System
Kurume City, Western Lease plus 41 others

25. Kagoshima Videotex System
Kagoshima Prefecture, City Offices plus 27 others

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Table 2

MITI has proposed the following research programs for the initial phase of Human Frontiers:

- Biometic-related R&D projects to produce new substances and make production processes more efficient.
- The study and creation of enzymes with sophisticated catalytic capabilities for possible energy resource and environmental applications.
- The study and explanation of human physiological mechanism to develop materials and new physiological active substances such as anticancer drugs and antibodies.
- The study of the brain and nervous system to develop information processing and control systems.
- The study and imitation of living organisms' motor functions to develop robot technology that incorporates humanlike movements.
- The study and patterning of muscles and flagella to develop a bioengine--a device with a revolutionary non-fuel-based propulsion system that would be non-polluting and operate under normal heat and pressure.

Table 3

Next-Generation Industrial Basic Technology Research and Development Project Organization

	Research Area	Dates	(Million $) Total R&D funds	Project Description	Management Group	Companies Participating	National Laboratories Participating
NEW MATERIALS	Fine Ceramics	1981-1990	70	Development of structural materials having abrasion resistance, high precision, high resistance to corrosion and high strength in a high-temperature environment.	Fine Ceramics Technical Research Association	Asahi Glass, Toshiba Electro-Chemical Ind, Japan Specialty Ceramics Ind, Kyocera Kurosaki Kurosaki Ceramics	Osaka Ind Tech Exp Lab, Chemical Tech Res Inst. Machinery Tech Res Inst. Nagoya Ind Tech Exp Lab, Inorganic Materials Res Inst
	High-Efficiency High-Polymer Separation Membrane Materials	1981-1990	55	Development of a high-efficiency liquid and/or air separation membrane to enable separation, concentration and refining of materials difficult to separate except at high energy cost.	High Polymer Basic Technology Research Association	Toray, Toyo Spinning, Daicel Chemical Ind. Kuraray	Chemical Tech Res Ctr, Products Science Res Ctr, Fiber High Polymer Materials Res Ctr
	Electrical Conductive High Polymer Materials	1981-1990	28	Development of high polymers with high electrical conductivity, good stability and easy to fabricate and having new function not found in current electrical and electronic materials.	"	Asahi Kasei, Sumitomo Chemical Ind, Sumitomo Electrical Ind, Teigin	Fiber High Polymer Materials Res Ctr Electronics Tech General Res Inst
	High-Performance	1981-1988	45	Development of high heat resistant alloys with specific characteristics of heat resistance, pliability and light weight.	Next-Generation Metals, Compound Materials R&D Assn	Ishikawajima Harima Hvy Ind, Kobe Steel, Mitsubishi Metals, Hitachi Metals, Sumitomo Elec Ind	Machinery Tech Res Ctr, Metals Tech Res Ctr Nagoya Ind Tech Exp Inst
	High-Crystalline High Polymers	1981-1990	35	Development of high-polymer material having a high crystallinity and with a respresentative dynamic bending elasticity of more than 100GPa.	High Polymer Basic Technology Research Association	Teijin, Toray, Mitsubishi Kasei Mitsubishi Petrochemical	Fiber High Polymer Materials Res Ctr
	Compound Materials	1981-1988	60	Development of metallic compounds (FRM) and resin compounds (FRP) which are light and strong, for use as high-strength structural materials.	Next-Generation Metals, Compound Materials R&D	Toray, Teijin, Mitsubishi Hvy Ind, Kawasaki Hvy Ind, Japan Carbon, Toshiba Machinery, Toyota Auto	—
	Light-Responsive Materials	From 1985	—	Development of materials for possible use of memories because of changes in their structures (absorption/refraction) due to light.	—	Toray, Mitsubishi Elect, Sony, Hitachi, Kasei	—
BIOTECHNOLOGY	Bioreactor	1981-1990	60	Development of a bioreactor that will conserve resources and energy in sectors of the chemical industry.	Biotechnology Dev Technology Research Association	Mitsubishi Kasei, Mitsubishi Gas Chemical, Kao, Mitsui Petrochemicals	Chem Tech Res Ctr, Fiber High Polymer Materials Res Ctr Sanitary Products Industries Tech Res Inst
	Mass Cell Cultivation Technology	1981-1989	28	Along with the development of a substitute for tallow and blood serum, which are essential in animal cell cultivation, development of basic technology for high-density cell cultivation using this substitute.	Biotechnology Dev Tech Res Assn	Toyo Brewery, Kyowa Fermentation, Ajinomoto, Takeda Pharmaceutical	—
	DNA Reformation Utilization Technology	1981-1990	55	Using the vector strain approval by DNA experimental guidelines as a host, the development of a new production technology to produce new microorganisms using DNA reformation technology on an industrial basis.	"	Mitsui Toatsu, Sumitomo Chemical Ind, Life Research Inst	Chemical Tech Res Ctr, Fiber High Polymer Materials Res Ctr Sanitary Products Ind Tech Res Inst
NEW FUNCTIONAL ELEMENTS	Ultra Latticed Elements	1981-1990	45	Development of ultra structural latticed elements made from ultra-thin film crystals uniformly arranged in multi-latticed form and semiconductor film crystals.	New Function Elements R&D Assn	Fujitsu, Hitachi, Sumitomo Elec Ind, Sony	Electronics Tech General Research Inst
	Three-Dimensional Circuit Elements	1981-1990	50	Development of a multifunctional integrated element having sensor capabilities, signal changing capabilities.	"	Nippon Electric, Toshiba, Mitsubishi Elec. Matsushita Elec.	"
	High-Strength Elements to Withstand Environment	1981-1988	45	Development of an element to withstand extreme environmental changes depending on use, i.e. radiation, heat, integration.	"	Toshiba, Hitachi, Mitsubishi Elec.	"

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Table 4

NEXT GENERATION RESEARCH PROJECT
PRIVATE SECTOR PARTICIPANTS

New Materials

High-efficiency separation membranes

Toray Industries, Inc.
Teijin Limited
Asahi Chemical Industry Co., Ltd.
Kuraray Co., Ltd.
Toyobo Co., Ltd.

Conductive high polymers

Sumitomo Electric Industries, Ltd.
Daicel Chemical Industry, Ltd.
Asahi Glass Co., Ltd.
Mitsubishi Chemical Industries, Ltd.

Crystalline high polymers

Toray Industries, Inc.
Teijin Limited
Asahi Chemical Industry Co., Ltd.
Sumitomo Electric Industries, Ltd.
Sumitomo Chemical Co., Ltd.

Fine Ceramics

Toshiba Corporation
Kyoto Ceramic Co., Ltd.
Ishikawajima-Harima Heavy Industries
Kobe Steel, Ltd.
Showa Denko K.K.
Sumitomo Electric Industries, Ltd.
Asahi Glass Co., Ltd.
Denki Kagaku Kogyo K.K.
NGK Insulators, Ltd.
NGK Spark Plug Co., Ltd.
Kurosaki Refractories Co., Ltd.
Toyoda Machine Works, Ltd.
Shinagawa Refractories Co., Ltd.
Inoue JAPAX Laboratory
Toyota Motor Co., Ltd.

High-performance, crystal-controlled alloys

Hitachi, Ltd.
Kobe Steel, Ltd.
Daido Steel Co., Ltd.
Mitsubishi Metal Corporation

Hitachi Metals, Ltd.
Sumitomo Electric Industries, Ltd.
Ishikawajima-Harima Heavy Industries

Processing technology

Mitsubishi Heavy Industries, Ltd.
Fuji Heavy Industries, Ltd.
Toyota Motor Co., Ltd.
Toshiba Machine Co., Ltd.
Ishikawajima-Harima Heavy Industries
Mitsubishi Electric Corporation
Kawasaki Heavy Industries, Ltd.

High polymer compound materials

Toray Industries, Inc.
Teijin Limited
Mitsubishi Chemical Industries, Ltd.
Nippon Carbon Co., Ltd.

Biotechnology

Mass cell cultivation

Asahi Chemical Industry Co., Ltd.
Ajinomoto Co., Inc.
Kyowa Hakko Kogyo Co., Ltd.
Takeda Chemical Ind., Ltd.
Toyo Jozo Co., Ltd.

Bioreactor

Kao Soap Co., Ltd.
Daicel Chemical Industry, Ltd.
Denki Kagaku Kogyo K.K.
Mitsui Petrochemical Industries, Ltd.
Mitsubishi Gas Chemical, Ltd.
Mitsubishi Chemical Industries, Ltd.

Recombinant DNA utilization technology

Sumitomo Chemical Co., Ltd.
Mitsui Toatsu Chemicals, Inc.
Mitsubishi Chemical Industries' Life Science Institute

New Functional Elements

Super lattice devices

Fujitsu Limited
Hitachi, Ltd.
Sumitomo Electric Industries, Ltd.

Three dimensional circuit cells

Nippon Electric Co., Ltd.
Oki Electric Ind. Co., Ltd.
Toshiba Corporation
Mitsubishi Electric Corporation
Sanyo Denki Co., Ltd.
Sharp Corporation
Matsushita Electric Ind. Co., Ltd.

Reinforced cells for extreme conditions

Toshiba Corporation
Hitachi, Ltd.
Mitsubishi Electric Corporation

National R&D laboratories participating in the 12 R&D projects are:

Fine ceramics -- Government Industrial Research Institute, Nagoya; Mechanical Engineering Laboratory; Government Industrial Research Institute, Osaka; National Institute for Research in Inorganic Materials.

Separation membranes -- National Chemical Laboratory for Industry; Industrial Products Research Institute; Research Institute for Polymers and Textiles.

Conductive high-polymers -- Electrotechnical Laboratory; Research Institute for Polymers and Textiles.

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Table 5

Table: UNIVERSITIES TAKING PART IN THE NEXT GENERATION RESEARCH PROJECT

Prefecture	Technopolis Region		Target Industrial Sectors	Measures Taken to Strengthen R&D Capacity
	Name of Region	Principal University(ies)		
Hokkaido	Hakodate	Hokkaido University	Marine-related industries and those making use of natural resources (electronics, mechatronics, biotechnology, etc.)	Expansion of the Hakodate Industrial Research Institute; establishment of the Hokkaido Prefectural Center of Industrial Technology
Akita	Akita	Akita University	Electronics, mechatronics, new materials, natural resources, energy, biotechnology	Expansion of the Akita Prefectural Institute of Industrial Technology
Niigata	Nagaoka	Nagaoka College of Science and Technology	Higher systems industries, urban industries (design, fashion), industries utilizing local natural resources	Establishment of the Nagaoka Center for the Promotion of Regional Technological Development and the Nagaoka Center for Information Studies
Tochigi	Utsunomiya	Utsunomiya University	Electronics, mechatronics, fine chemicals, new materials, software	Establishment of the Utsunomiya Technopolis Information Center
Shizuoka	Hamamatsu	Shizuoka University/ Hamamatsu College of Medicine	Optoelectronics industries, advanced mechatronics, home sound culture (electronic musical instruments), etc.	Establishment of the Institute for Research on Electronic Machine Technology and the Institute for Research on Medical Appliance Technology; expansion of the Shizuoka Prefectural Industrial Research Institute
Toyama	Toyama	Toyama Univ./ Toyama College of Medicine and Pharmacology/ Others	Mechatronics, new materials, biotechnology (medical, etc.), information industries	Relocation of the Toyama Prefectural Institute of Industrial Technology; establishment of the Center for Research on Life Sciences and the Center for Exchange in Advanced Technology
Okayama	Kibikogen	Okayama University/ Okayama College of Science	Biotechnology, electronics, mechatronics (medical and pharmaceutical industries), etc.	Reorganization of the Okayama Prefectural Institute of Industrial Technology; establishment of the Center for Research on Biotechnology
Hiroshima	Hiroshima Chuo	Hiroshima University	Electronics, mechatronics, new materials, biotechnology, etc.	Establishment of the Center for Research on Frontier Technologies; expansion of the Hiroshima Prefectural Industrial Research Institute
Yamaguchi	Ube	Yamaguchi University	Electronics, mechatronics, new materials, ocean development, biotechnology, etc.	Expansion of the Yamaguchi Prefectural Industrial Research Institute; establishment of the Yamaguchi Prefectural Institute of Industrial Technology and the Institute for Research on New Materials
Fukuoka–Saga	Kurume–Tosu	Kurume College of Engineering/Kurume University	Mechatronics, fine chemicals, fashion, next generation (bio) industries, etc.	Creation of the Information Center of the Center for the Promotion of Local Industry
Oita	Kenhoku-Kunizaki	Oita Univeristy/Oita College of Medicine/ Others	Electronics, mechatronics, bioindustry, software	Establishment of the High Technology Research Institute and the Training Center; expansion of Oita Prefectural Industrial Research Institute
Kumamoto	Kumamoto	Kumamoto Univ./ Kumamoto College of Engineering/Others	Applied machinery industry, biotechnology, electronic equipment, information systems industry	Establishment of the Center for Research on Applied Electronics Machinery Technology; expansion of the Kumamoto Prefectural Industrial Research Institute
Miyazaki	Miyazaki	Miyazaki Univ./Miyazaki College of Medicine	Local-oriented (bio), introduction-oriented (electronics, etc.), and urban-oriented (urban systems) industries	Establishment of the Joint Research and Development Center; expansion of the Miyazaki Prefectural Industrial Research Institute
Kagoshima	Kokubu-hayato	Kagoshima Univ./ Kyushu Gakuin Univ.	Electronics, mechatronics, new materials, biotechnology, etc.	Establishment of the Center for Research on the Development of Fine Ceramics Products and the Kagoshima Prefecture General Institute of Industrial Technology

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Table 6

Summary of ERATO Projects

Jun'ichi Nishizawa (Tohoku University) on making perfect crystals. Works with Mitsubishi Electric Corp., Hamamatsu Photonics Co., Mitsubishi Metal Industries Co. (1981-86)

Ken Matsumoto (Tohoku) on amorphous compounds, new inorganic materials for industrial use. (1981-86)

Kazumitsu Hayashi (Japan Vacuum Metallurgical Co.) on ultra-fine particles of metal compounds. (1981-86)

Naoya Ogata (Sophia University -- Tokyo) on fine synthetic polymers imitating natural fibers. (1981-86)

Den'ichi Mizuno (Teikyo University) bioholonics project on coordination of body functions. (1982-7)

Osamu Hayaishi (Osaka Medical College) on information transfer between cells. (1983-86)

Horikoshi (RIKEN) on "superbugs," microorganisms with special properties. Work at RIKEN and Hamamatsu Photonics Co. (1984-89)

Shoichiro Yoshida (Nikon) nano-mechanism project on micro-analysis of matter. (1985-90)

Haruo Kuroda (University of Tokyo) on chemical nature of solid suraces. (1985-90)

NEW: Hirokazu Hotani (Kyoto University) on how organisms react to changing environments at the molecular level. (1986-91)

NEW: Humio Inaba (Tohoku University) on how microorganisms absorb and emit photons. (1986-91)

NEW: Quantum magnetic flux in cryogenic environments as an information carrier (1986-91).

Three projects from ERATO have been selected as candidates for the "High Technology R&D Consortium" system, to begin in JFY86 (1 April 86 through 31 March 87), for extension of results toward application and patentability. These are: fine polymers, ultra-fine particles, and amorphous compounds. Also selected, from STA's National Institute for Research in Inorganic Materials is project Perovskite Functional Ceramics. The final selection is by JRDC, including invitations to private sector.

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Table 7

International Frontier Research System (STA) Projects

Frontier Materials -- new materials for electronics
- Quantized Elements and Devices
- Molecular Electronic Elements and Devices
- Bioelectronic Elements and Devices

Biological Background of Homeostasis -- aging and plant improvement
- Plant Homeostasis
- Chromosomes
- Biomedia
- Intestinal Flora

Research is to be conducted at Institute for Physical and Chemical Research (RIKEN). Staff is to be 35 full time scientists. Announced objective to hire one-third from abroad. Construction includes domestic facilities for foreign staff.

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Table 8

Ministry of Education Grants for Specially Promoted Distinguished Research (Selected in JFY85)

Theoretical and Corroboratory Studies on Universality and Individuality of Japanese Language.

Establishment of Methodology for Archaeo-Historical Studies Based on Analyses of Data of Chronological Variation Patterns of Old Tree Growth Rings.

Development of New Systems for Observation of Surface Atomic Configurational Structure, and Studies on Semiconductor Surface Superlattice Structures.

Search for Magnetic Monopoles and Other New Super Heavy Particles.

Quantum Hall Effects & Localization of Valence Electrons: Quantum Effects in Electrical Conduction.

Studies of Physical Characteristics of Interfaces Between Chemical Compound Semiconductors and Insulators, and on Their Applications.

Dynamic Structure and Functional Regulation of Protein Synthesis Systems.

Control Mechanisms in Biosynthesis of Blood-sugar-reducing and Blood-pressure-lowering Peptides.

Elucidation of B-Lymphocyte Hyperplasia and Differentiation Mechanisms and Studies on Their Anomaly Control

Studies on Animal Cell Division Mechanisms.

Molecular Biological Studies on Functions and Regulatory Mechanisms of Enzymes in Higher Animals.

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Table 9

MAFF Biotechnology Projects for JFY 1986

I. Breeding through biotechnology for the 21st century

1. High technology plant breeding (for increased energy efficiency)

2. Aiding regional biotechnology development

3. Development of basic technologies
   - Research on cultured seeds
   - Mechanisms of gene manifestation
   - Analysis of gene structure in agronomic biology (new)*
   - New organism development by cell fusion and nucleus transplantation
   - Improvement of microorganisms and plant cells through cell fusion*
   - Production of seeds and seedlings through tissue culture*
   - Breeding by gynogenesis of fish and shellfish

4. Improvement of the gene bank

II. Technological innovation in food and related industries
   - Development of bioreactor systems in the food industry*
   - Development of basic technology for agricultural drugs*
   - Immuno-diagnostic methods of livestock diseases*
   - Basic technology for new fertilizers (new)*
   - Biomass conversion
   - Dynamics of root environment (new)

III. Center for R&D on Bio-Industrial Technologies

1. Financed Projects
   - Development of potatoes suited to manufacturing
   - Disease-resistant tomatos for year-round cultivation
   - Agricultural machines using artificial intelligence
   - New materials for coating crops
   - Damp-proof greenhouse heater
   - Measurement technology for surface water and soil using biosensors
   - Decontamination of agricultural waste water with microorganisms
   - Forestry machinery using forest biomass resources for power

2 Investment Projects
   - Biotechnology Research Center -- development of new breds
   - New food distribution systems

Sources: TOKI NO UGOKI, 15MAR86; NIHON KEIZAI SHIMBUN, 13AUG85

* Projects being conducted cooperatively with industry.

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Attachment 1

International Research Cooperation

JAPAN TRUST

JAPAN TRUST

JAPAN KEY TECHNOLOGY CENTER

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1. Introduction

The JAPAN TRUST international research cooperation service is one of the activities undertaken by the Japan Key Technology Center.

The Japan Key Technology Center is a specially approved legal organ inaugurated in October 1985 as a key institution for promoting experimental research of basic technology in the private sector.

This center was established with a total capital of 14 billion yen, of which 5 billion yen was invested by more than six hundred private enterprises upon approval of the Ministry of International Trade and Industry and the Ministry of Posts and Telecommunications in accordance with the Law for the Facilitation of Research in Fundamental Technologies (promulgated and enforced in June 1985).

So far, the promotion of experimental research in the basic and application stages of technology in the private sector of Japan has not been sufficient. Therefore, it is the role of this center, as an overall service institution, to promote the research and development of key technology by taking advantage of the technology development capabilities of the private sector, and further implement the research and development of key technology in cooperation with the industrial, academic, and government sectors.

The main business lines of this center are as follows:

(1) Invitation of researchers from overseas countries (the JAPAN TRUST international research cooperation).
(2) Promotion of joint research and others, and development through collaboration between industrial, academic, and government sectors.
(3) Collection, distribution, and investigation of information for research.
(4) Investment or loaning of capital required for experimental research pertaining to key technology carried out by the private sector.

Note: The "key technology" implied here refers to the technology for the mining, manufacturing, telecommunications, and broadcasting industries (including the cable broadcasting industry), and other technology for the utilization of radio waves pertaining to telecommunications, which are under the control of the Ministry of International Trade and Industry and the Ministry of Posts and Telecommunications and which are expected to contribute substantially to reinforcing the foundations of the national economy and the people's standard of living. The majority of the major technology development themes are considered to be included in fields under the responsibility of the Ministry of International Trade and Industry and the Ministry of Posts and Telecommunications.

2. Objectives of the JAPAN TRUST International Research Cooperation Service

The objectives of the JAPAN TRUST international research cooperation service is to invite overseas researchers who are engaged in experimental research pertaining to key technology and to promote international research cooperation.

(1) Our country, Japan, has been incessantly directing its efforts to acquire overseas technology. However, it is considered necessary for Japan, in the future, to return the benefits obtained so far from various overseas countries.

(2) For promoting the development of creative technology, however, it is considered highly important to broaden the mutual exchange of researchers of various countries with different cultural and spiritual backgrounds and different ways of thinking.

(3) From the above-mentioned points of view, it is considered essential to invite researchers from overseas countries and promote international research cooperation in wide ranging fields of key technology.

3. Outline of the Invitation of Overseas Researchers

Any overseas researcher to be invited under the JAPAN TRUST international research cooperation service is, in principle, required to have a Ph.D. or equivalent qualification, and will take part mainly in the research and development of private enterprises. In principle, the invitation period will last up to one year.

(1) Any overseas researcher to be invited is required to have been engaged in research in that field of key technology, and have a Ph.D., or else be deemed to have equivalent research capability.
(2) The researcher to be invited will be recruited publicly by the Key Technology Center.
(3) Researchers will be selected from those recruited publicly by the center, and all necessary invitation proceedings will be handled by the center.
(4) The invited researcher will take part in research and development mainly at the research institutes of private enterprises (or government/national research laboratories, as required).
(5) In principle, the invitation period can last up to one year, providing that the period may be extended.
(6) The following allowances and expenses will be provided for the invited researcher:
   a. Travelling expense
   b. Living expenses
   c. Preparation allowance
   d. Premium for damage insurance

(For inquiry regarding the JAPAN TRUST international research cooperation service, refer to Page 6)

4. Financial Source of Expenditures Necessary for Invitation

Incurred invitation expenditures will be covered by the operation profit of the public trust fund established by a number of private supporters (benefactors)

(1) In order to invite researchers from overseas countries, the money contributed by the benefactors (private organizations and individuals) who support the objectives of this project is first established as the JAPAN TRUST, a public trust fund.
(2) The expenditures necessary for invitation will be covered by the operation profit of this public trust fund.
(3) The mechanism of the JAPAN TRUST international research cooperation service is as presented in the reference diagram of Page 5.

Reference Diagram Mechanism of the JAPAN TRUST International Research Cooperation Service