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12 March 1982

Japan Report

(FOUO 17/82)

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JAPAN REPORT

(FOUO 17/82)

CONTENTS

POLITICAL AND SOCIOLOGICAL

JAPAN

FOREIGN MISSIONS TO BE ALLOWED TO OPERATE RADIOS

OW221051 Tokyo SANKEI SHIMBUN in Japanese 19 Feb 82 Morning Edition p 1

[By reporter Kijio Sakakibara]

[Text] The Posts and Telecommunications Ministry has decided to revise the wireless telegraphy act to permit foreign embassies and legations in Japan to have their own radio communication facilities. The decision will be included in a bill of amendments to the act which is being prepared by the Ministry for Submission to the current diet session. The revision is also designed to enable Japanese diplomatic establishments abroad to have their own wireless communication facilities, under the "principle of reciprocity," so that in the future such communication disruptions as that which happened to the embassy in Poland can be avoided. All communications with the Japanese Embassy in Warsaw were disrupted for nearly a month due to the suspension of general circuits under the martial law rule.

According to the Posts and Telecommunications Ministry, there was a strong request from the Foreign Ministry to authorize foreign diplomatic establishments to operate their own radio stations.

Article 5 of the present wireless telegraphy act stipulates that "a foreign government or its representatives" are not licensed to operate a radio station; under the principle of diplomatic "reciprocity" Japanese embassies abroad also were not allowed to have their own radio facilities by the governments of the respective countries.

Japanese embassies abroad have thus been depending solely on general communciations circuits for their communications with the Foreign Ministry in Tokyo. Troubles occurred in December last year when the martial law rule in Poland suspended operations of the general circuits for nearly a month, cutting all contacts with the embassy and causing problems in the efforts to protect Japanese nationals as well as in other areas.

This prompted the Foreign Ministry to review the need for the nation's embassies and legations abroad to have their own radio communication facilities, and to strongly ask the Posts and Telecommunications Ministry to revise the wireless telegraphy act. As an initial step, the Posts and Telecommunications Ministry decided to delete the phrase "a foreign government or its representatives" from the text of article 5 of the act. Possible amendments to other related articles are also under study.

CSO: 4120/163

ECONOMIC

MITI MAY SEND ADVISER NAOHIRO AMAYA TO U.S.

OW221400 Tokyo JIJI in English 1343 GMT 22 Feb 82

[Text] Tokyo, 22 Feb (JIJI Press)--The Ministry of International Trade and Industry is considering sending its adviser, Naohiro Amaya, to the United States from late this week to early March to warn against the implementation of trade reciprocity bills, which Japan sees as threatening bilateral trade. The trip, to major cities such as Washington, New York and Boston, would coincide with renewed publicity efforts in the United States by the foreign office. Miti is also studying the possibility of using American cable television networks in its drive to put Americans wise to Japan's sincere efforts to solve trade friction with the United States and Western Europe.

But there is little expectation that Tokyo's efforts so far, including a reduction in advance of import tariffs and the lowering of non-tariff trade barriers, will lead to any significant easing of pressure from Washington. Consultations are now under way between Miti and other government agencies on what additional steps the government can take by the time Foreign Minister Yoshio Sakurauchi visits the United States in late March. Among the new measures reportedly under consideration are the advocacy of framing rules regarding investment and services in the arena of the general agreement on tariffs and trade (GATT), a review of the list of product items whose imports into this country are still restricted, and an increase in the number of retailers of American-made tobaccos. However, it is clear the government would want more thrust to impress the Americans.

The third round of talks on the stalled project to build a gigantic petrochemical complex in Bandar Khomeyni in Southern Iran will be held in Tehran 23-27 February. The joint venture project, undertaken by Iran-Japan Petrochemical Co (IJPC), now hangs in the balance with the Mitsui group, the Japanese partners, displaying reluctance because of the project's soaring costs. The Iran-Iraq war has left the venture in abeyance with no breakthrough in sight. Miti indicates no change in the Japanese position, nor does it anticipate any drastic proposals from the Iranian side at the Tehran talks.

Nevertheless, the ministry says it is important to continue dialogue with the Iranians. Rumors get abroad from time to time that Iranian leader Ayatollah Ruhollah Khomeyni is dead, and Miti is concerned they could throw the Gulf nation into confusion and deprive the Tehran Government of the ability to proceed with negotiations.

Miti will enter into discussions with the Ministry of Posts and Telecommunications on the liberalization of data communication whis week. The Posts and Telecommunications Ministry is inclined to incorporate it in a package proposal only in a vague form. But Miti is bent upon full liberalization based on a recent interim report of the second extraordinary administrative research council, a government advisory body.

CSO: 4120/161

SCIENCE AND TECHNOLOGY

COMPUTER DEVELOPMENT TRACED UP TO FIFTH GENERATION R&D GOALS

Tokyo DENKI SHIMBUN in Japanese 8-11, 15-18 Dec 81

[Article by Sozaburo Okamatsu, head of Electronics Policy Division, Bureau of Machine Intelligence, MITI]

[8 Dec 81 p 3]

[Text] To Break the Barrier of the Neuman-Type Computer

Development of computer technology, which has made such brilliant progress so far, entered the "fourth generation" when super LSI became practical. By the 1990's, a brand new type of computer capable of understanding human speech is expected to make its appearance. Confronted by the development of an information society and the need for this type of advanced computer, MITI undertook the development of the "fifth generation computer" starting in 1981. To be sure, this "fifth generation computer" is not yet generally well understood, partly because it employs a computational format basically different from that of the conventional computer and partly because its development has just begun. As part of its technology series, this newspaper will introduce the circumstances related to R&D of the "fifth generation computer" and its prospects.

Circumstances Leading to R&D of Fifth Generation Computer

Today, the computer is said to have entered the fourth generation, in which super LSI elements are utilized. In approximately 35 years since the first practical computer was developed, the computer has experienced a number of generation changes and expansion in the number of functions as a result of innovative technological development.

The greater part of these computers belong to the so-called Neuman-type based on the theory developed in 1946 by Dr von Neuman in the United States.

If we look forward into the future, the computer environment is expected to change drastically in the next 10-year period, and as the field of applications is expanded rapidly, new utilization formats and the technology to realize them will be in demand.

However, with the Neuman-type computer, the software increases enormously in size and complexity as the computer is applied to more and more advanced problems.

The basic flaws of the present-day computer having their origin in the construction and design concept of the computer have become evident, and it is highly probable that the computer of today may not be able to cope with the advanced functions demanded by the future.

Therefore, based on the past experience in the life cycle of technological change, a brand new fifth generation computer based on brand new theory and technology is expected to appear in the early 1990's.

MITI has therefore undertaken R&D of the fifth generation computer as a national project on the basis that computer technology is not only one of the basic technologies in support of industry, but also a technology indispensable for the establishment of an abundant informationalized society.

The Background of Research and Development

1. Possibility Due to Advancement in Semiconductor Technology

The development of semiconductor technology is quite astonishing, as evidenced by the development of super LSI. Within 10 years, a chip several millimeters square containing several million bits of memory elements or hundreds of thousands of gates (gate = the smallest unit of logic element) may become a reality.

In view of the recent technological advancement and reduction in the hardware cost, it is necessary to undertake R&D of a computer system desirable in the 1990's by drastically reexamining the construction of the computer.

2. Problems Related to the Software

Running counter to the trend of hardware technology, the software cost is rising year after year, and 80-90 percent of all 1985 information processing cost is expected to be the software cost.

This is so because the computers used today are dependent on the software. We must reevaluate from scratch the construction, the basic concept, and the language theory concerning the computer and carry out R&D of the software system which will be desirable in the 1990's.

3. Utilization of the Results of Basic Theoretical Research

Those research activities which are at the basic research stage today, including analysis of natural language and study of artificial intelligence, are expected to be the technologies which will have an important impact on the field of information processing in the future. It is therefore imperative that due attention be paid to these basic theoretical research activities, and new development of computer technology must be attempted through introduction of new concepts and fruits of research activities.

4. Changes in the Social Environment

Observing the conditions of society that are expected to exist in the 1990's, analyzing the demands that will be made by this society on computer technology,

and viewing it from the standpoint of the user, the computer system that will be desirable in the 1990's must be carefully investigated.

The LSI package used in the computer.

[9 Dec 81 p 3]

[Text] Epoch-Making "Internally Stored Program"

The History of Computer Development (I)

In science fiction novels, scenes in which man and computer or robot carrying on a conversation naturally are often depicted. The day when computers may break the shell of being just a "computing machine" and truly become man's associate may not be too far off.

Computers are already so deeply involved in our daily lives today that it is fair to say that we cannot do without them. Newspaper editing, telephone exchange, traffic signal control, seat reservations, and deposit and withdrawal at the bank--computers are being utilized all around us today.

However, the history of the practical computer is surprisingly short: only about 35 years.

Indeed, we must not forget that before the practical computer was born, the headwaters of technology which sprang up in ancient China were passed on by numerous mathematicians and scientists over a long period of time.

There are three mainstreams leading to the establishment of the practical computer we know today.

The first stream consists of a "computing machine" such as the abacus which was the product of an attempt to mechanize the ability to count numbers. By the 19th century, a machine capable of computing square root and cube root to say nothing of addition, subtraction, multiplication and division was perfected through the use of a combination of intricate gear trains.

The second stream has its origin in the pattern paper (punch cards) that was used to control the threads of a weaving machine. A "statistical machine" which handles and classifies large numbers belongs to this stream. This machine demonstrated its power by processing the 1890 U.S. census data in 2 years (a population of 62 million), which formerly took 8 years done manually.

The third stream consists of a "logic machine" which generalizes and mechanizes the computing process by analyzing the human thought process employed in computation and patterning after it. It represents the most substantial way of thinking related to mechanization of the algorithm. It has been judged the key which opened the way to today's research into artificial intelligence. It is also expected to play an important role in the development of the fifth generation computer.

These three streams have been united through the introduction of electronic technology and adoption of the binary system, and significant progress has been made since.

The practical digital computers of today include the MARK I (Harvard, 1944) using electromagnetic relays, and the world's first genuine computer (electronic computer) developed after electronic technology was introduced was ENIAC (Pennsylvania University, 1946).

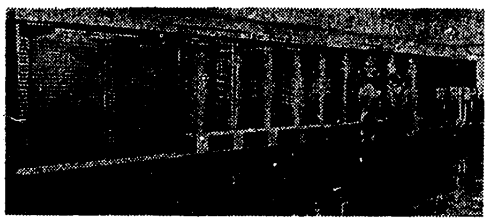
This computer consisted of 18,000 vacuum tubes, weighed 30 tons, consumed 150 kW of electric power, and required a room big enough for 100 tatamimats to contain it. Its performance characteristics, including 0.2 millisecond for addition and subtraction and 3 milliseconds for multiplication, were considered marvelous at the time (as a reference, the addition speed of the modern computer is of the order of approximately one-millionth of a second).

However, ENIAC's electric circuit had to be reassembled for different jobs. The lack of a large data memory capacity was one of its shortcomings.

The idea advanced by Von Neuman, a mathematical genius, to eliminate these shortcomings consisted of an internally contained program format (commands and data are contained in the "memory unit" and retrieved from there for processing).

The prototype of the modern computer (Neuman-type computer) was completed when EDSAC (Cambridge University) appeared in 1949, followed by EDVAC (Pennsylvania University) in 1952. The history of the modern computer had just begun.

Since then, the performance characteristics of the computer have improved by leaps and bounds, but no significant change in the essential principle has been made up to today.



The computer MARK I contained 3,300 electromagnetic relays (completed in 1944).

[10 Dec 81 p 3]

[Text] The Fourth Generation Computer Using Super LSI Makes Its Appearance

History of Computer Development (II)

Who could have guessed that the huge computer which occupied a room big enough for 100 tatamis could be miniaturized to fit in the palm of one's hand after only 35 years.

The development process of the practical computer from its inception to today is often divided into "generations" based on the changes in technology. Today is the dawn of the fourth generation.

The first generation was the "vacuum tube era" which began in 1946 with the completion of ENIAC.

During that generation, the computer was utilized with programs written in machine language consisting of a series of binary numbers or in assembly language consisting of command code symbols. Toward the end of the first generation, programming languages such as FORTRAN (scientific and technical computation language) and COBOL (business computation language) were developed. These languages could be translated into machine language automatically and are still being used today. As a result, the number of users expanded significantly.

As the speed of computation and processing was upgraded, the operating sequence was indicated to the computer through use of control cards, enabling the computer to continuously carry out necessary operations such as assigning the input unit and retrieving a program from the memory.

The second generation, the "transistor era," started in 1959 when the commercial computer using transistors was introduced.

The first generation vacuum tube computer had problems because of the huge space it occupied, the frequent failures, and the large quantity of heat generated. These problems were solved through use of the transistor, which possesses many advantages over the vacuum tube, including a requirement for approximately one-thousandth the electric power consumption, small size, and long useful life.

The transistor (for transfer resistor) was invented in 1947 by Dr Shockley et al of Bell Laboratories (the United States). It was found capable of functioning like a vacuum tube through utilization of the property of certain substances (known today as semiconductors) such as silicon and germanium which become conductive or nonconductive depending on the conditions.

The second generation may be termed the true computer utilization period, and the present-day operating system consisting of a software system was firmly established. The remote batch format, in which a user at a remote location can log-in and use an advanced large-scale computer at a central location via a communications circuit, was also introduced during this period.

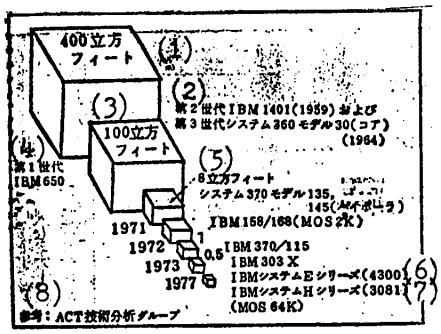
The third generation, consisting of the "IC (integrated circuit) era," started in 1964 with the appearance of the IBM 360 series. The IC was successfully developed in the early 1960's by integrating an entire circuit consisting of various parts performing various functions, such as rectification, amplification, and resistance, on a single chip.

In the early days of development, the work accuracy of the IC was of the order of 15 microns and it contained one-two gates of logic circuit per chip (1 gate in general consists of one-four transistors, two-five resistors, and three-six diodes).

Since then, high-density integration and miniaturization of IC has progressed rapidly, and by the 1970's, LSI (large-scale integrated circuit), consisting of more than 100 logic gates or 1,000 memory bits per chip, appeared. Then, the 3.5th generation computer, represented by the IBM 370 series using LSI's, appeared.

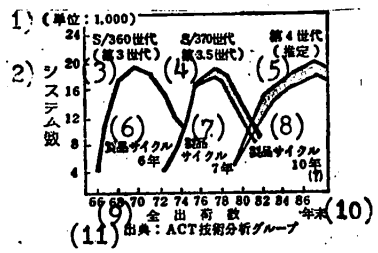
During this period, significant advancement was also made in the utilization format--for example, the time-sharing method of computer utilization in which an arbitrary number of users can access the computer from on-line terminals and share the use of the computer on a divided-time basis, and transition from the batch process to the on-line process and also from the concentrated processing format to distributed processing.

And since the technology of drawing lines with an accuracy in excess of 1 micron has been established, it is now possible to integrate more than 1,000 logic circuits or more than 100,000 memory bits on a single chip. This means the threshold of the era of super LSI and the fourth generation computer using it. The quickening can be felt by the announcement of the IBM H series made in 1980.



The volume (cubic feet) per 1 million characters of IBM memory.

Key: (1) 400 cubic feet
(2) The second generation IBM 1401 (1959) and the third generation 360 model 300 (core) (1974)
(3) 100 cubic feet
(4) The first generation IBM 650
(5) 8 cubic feet, system 370 model 135, model 145 (bipolar)
(6) IBM system E series (4300)
(7) IBM system H series (3081)
(8) Reference: ACT Technical Analysis Group



The generation changes seen in IBM products

Key: (1) (Unit: 1,000)
(2) Number of systems
(3) S/360 generation (third generation)
(4) S/370 generation (3.5th generation)
(5) Fourth generation (estimate)
(6) Product cycle 6 years
(7) Product cycle 7 years
(8) Product cycle 10 years(?)
(9) Total output
(10) Year end
(11) Source: ACT Technical Analysis Group

[11 Dec 81 p 3]

[Text] "New Idea" Electronic Computer To Appear in Next 10 Years

Necessity for Development of Fifth Generation Computer

The advancement of computer technology has been extremely rapid. In the relatively short period of about 35 years, from the development of the first practical computer until today, significant achievements have been made in high speed and miniaturization, and an advanced technical level represented by the fourth generation computer using super LSI is about to be reached.

Under these circumstances, why is it necessary to develop the fifth generation computer? Because the Neuman-type computer has reached its limit. It is therefore imperative to develop a new type of computer, and this new computer technology is very important.

Demand for the Development of New Computer

The present-day computer technology is based on the theory advanced by Von Neuman in 1946. Its goals were set from its inception on high speed, large capacity, and digital computation, and its development has been guided by these principles throughout the period.

The hardware cost was very high at the time the Neuman-type computer was developed, so the computer design was based on a concept of making the machine structure simple while achieving the necessary functions through accumulation of programs.

As a result, the following problems cropped up as the utilization of the computer became more advanced and sophisticated and the fields of application broadened.

1. As the fields of application were expanded from the scientific field to include the business processing field, the demand for a computer input-output format compatible with the format of communciations by which human beings transfer information, such as voice, letter, and diagram, became stronger and stronger. However, conventional computers are designed to process only digital data, with a consequent restriction on its input-output format. This placed strict restrictions on the areas of application and the method of utilization. The computer utilization cannot be expanded freely.

2. Since the conventional computer is software-dependent, expansion of computer functions and expansion of the utilization field are tied directly to the heavily loaded operating system and the operating software. This has evolved into a situation known as a software crisis, in which the rise in personnel expenditure and the low productivity of the software compound the problem.

In order to alleviate this difficulty, it is not enough to treat the problems surrounding the software only. A reexamination of the basic concepts, including computer structure, basic ideas, and the language theory, is called for.

3. The Neuman-type computer employs the sequential processing format, in which the commands and data are first stored inside the main memory unit, and during the processing the content of the main memory unit is transferred one word at a time from it to the central processing unit through a narrow and straight route (called Neuman's narrow path or bottleneck) connecting these two units.

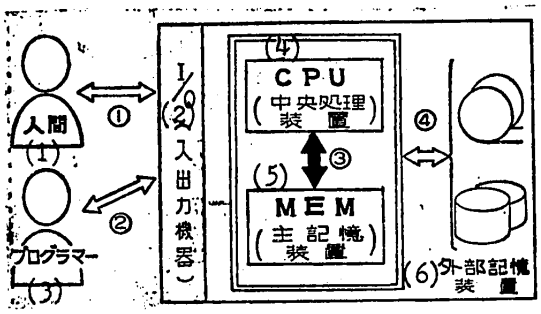
In addition, the data traffic consists mainly of the data name and not useful data. Therefore, a limit is imposed on the computational processing speed, and this type of computer cannot cope with the tremendous expansion in functions expected in the future.

4. During the data processing period, the data to be processed can also be transferred from the external memory units (secondary units), such as magnetic disks and magnetic tapes, to the main memory unit as they are needed. However, as the volume of data handled became so big as to require the use of a gigantic data base, the data transfer speed between the external memory units and the main memory unit became another bottleneck.

In order to solve this problem, development of a secondary memory unit, equipped with some judgmental functions so it will be able to transfer only the necessary data to the main memory, has become highly desirable.

At the same time, a new technical foundation is maturing, with which new architecture, improvement of computer intelligence, and new functions may be realized. This new technological foundation contains the seeds for the development of the new technologies conceived in the past several years--for example, super LSI technology, large capacity memory unit, and the mass application technology for super LSI's, including research into a separated instruction [funkyo 0433 2403] system and a parallel processing system, and development of the elemental technology for the realization of artificial intelligence and pattern recognition technology.

Taking into consideration the correspondence between these needs and seeds, it appears quite certain that new computers based on a brand new concept will appear within the next 10 years and accomplish another big stride in the 30-year history of computer technology.



The problem points of the present-day computer

Key:
(1) Man
(2) Input/output unit
(3) Programmer
(4) CPU (central processing unit)
(5) MEM (main memory unit)
(6) External memory units

[15 Dec 81 p 3]

[Text] Ultra Modern Technology for Broad Foundation of Industry

Necessity for Development of Fifth Generation Computer

The Importance of Computer Technology

There is no need to reiterate how much power can be developed from the utilization of the computer. Without the computer, one cannot imagine how that gigantic space shuttle could be launched into space and then returned to earth to land on a predetermined airfield (which is only a spot viewed from the global scale) without the slightest error.

Computers have not only entered factories and offices, but they have also permeated deep into our daily lives and become the "central nerve of our economic society," playing an increasingly important role in a society that is growing more sophisticated and complex. The number of general purpose computers in Japan has reached approximately 88,000 (end of March 1981), and Japan has become the world's second most informationalized nation, after the United States.

Such expansion in the field of computer utilization and continued development of the informationalized society are in large part due to the phenomenal progress of semiconductor technology centered around the IC (integrated circuit). With the appearance of super LSI today, we are entering a period in which the once large-scale computer is making an appearance as an office computer or personal computer.

Furthermore, the microcomputer, which was realized by integrating the computer functions in a single chip, has been incorporated into numerous machines, including machine tools, automobiles, robots, and household electric appliances, imparting in each new functions, higher performance, and better quality. Some new composite products have even been born.

Based on the viewpoint that computer-related technologies constitute the most important technologies which are the sources of an international competitive edge and thus may affect the nation's future, every nation in the world is investing a large sum of public funds to assist in the technological development and cultivate its computer industry.

In the United States, the computer enterprises are enjoying indirect assistance through enormous military demand centered around the Department of Defense and the tremendous technical development undertaken by NASA for the purpose of space development as well as military applications.

IBM was able to grow into the "giant" it is today, holding approximately 60 percent of the world's share less than 30 years after World War II, because of this enormous backup. The Department of Defense has recently launched a new 6-year project on VHSIC (very high speed IC) research with an investment of $200 million.

In Great Britain, France, and West Germany, too, the development of technologies related to the computer is said to receive huge public subsidies, estimated at over 10 billion yen a year.

Although Japan's computer industry has grown smoothly so far, the total share of all Japanese computer makers is no more than 7 percent, compared with the 80 percent share held by the American makers. The difference in the enterprise power is plainly evident.

Up to now, the goal of Japanese makers has been to catch up with the advanced technology of the Euroamerican nations, but Japanese makers have become somewhat comparable with these advanced makers in a portion of the technical field, such as super LSI.

However, Japan's improved technological power has been greeted by the Euroamerican advanced nations' reluctance to supply the ultra-modern technologies. This trend will probably worsen in the future.

Computer technology is a field in which progress is very rapid. If a nation fails to endeavor, it will soon be dethroned from the position of a technically advanced nation.

Therefore, Japan must strive to improve its own unique technological development potential, and it must keep on carrying out research and development with large sums of financial assistance in order to insure the future development of its computer industry, which constitutes the foundation of vast industries.

On this basis, it appears highly significant that R&D of the fifth generation computer, which involves ultra-modern and broad technical bases, should be undertaken aggressively as a national project.

	(1) IBM	(2) Japan's A company computer department	(1)/(2)
Total sales	$26.2 billion (5.933 trillion yen)	581.7 billion yen	10.2
Profit before tax	$5.9 billion (1.5458 trillion yen)	31.6 billion yen	48.9
Profit to sales ratio	22.5 percent	5.4 percent	--
R&D expenditure	$1.5 billion (339.7 billion yen)	53.8 billion yen	6.3
Capital	$4 billion (1.048 trillion yen)	44.6 billion yen	23.5
Own capital ratio	61.6 percent	30.6 percent	--

Note: 1. IBM: 1980; Japanese maker: 1980
2. Dollar conversion rate: 226.45 yen (average value, 1980 calendar year) (A large difference exists in the enterprise power of the U.S. maker and the Japanese maker.)

[16 Dec 81 p 3]

[Text] Logic Type "Nuclear Language" Desirable

Theme and Prospects Related to R&D of Fifth Generation Computer (I)

The fifth generation computer will be an intelligent, information processing-oriented computer system capable of meeting the needs of the highly advarced and diversified society of the 1990's.

To utilize the computer today, man must prepare a program by carefully analyzing the processing method and the operational sequence and then instruct the computer.

However, if the computer is to really become man's companion, then the intelligence level of the computer must be raised first of all. That is, the computer must acquire the function of automatically making judgments by using the data accumulated in its own knowledge data base.

Second, instead of man working for the convenience of the computer, the machine, the computer, must acquire the necessary functions so that man may be able to utilize it using the most natural information transfer format he knows, including daily conversation, writing, and diagrams (intelligent interface function and automatic program synthesis function). It is necessary to improve drastically the man-machine communication capability.

Furthermore, these functions must be capable of processing the problem at high speed within a practical time limit, using a format which can fully utilize the potential of the super LSI.

These functions must also be able to contribute positively to the realization of such systems as a machine translation system and a consultation system in various specialized fields, which could not be realized easily by the conventional computer technology.

To be able to realize the fifth generation computer, innovative technological development must be carried out covering a large area, including hardware, architecture technology (construction format) and software technology. The themes for research and development are as follows.

1. Problem-Solving Reasoning System

This system constitutes the nucleus of the processing function of the fifth generation computer. It determines the level of intelligence capacity and the flexibility (adaptability) of the computer.

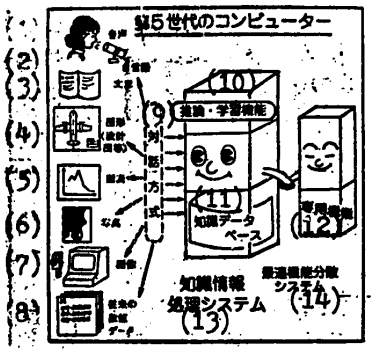
For a computer to be able to make up for incomplete instructions concerning a problem and to form a complete model of the problem (computer understanding of the problem), or to process the problem and find its solution (the goal) based on various abstract facts including axioms and laws stored in the system as knowledge (computer reasoning), research and development of the following items must be carried out first: 1) a "nuclear language" suitable for the reasoning process with which both the method of solution and the data can be described; 2) "basic software for problem-solving and reasoning" which carries out the reasoning operation using the equivalency format (substituting something with its equivalent); 3) "parallel processing type architecture using distributed control format" with which to carry out parallel processing at high speed.

For example, in order to compute the "average age" of a group using the modern computer, the areas in which to carry out various computations including the sum of ages and the number of persons must be defined and the method of computation indicated to the computer by a program.

However, as far as we are concerned, we do not care about the convenience of the computer as long as we get the average age. Therefore, the computer should be taught the general concepts such as "average" and "age" (including the method of computing and information concerning the sequence of operation). To be able to do this, a "nuclear language" of the logic type which facilitates logic description is considered most desirable.

To utilize these concepts, the computer must be in possession of a mechanism by which the computational method, consisting of dividing the "sum of ages" by the "number of persons," can be found automatically (the reasoning mechanism)--the mechanism being provided by software. A reasoning format using syllogism (e.g., if A = B and B = C, then A = C) comes to mind as a possible solution to this problem.

Furthermore, until the necessary solution can be obtained, the reasoning process must carry out a number of operations by the trial and error method. Therefore, in order to be able to obtain the solution within a reasonable practical time limit, a reasoning structure which is based on the parallel processing architecture of the distributed control type, capable of carrying out parallel processing simultaneously, is considered necessary, and the data flow format is considered the most powerful.



The fifth generation computer

Key:

(1)	Voice	(8)	Conventional digital data
(2)	Daily conversation	(9)	Conversation format
(3)	Writings	(10)	Reasoning-learning function
(4)	Drawings (blueprint, etc)	(11)	Knowledge data base
(5)	Charts	(12)	Special function
(6)	Photographs	(13)	Knowledge-information processing system
(7)	Picture images	(14)	Optimum function distribution system

[17 Dec 81 p 3]

"Resource Bag" as Nucleus of Processing Function

Theme and Prospect Related to R&D of Fifth Generation Computer (II)

2. Knowledge Base (Knowledge Data Base) System

This system, together with the problem-solving reasoning system, constitutes the nucleus of the processing function of the fifth generation computer. The knowledge base--in other words, resource bag--is a collective body consisting of organized information corresponding to the knowledge of a human being.

Up to now, the computer is programmed separately for each problem it is to solve, so the information used by the computer is confined to that which pertains to a specific problem.

However, if a computer is expected to find out the related data, to understand the problem to be solved, and to find out the method for solving the problem, its data base must store the information in such a way that it can be utilized as "knowledge" rather than as a mere collection of individual data. To be able to realize such a knowledge base system, it is first necessary to carry out R&D of the following items: 1) "knowledge expression language" suitable for expressing and acquiring new multidimensional knowledge; 2) "basic software for the management of knowledge base" capable of accumulating and searching for knowledge; 3) "knowledge base structure" based on a multidimensional memory (structural memory) instead of a one-dimensional memory.

The content of the knowledge base may vary according to the field of application. For example, in a machine translation system, the knowledge base may contain data concerning vocabulary and grammar. The knowledge base used in a special field such as medicine may be said to contain a specialist of the field in it.

The "knowledge base structure" must be such as to facilitate execution of collective computation based on the relative logic with high speed and high efficiency. A relative algebraic machine with parallel architecture is considered highly desirable.

3. Intelligent Interface System

This system is to give a flexible conversational function to the fifth generation computer so as to eliminate the gap between the language used by man and the language used by the machine.

To be able to realize such a function, it is first necessary to carry out R&D of the following items: 1) "basic software for the management of intelligent interface" capable of natural language processing and voice processing by means of phoneme recognition and diagram and picture image processing; 2) "intelligent interface structure" consisting of a special elemental processor capable of processing voices and signals; 3) "high performance man-machine interface unit" capable of advanced processing of voice, diagram, and picture image, as the machine becomes more advanced.

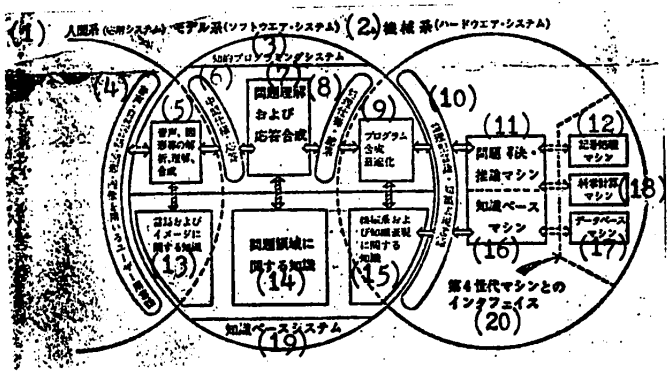
4. Intelligent Programming System

It is necessary to carry out R&D of an intelligent programming system which will be capable of synthesizing a program which meets the needs of the user by withdrawing those programs having the necessary functions from the algorithm bank (knowledge base) using its own reasoning power and assembling them, and then verifying that the optimized program thus synthesized satisfies the needs.

5. Basic Application System

It is also necessary to carry out R&D of the basic application systems representing human functions, including listening, speaking, looking, drawing, thinking, and solving, which constitute the foundation for various other types of application systems.

The secondary themes may include a multilingual "machine translation system" which is also capable of significant information processing and a "consultation system" which is capable of giving appropriate instructions in response to various requests made by the user by utilizing its vast knowledge base system containing special knowledge of a particular field.



Conceptual diagram of the fifth generation computer from the viewpoint of programming

Key:
(1) Human system (application system), model system (software system)
(2) Human system (hardware system)
(3) Intelligent programming system
(4) User language using voice, natural language, diagram, and picture image
(5) Analysis, understanding, and synthesis of voice, diagram etc
(6) Intermediate specifications and responses
(7) Problem solving and response synthesis
(8) Processing specifications and results
(9) Optimizing program synthesis
(10) Logic language, knowledge expression language
(11) Problem-solving reasoning machine
(12) Symbol-processing machine
(13) Knowledge related to language and image
(14) Knowledge related to the problem
(15) Knowledge related to machine system and knowledge expression
(16) Knowledge base machine
(17) Data base machine
(18) Scientific computation machine
(19) Knowledge base system
(20) Interface with the fourth generation machine

[18 Dec 81 p 3]

[Text] Flexible R&D System Necessary; International Cooperation Too

Development Plan for the Fifth Generation Computer

According to the past history of computer development, by the time a new generation of machine is made public, the R&D of technologies which will become the basis of the next-generation machine have already begun. R&D of the fifth generation computer based on innovative theory and technology is expected to require about a period of 10 years, and the R&D activities may be roughly divided into three phases.

The first phase consists of the first 3 years (1982-84). This is the period in which "development of basic technologies" including the hardware, architecture, and the software of the fifth generation computer will be carried out. The major projects for this phase are as follows.

1. Design and trial manufacture of the component elements of the reasoning mechanism and the knowledge base mechanism, which constitute the nucleus of the fifth generation computer. The component elements include various modules according to various functional mechanisms, including a basic mechanism module and a data flow mechanism module for reasoning and knowledge base.

2. Design and manufacture of an experimental action simulator to be used for the purpose of evaluating the construction and combination format of various component elements of the module system used for simulating various modules according to various functional mechanisms.

3. Design and trial manufacture of basic software system comprising the nucleus of the knowledge information processing system. This system may be called the operating system of the fifth generation computer. It contains software modules for various functions, including problem solving, reasoning, knowledge base management, intelligent interface, and intelligent programming.

4. Design and trial manufacture of a software develcpment pilot model (small-scale pilot model of serial control reasoning computer) which is to be used to carry out development of software for the fifth generation computer efficiently. This pilot model is to be derived from existing Neuman-type architecture by remodeling and improving a portion of it, and a language suitable for reasoning processing will be selected and improved.

5. One of the goals of developing the fifth generation computer is to design its structure in such a way that the potential of super LSI can be fully utilized. Therefore, a technology with which super LSI design may be carried out efficiently must be developed first. In addition, a complete set of tools used in support of the R&D activities, including machines and the networks interconnecting them, must also be provided.

The second phase consists of the next 4 years (1985-1988). This is the period in which, based on the results obtained during the first phase, development of a "small-scale subsystem" is to be carried out. The two mechanisms comprising the nucleus of the fifth generation computer will have been finished by this stage.

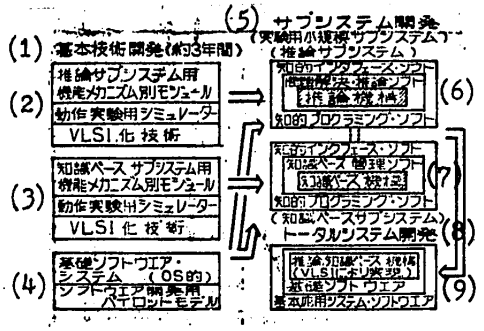
The third phase consists of the last 3 years (1989-1991). This is the period in which development of a "total system" is to be carried out by combining all R&D results obtained thus far, including the reasoning mechanism, the knowledge base mechanism, and the software. By this stage, a basic application system will have been trial manufactured based on the prototype of the fifth generation computer and its performance and functions will have been explored and proved.

For this R&D project, a budget of approximately 509 million yen was requested for the development of basic technologies to be carried out in 1982.

The Drive System for Development of the Fifth Generation Computer

To carry out R&D of the fifth generation computer successfully, the most advanced technologies which are to become the nucleus of the future information-related technologies will be required, and at each phase of the development, the results must be evaluated thoroughly and carefully. Therefore, a flexible R&D system suitable for a new generation, in which all concerned, including universities, governmental research institutes, makers and users, may participate positively in the area of the specialty of each, is highly desirable.

Moreover, the international symposium on the fifth generation computer held in October this year was attended by approximately 100 specialists representing 14 countries, including the United States, Great Britain, France, and West Germany. Although this project did catch sufficient world attention, some form of international cooperation seems desirable in view of the fact that the magnitude of this project is so enormous, the technologies involved so basic in nature, and the extent of the contribution that Japan may make.



R&D activities for the fifth generation computer

Key:
(1) Development of basic technologies (approximately 3 years)
(2) Modules according to functional mechanisms used in reasoning subsystem; simulator to be used for action experiment; technologies to realize VLSI
(3) Modules according to functional mechanisms used in knowledge base subsystem; simulator to be used for action experiment; technologies to realize VLSI
(4) Basic software system (OS-type); pilot model for software development
(5) Subsystem development (small-scale experimental subsystem)(reasoning subsystem)
(6) Intelligent interface software; problem-solving reasoning software, reasoning mechanism; intelligent programming software
(7) Intelligent interface software; knowledge base management software; knowledge base mechanism; intelligent programming software; (knowledge base subsystem)
(8) Total system development
(9) Reasoning knowledge base mechanism (realized by VLSI); basic software; basic application system software

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CSO: 8329/0746

COUNTRY MOVES TOWARD NUCLEAR ENERGY GENERATION

Tokyo BUSINESS JAPAN in English Feb 82 pp 33-35

[Article by Shigeru Matsui: "Japan Moving Rapidly Toward Expanded Nuclear Energy Generation"]

[Text] JAPAN's power consumption increased at an average annual increase of 8.9% from fiscal 1971 to 1973. At the end of 1973, the first oil crisis took place as the Arab oil producing countries resorted to a strategy of suddenly increasing oil prices by several times as a result of the fourth Middle East war. Consequently, Japan's power consumption decreased by 8.6% from the previous year in fiscal 1974. From fiscal 1976 to fiscal 1979, the nation's power consumption grew at an average annual rate of 5.8%. Due to cool weather during summer months, power consumption declined to 98.9% of the previous year's level in fiscal 1980. According to a forecast by the Japan Electric Power Research Committee, however, the nation's power consumption from now to fiscal 1990 is expected to grow by 6.3% on an annual average.

Of the nation's total power output in fiscal 1978, oil thermal power generation assumed 51.7%, hydraulic generation 22.3%, LNG thermal generation 10.9%, LPG thermal generation 0.5%, coal thermal generation 3.7% and geothermal generation 0.1%. Though the rate of oil thermal generation assumes a high position, the price of oil has gone up sharply. The price of crude oil was only $13 per barrel at the end of 1978, but it grew to nearly $40, about three times, in only two and half years. It has now slightly declined and the extraordinary general assembly of the Organization of Petroleum Exporting Countries (OPEC) held in October 1981 adopted the unified price of $34 per barrel. Of the total cost of oil thermal generation, fuel costs assume 75.6%, an extremely high rate as compared with 34.1% for coal thermal generation and 26.2% for nuclear power generation. This has been markedly affecting power generation costs in general.

As far as power generation costs are concerned, oil power generation costs ¥18.8 per kW/hour, while coal generation costs ¥12.3, nuclear generation only ¥10.3 and LNG generation ¥16.1.

Though the initial cost is relatively high for hydraulic generation, it costs less from a long-term standpoint as there is no fuel cost. This is an appropriate type of power generation for Japan which depends on foreign countries for fuel sources, but hydraulic resources in Japan have already been almost fully exploited. In this sense, emphasis is being placed on pumping-up power generation that recycles used water. It is planned that the power industry's output through this method – it amounted to 9,100,000 kW in fiscal 1978 – will be increased to 27 million kW in fiscal 1990. Along with this, there are plans to increase the industry's hydraulic power output, which totaled 17,150,000 kW in fiscal 1978, to a level of 23 million to 24.5 million kW in fiscal 1990, some 1.34 to 1.43 times.

Main emphasis will thus be placed on nuclear, coal and LNG thermal generation. The largest emphasis will be placed on the most inexpensive nuclear power generation, which costs only 54.8% of the amount for oil thermal generation for basic fuels. The power industry's targets for power generation according to the types of power sources is shown in Table 1, based on a report by the Demand-Supply Committee of the Power Industry Deliberation Council.

The table indicates that nuclear power generation, which generated 12.7 million kW in fiscal 1978 or 10.8% of the industry's total output, is expected to produce some 28 million to 30 million kW in fiscal 1985, 15.6% to 16.8%, and some 51 million to 53 million kW or 22.1 to 22.9% in fiscal 1990. In fact, however, the ratio is expected to be somewhat less than these estimates.

There are 22 nuclear plants in operation with a total output capacity of 15,510,000 kW and 10 plants with a total capacity of 9,220,000 kW under construction scheduled to be completed for operation by the end of fiscal 1985. And even if another one, approved by the Deliberation Council for the Development and Adjustment of Electric Power Sources and to be put into operation with a total output capacity of 1,100,000 kW by the end of fiscal 1985 is included, the total output capacity will reach only 25,830,000 kW, 92.3% of the target capacity. In addition, it is hardly believable that the nation will complete another 20 or so plants with a combined output capacity of some 28 million kW within five years after fiscal 1985. Nevertheless, the above council intends to give approval to the power companies for new locations for nuclear plants at the earliest possible opportunities. In this sense, it is almost certain that the number of nuclear plants will increase from now on and it will be in the not too distant future that their scale will expand from the current scale of 1,100,000 kW each to 1,300,000 kW.

As far as commercial power generating reactors currently in operation are concerned, all, except for one in operation at Tokaimura, Ibaraki Prefecture, by Japan Nuclear Generation Co., are light-water type reactors. The one at Tokaimura is of cooled gas type. While Tokyo Electric Power, Chubu Electric Power, Chugoku Electric Power, Tohoku Electric Power and Japan Nuclear Generation Co. have utilized, through Toshiba and Hitachi, Japan's representative Electric Machinery companies, boiled water reactors made by General Electric Co., Kansai Electric Power Co., Kyushu Electric Power Co. and Shikoku Electric Power Co. have bought through Mitsubishi Heavy Industries Co. pressed water reactors from Westinghouse Corp. Plants currently in operation include 11 boiled water reactors with a combined capacity of 7,993,000 kW and nine pressed water reactors with a total capacity of 6,793,000 kW.

Throughout the world, however, there are about twice as many pressed water reactors in operation as boiled water ones, and their number is expected to further increase.

To briefly explain about these reactors, while in a boiled water reactor (BWR), steam, that rotates the turbine, is directly heated in the pressure vessel of the reactor, in a pressed water reactor (PWR), water that has been heated in the pressure vessel of the reactor is transfered to different water. Steam that has thus been generated rotates the turbine. The structure of a PWR, therefore, is more complicated than that of a BWR, but the steam that rotates the turbine is less polluted than in the BWR.

Tokyo Electric Power Co., the nation's largest power company, was using solely BWRs. Now it has started preparations for incorporating PWRs. At present, Tokyo Electric Power is the world's largest user of BWRs. The company has requested Toshiba and Hitachi, which have provided the former with BWRs, as well as Fuji Electric to study technology concerning PWRs produced by West Germany's Kraft Werke Union (KWU) which it is planning to induce. This technical tieup with KWU has been concluded with the approval of General Electric Co. with which Tokyo Electric has been long enjoying cooperation in technology concerning BWRs.

The PWR produced by KWU has been completed with KWU's technology which was developed on the

Table 1. Ratios of Power Generation by Power Source at the End of Each Fiscal Year

(Unit. 10,000 kW)

Fiscal 1978	Fiscal 1978		Fiscal 1985		Fiscal 1990		Fiscal 1995	
		Ratio (%)		Ratio (%)		Ratio (%)		Ratio (%)
Nuclear	1,270	10.8	2,800~3,000	15.6~16.8	5,100~5,300	22.1~22.9	7,400~7,800	26.7~28.2
Coal	440	3.7	1,000	5.6	2,200~2,300	9.5~10.0	3,300~3,600	11.9~13.0
LNG	1,275	10.9	3,200	17.9	4,050~4,350	17.5~18.8	4,600	16.6
Hydraulic	2,625	22.3	3,950~4,030	22.1~22.5	5,000~5,150	21.6~22.3	5,950~6,200	21.5~22.4
Ordinary	1,715	14.6	2,000~2,080	11.2~11.6	2,300~2,450	10.0~10.6	2,600~2,850	9.4~10.3
Pumping-up	910	7.7	1,950	10.9	2,700	11.7	3,350	12.1
Geothermal	10	0.1	50~80	0.3~0.4	200~300	0.9~1.3	400~600	1.4~2.2
LPG	60	0.5	450	2.5	600	2.6	600	2.2
Oil	6,085	51.7	6,450~6,140	36.0~34.3	5,950~5,100	25.8~22.1	5,450~4,300	19.7~15.5
Total	11,765	100	17,900	100	23,100	100	27,700	100

Source: Interim report by the Demand and Supply Subcommittee of the Electric Enterprise Deliberation Council.

basis of fundamental technology introduced from Westinghouse Electric Corp. of the U.S.

Tokyo Electric does not intend to induce the PWRs as they are from KWU. First of all, the company plans to dispatch engineers to KWU for feasibility study. And if the study proves the feasibility of such induction, the company will then start preparations for it.

The engineers to be dispatched will be selected from among those working for the three Japanese makers. Technology concerning the core of the reactor will be dealt with by those from Toshiba and Hitachi, both of which have long-time experiences with light-water reactors, while those from Fuji Electric will study the peripheral portions of the reactor. Fuji Electric once provided Japan Nuclear Generation Co., Japan's first company to engage in nuclear generation on a commercial basis, with the Tokai No.1 reactor, a gas-cooled reactor. But since light-water reactors (LWRs) became the mainstay of Japan's nuclear generation, Fuji Electric Co. has shown no results at all in providing reactors. The reason why the company has been selected one of the three companies this time is that the company has been technical cooperating with KWU.

Such moves on the Japanese side have been gratefully accepted by KWU. The company was established in 1973 as the result of the amalgamation of the nuclear departments of both Siemens & Halske, A.G. and Telefunken. KWU is Siemens' 100% subsidiary and the only maker of nuclear reactors in West Germany. The company once succeeded in the standardization of LWRs with an output capacity of 1,250,000 kW. KWU, however, has been confronted with managerial difficulties in recent years. There have been no new orders from the domestic market. The company also lost the Iranian market after the revolution. Even though KWU received an order from Brazil, no construction work has yet been successfully promoted. KWU had thus almost decided to cut back its personnel. KWU is now expected to show strong recovery because of Japan's interest and the new contract with Tokyo Electric Power Co.

Not only Tokyo Electric Power but also other Japanese power companies and electric machine makers have been studying West Germany's nuclear technologies. Nuclear generation in West Germany, like that in Japan, was established on the basis of technology induced from the U.S. West Germany's nuclear generation has been based on the fundamental technologies of GE's BWRs and Westinghouse's PWRs. With the intention of developing West Germany's own technology concerning LWRs, the government in 1964

requested that Siemens and two other companies study such technologies. Total costs for research and personnel for this purpose were extended by the government and a huge amount equivalent to some ¥500 billion was spent in the five years between 1964 and 1968. As a result, West Germany succeeded in the development of its own system of nuclear power generation. It became possible for West Germany to cancel its contracts for technology induction from the U.S. The nuclear generation departments of both Siemens and AEG Telefunken were thus amalgamated and KWU was established in 1973.

While West Germany was concentrating its efforts on developing technology concerning LWRs, the Japanese government spent only ¥6 billion for technology concerning LWRs out of its aggregated budget of ¥360 billion for nuclear generation from 1954 to 1973. From fiscal 1974 on, the government started to spend more for LWRs, ¥12 billion for the first fiscal year. This difference in expenditure has failed to make Japan reach the level where it can design its own systems as West Germany has done. Japan still needs to study some West German technologies.

In 1975, the Ministry of International Trade and Industry (MITI) established a study committee for improving and standardizing equipment for nuclear power generation as well as a committee for improving and standardizing nuclear generating facilities. Projects to improve and standardize LWRs were thus initiated. The projects are, in fact, following the pattern of similar projects in West Germany. The Japanese projects are divided into three stages of development. On the basis of both the first stage study from 1975 to 1977 and the second stage study from 1978 to 1980, model plants are expected to be completed in the third stage study from 1981 to 1985. By means of the model plants, improvement in capability for systems designing and in operational reliability will be attempted. Four model plants will be built including a BWR and a PWR with an output capacity of 800,000 kW each and a BWR and a PWR with an output capacity of 1 million kW each.

It was with the intention to learn from West Germany in mind that the first joint conference of specialists on nuclear generation and energy was held in West Germany in February 1980 with some 20 nuclear generation specialists from Japan attending.

Japan is thus intending to complete its own technologies concerning LWRs by inducing technologies from West Germany.

In addition to its intention to induce technologies for KWU-type PWRs from West Germany, Tokyo Electric Power Co. is also promoting improvements for conventional BWRs. It has exchanged a memorandum with GE, Toshiba and Hitachi concerning a project to develop new BWRs over the next five-years. Such power companies as Chubu, Tohoku and Japan Nuclear Power Generation are participating in this project, which is promoting development of an improved-type A Model BWR. Results are expected to be utilized in future nuclear generation for plants with an output capacity of 1.3 million kW.

The monopoly held by Mitsubishi Heavy Industries in the PWR market is thus expected to be broken down by the new entries, Toshiba and Hitachi. Meanwhile, Mitsubishi Heavy Industries is promoting the development of a new PWR in cooperation with Westinghouse Electric Corp. Mitsubishi Heavy Industries has recently decided to extend cooperation in both technical and business aspects to Korea Heavy Industries Co., South Korea's only nuclear plant manufacturer.

The aforementioned project to induce technology from West Germany for improving and standardizing LWRs is intended not only to fulfill requirements for the present LWRs but also to solidify the foundation for inducing in the future technologies for fast breeding reactors (FBRs). Therefore, it is necessary to train engineers, who have experience in handling various technical problems concerning nuclear reactors, for these future projects. It is with this intention that Tokyo Electric Power has requested both Toshiba and Hitachi not only to improve the conventional BWRs but also to undertake the study of KWU-Model PWRs so as to raise the technical level of their engineers.

When Japan completes its acquisition of technologies concerning LWRs, its nuclear power generation

industry is expected to either take a route toward directly inducing FBRs or inducing FBRs only after having attempted power generation with advanced thermal converter reactors (ATRs) developed by the Power Reactor and Nuclear Fuel Development Corporation.

As far as ATRs are concerned, experimental reactors have already been in operation in the past two and a half years. Construction of commercial plants has been considered, but as construction and power generating costs are so high, power industry circles are not very enthusiastic about the construction of such plants. Nevertheless, as an ATR can use reprocessed fuel that have been used once by LWRs, some people insist that ATRs be induced until FBRs can be realized.

As for FBRs, the Power Reactor and Nuclear Fuel Development Corp. started preparatory designing in 1968. The cost for constructing a FBR is about ¥400 billion, with the budget being allocated from fiscal 1981. Of the total construction cost, 20% or ¥80 billion will be borne by the related private enterprises, including ¥60 billion for power companies and ¥20 billion for machinery manufacturers.

The power industry decided to extend cooperation for the construction project with the Japan Nuclear Generation Co. as the project representative. A section to be engaged in the development of the FBR was set up at the company in February 1981 and with the concerted efforts of engineers specialized in FBRs from every company concerned, technical cooperation is being extended for the completion of the reactor. The target is to develop a proving reactor with a capacity of 1 million kW once the experimental reactor has been proven successful in the experiment currently under way. Conceptional designing of the proving reactor was started in March 1981. The 3-year program is being under taken by a section set up to develop FBRs in the Electric Enterprise Federation.

On the side of machinery makers, the Fast Breeder Engineering Co. was established in April 1981 through the joint efforts of the four nuclear plant makers – Toshiba, Hitachi, Mitsubishi Heavy Industries and Fuji Electric Co. The company will design FBRs.

Nuclear generation authorities in both the U.S. and Britain have recently inquired of their counterparts in Japan on an informal basis concerning the feasibility of conducting joint development of FBRs. It will be interesting to see how these moves progress.

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CSO: 4120/160

SCIENCE AND TECHNOLOGY

COUNTRY REPORTED 'A STEP CLOSER' TO NUCLEAR FUSION

OW181405 Tokyo THE DAILY YOMIURI in English 17 Feb 82 p 2

[Text] Japanese scientists have come a step closer to nuclear fusion power stations with the recent completion of a new plasma heating system which they claim to be 10 times more powerful than any other. [passage published in boldface]

Researchers at the Japan Atomic Energy Research Institute said that new device would help them heat plasma, the ionized gas that fuels the fusion reactor, to a level high enough for a self-sustaining fusion reaction within fiscal 1985.

With the device just completed last year-end, they have successfully sent powerful heating beams for a record 10 seconds as against 0.3 second in the US.

The feat came while scientists are still racing for the development of a system capable of bombarding plasma with neutral heating particles for one second or so.

"Ten seconds are required for the next-generation test nuclear fusion reactor rather than for the research reactor we are developing at present," said one institute researcher.

The plasma is required to [be] heated to 100 million degress C to harness surplus energy, and many scientists are trying to attain the critical heat through particle bombardment.

One common trouble was in the short-lived heating beams as the result of the overheating of the emitter, mostly in a fraction of a second.

The Japanese scientists have succeeded in keeping the high-energy beams for 10 seconds primarily through developing a unique cooling system for the emitter.

They plan to use the new heater for their experiments on the TOKAMAK (Troidal Camera Magnet) fusion simulator, hoping to attain the critical fusion level within fiscal 1985.

In the TOKAMAK test device, plasma is heated to nearly 20 million degrees with electricity while the beams of neutralized hydrogen nuclei, traveling at a speed of 3,800 kilometers per second, provide heating energy the rest of the way toward 100 million degrees.

According to the institute, however, the latest break-through would not spell the imminent arrival of the nuclear fusion age. "We are still at a half-way mark," said one of the institute's researchers.

He said the practical use of fusion energy would be preceded by developing high-power superconductive magnets to contain the critical plasma and new materials to shield the strong neutrons generated during fusion reaction.

CSO: 4120/162

NEW PUMPS FOR NUCLEAR ENERGY, SPACE EXPLORATION

Tokyo BUSINESS JAPAN in English Feb 82 pp 91-92

[Article: "New Pumps to Open Way to Nuclear Energy and Space Exploration"]

[Text] HIGH level technology is required in the manufacture of pumps for feeding water to the boiler in thermal electric power plants. Technical know-how of large-size pumps was inducted from abroad repeatedly after the construction of the Chikujo Thermal Power Plant by Kyushu Electric Power Co. in 1952.

The discharge capacity of feed pumps has markedly increased along with the increasing output capacity of power station. The latest model has as high a pressure as 300 kg per 5 cm^2. Previously the driving force was electric motors but now turbines of rapid revolution are used. Domestic technology has now reached an international level and many large capacity pumps are used for pumping up water for power plants. Their reliability has phenomenally improved. Japanese-made pumps have been installed in both waterworks and for sewerage in huge cities, and in long undersea tunnels.

The types of pumps can be divided basically into centrifugal pumps, axial flow pumps, diagonal flow pumps, rotary pumps and reciprocating pumps. They can also be classified into corrosion-resisting pumps, submarine pumps, etc.

Centrifugal pumps are used to feed liquid with centrifugal force by rotating the impeller within the casting. Such pumps assume more than 1/3 of the total output of pumps and are extensively used for water supply and drainage at power stations and factories, and for agricultural irrigation. Growth rates of single-stage models and multi-stage models in the past five years were 132.4% and 139.7% respectively.

Axial flow pumps are used to feed liquid in the direction of the axis like a motor fan and are suitable for large-capacity, low-head water feeding. Diagonal flow pumps make use of both the thrust of the rotating blade and centrifugal force and have the characteristics of both centrifugal pumps and axial flow pumps. Such pumps have high cavitation characteristics and are highly adaptable to varied flows so that they are widely used for drainage systems. The output of diagonal flow pumps increased even in the period of recession following the oil crisis. The output in 1979 attained a peak of ¥33,300 million. The growth rate corresponded to 260.1% compared with 1974.

Rotary pumps are subdivided into Lutz pumps and screw pumps. They are resistant to high pressure and are used in fields where durability is required as compared with reciprocating pumps.

Corrosion-resistant pumps are made by lining the interior of the above-mentioned pumps with tantalum, titanium, fluoride resin or polyvinyl chloride. Their production is stagnating after attaining a peak in 1974, chiefly owing to the slowdown of equipment investments in the chemical

Table 1. Pumps Production

(Unit: ¥1 million)

Type \ Year	1974	'75	'76	'77	'78	'79	'79/'78 (%)	'79/'74 (%)
Centrifugal pumps (single-stage)	43,427	40,359	40,328	47,023	49,424	57,518	116.4	132.4
Centrifugal pumps (multi-stage)	18,775	19,708	19,492	22,076	23,270	26,234	112.7	139.7
Axial flow pumps	4,624	4,433	3,940	2,720	4,902	3,997	81.5	86.4
Diagonal flow pumps	12,838	13,431	19,763	16,465	24,894	33,389	134.1	260.1
Rotary pumps	5,325	4,231	4,187	5,494	5,382	5,934	110.3	111.4
Reciprocating pumps	5,844	5,942	4,900	4,697	4,532	5,478	120.9	93.7
Corrosion-resisting pumps	18,183	15,186	10,579	9,972	9,123	10,701	117.3	58.9
Submarine pumps	21,594	18,726	23,763	26,603	29,995	39,669	132.3	183.7
Other pumps	10,747	10,313	6,837	7,827	7,957	7,913	99.4	73.6
Subtotal	141,357	132,329	133,789	142,877	159,479	190,833	119.7	135.0
Compared to previous year (%)	(128.4)	(93.6)	(101.1)	(106.8)	(111.6)	(119.7)	–	–
Vacuum pumps	7,431	6,223	6,158	6,941	7,452	9,236	123.9	124.3

industry. Production in 1979 corresponded to 58.9% of 1974.

In many cases, a centrifugal pump is submerged with a motor to be used as a submarine pump. Such pumps are suitable for use in civil engineering works, sewerage, deep wells, etc. As they are comparatively easy to maintain, their use has shown marked progress in recent years. The output in 1979 was the highest past record corresponding to 183% of the figure in 1974.

Like other industries, the pump industry received a paralyzing blow during the recession period after the first oil crisis. But it has been gradually recovering since 1977 thanks to the resumption of public works including the construction of new sewerage systems.

Vacuum pumps have shown rapid progress in postwar years and include two types, mechanical and diffusion. The mechanical type includes several types such as the Nash and Lutz models, and is used for machines with comparatively low vacuum. Along with the development of vacuum engineering in recent years, requirements for super high vacuum pumps have become more strict, and large-scale oil diffusion pumps and others are manufactured for use in nuclear power generation and space development.

Pumps of large size and capacity are produced by the ten leading manufacturers, and as for small-size general-purpose pumps, large manufacturers have established mass production setups through standardization. In the case of medium-size pumps, as they vary by use in capacity, pressure, temperature and liquid to be handled, medium and smaller specialized manufacturers are mostly engaged in their production.

As far as feed pumps for boilers in thermal power plants are concerned, the discharge pressure was at a level of 60 kg per 5 cm^2 in prewar years. Tokyo Electric Power's power station built in 1954 used pumps with a pressure of 120 kg. Pumps for use in power stations with an output capacity of 1,000 MW in recent years have a pressure of 310 kg per 5 cm^2 and a water feeding capacity of 1,740 tons per hour. At pumping-up power stations, machines with high capacities and head for both pumps and water wheels are in general use. The size of stations has become much larger than before, and today the largest pump has an output capacity of 350,000 kW.

Pumps for waterworks and sewerage systems are capable of feeding water over a very long distance. They are equipped with highly advanced control systems including the Kraemer system and the Serbius system so as to cope with the diurnal and seasonal variations of demand.

Countries in Europe and America are conducting intensive vacuum pump research and development for the nuclear industry and space exploration,

spending a huge amount of time and money. Japan is also consolidating its research setup in order to overcome the backwardness of its vacuum industry.

Production of pumps has made tremendous progress since the war through the induction of foreign technologies and the industry's effort to establish domestic production, supported by the high-paced growth of the nation's economy. Demand for pumps is still markedly growing for the construction of industrial plants in developing countries and public works being conducted in Japan.

Demand for pumps throughout the world is never likely to decrease. Japan's pump industry is urged to strengthen its foothold and establish a system to develop its own technology, which can improve its international competitive power. ◘

CSO: 4120/160

SCIENCE AND TECHNOLOGY

KOMATSU BEGINS SHIPPING PIPELAYERS TO USSR

OW050207 Tokyo NIHON KEIZAI SHIMBUN in Japanese 2 Feb 82 Morning Edition p 7

[Text] In defiance of the U.S. Government's request for a halt to its export of pipelayers to the Soviet Union as part of anti-Soviet economic sanctions, Komatsu Ltd has begun shipping pipelayers under an order received last autumn in connection with a West Siberian project. This was made known on 1 February.

Since the Export and Import Bank of Japan endorsed the deal with loans and since the Japanese Government takes the position that "it is difficult to have companies stop exporting goods under a contract which has already been concluded," the deal is likely to be blessed with a "tacit approval."

The deal calls for the export of approximately 36 billion yen (about $160 million) worth of pipelayers, bulldozers, etc, for use in a natural gas pipeline project eyed by the Soviet Government for West Siberia.

Last summer, when talks on the deal started, the project fell victim to the U.S. Government's opposition for its linkage to the Yamburg project. However, since the Soviet Union later changed the Yamburg project, Komatsu formally concluded the contract with the Soviet Machinery Import Corporation (MASHINOIMPORT) last October.

Subsequently, Reagan's U.S. Administration announced eocnomic sanctions against the Soviet Union in connection with the Polish situation, resulting in the suspension by caterpillar tractor and General Electric Companies of the United States of their export deals related to the West Siberian natural gas pipeline project.

Washington called on Komatsu to stop exporting pipelayers to the Soviet Union in line with these measures, and Komatsu for its part has been watching the development of talks between the Japanese and U.S. Governments. However, the Japanese Government takes the position that "the export deal has already been contracted for and the contract, endorsed by the Export-Import Bank's loans, has been already formally approved by the government." Minister of International Trade and Industry Abe has conveyed this position to the U.S. Government. It is believed that Komatsu came to the conclusion that, in view of the government's position, it may start shipping those which have already been contracted for. It started shipping since late last year and is scheduled to carry out the shipments in several installments over a period of several months.

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SCIENCE AND TECHNOLOGY

OPTICAL FIBER COMMUNICATIONS ARE ON TAKEOFF

Tokyo DIAMOND'S INDUSTRIA in English Vol 12, No 2, Feb 82 pp 8, 10-16

[Text]

Active in World Markets

In October, 1981, it was reported that Fujitsu Ltd., a leading Japanese communications equipment and computer producer, had made the lowest bid at an international bidding for the construction of the New York~Boston and Washington~Moseley corridors of an optical fiber communications network, which is being built by American Telephone & Telegraph Co. (AT&T). So far, Western Electric Co., AT&T's subsidiary, has supplied almost all the major equipment and systems AT&T bought. If a Japanese maker had joined the huge AT&T project, it would have been extremely significant for the future business of the Japanese communications equipment industry. However, Fujitsu was, in fact, ruled out for security reasons on the part of the U.S.

In making the bid, Fujitsu developed a new system to keep the cost of the project to a minimum. For optical fiber communications, mainly laser beams of the 0.85-μm (micron) range has been used. However, those of the 1.3-μm range are considered more suitable for long-distance, large-capacity communications. Fierce competition has been going on in the world to develop systems employing that range of laser beam, and Fujitsu is in the forefront in the development. In the AT&T project, Fujitsu proposed the use of a wide-band communications system of 135 Mb/s (mega bits per second) that would employ the 1.3-μm range. Because of the specific system, Fujitsu's system can drastically decrease the number of optical fibers and relay facilities compared with the system proposed by Western Electric.

It seems that Fujitsu had an apparent aim to avoid possible trade friction by buying American-made optical fiber cables which would account for about half the total cost of the project. Fujitsu planned to buy more American products, such as an electric generator to operate the system. However, Fujitsu could not join the project.

Fujitsu's tender for the AT&T project provided a chance for the Japanese industry to demonstrate to the world that its technology in optical fiber communications was above the international standard and that it had strong international competitiveness. The failure to win the bid drew the worldwide attention as Japanese and American government sources commented many times on the delicate matter.

Only a few years have passed since optical fiber communications technology was put to practical use. During the short period both government institutions and private firms in Japan have produced notable results in the development of optical fiber communications, while raising their technological standards in the field.

In February, 1977, Fujitsu and Furukawa Electric, a leading cable manufacturer, exported a 4.2-kilometer optical fiber communications system to the Telecommunication Authority of Singapore. That was the first such system to be put to practical use for public telecommunication in the world. In 1978, Nippon Electric Co. (NEC), Japan's largest maker of communications equipment, delivered an optical fiber communications system to link two telephone exchange stations 9 km apart to Vista Florida Telephone in the resort area of the Walt Disney World, Florida. This was followed by the conclusion of contracts for the export of similar systems to the U.S., Canada, Mexico, Argentina, Brazil, Hong Kong and Singapore.

Among big export contracts was a ¥25,000 million order for a tandem telephone exchange system using optical fiber cables that Nippon Electric Co. (NEC) and Sumitomo Electric Industries, another leading cable maker, jointly

received from ENTEL, the Argentine public communications corporation. NEC was also designated as a long-term vendor that would supply telephone exchangers to ENTEL over the next 15 years.

In addition to those mentioned above, a number of optical fiber communications systems were exported in 1981. In January, Fujitsu and Furukawa Electric jointly received an order for a new optical fiber communications trunk line network from the Hong Kong Telephone Co. An order for the railway system modernization project received by Mitsui & Co. in August included a 150-km optical fiber communications system. In October, NEC and Sumitomo Electric Industries received an order for a 250-km communications system employing the coaxial and optical fiber combined cables from the Mexican Transportation Ministry. Sumitomo Electric Industries also received a 130-km optical fiber communications system to be used by Manitoba Telephone Co. of Canada.

Optical fiber communications are spreading rapidly in the U.S. In 1981 NEC won a contract for an optical fiber communications system from New York Telephone under the wing of AT&T, while exporting similar systems to other U.S. firms. Recently, however, the U.S. raised import duties for optical fiber cables to 17.9% (8% in Japan). This could develop into a trade issue between the two countries, since there is another case – the AT&T decision to reject Fujitsu. Optical fiber cables have also been exported to European countries, but their quantities are still small.

On the other hand, developing countries whose telephone system lags behind that in advanced nations show strong interest in employing optical fibers in their new telephone networks. Makers of optical fiber communications equipment from various countries are frantic, trying to sell their products. But, in fact, a majority of orders are won by Japanese manufacturers. This proves strong competitiveness of the Japanese industry in this field.

Development of Unique Technology

The principle of optical fiber communications had long been known to experts. But the United States was the first to put this to practical use. It was reported in October, 1970, that Corning Glass Works had developed a glass fiber of a low transmission loss – 20 dB (decibels) per kilometer. This report triggered a worldwide race to develop optical glass fibers.

In Japan, NEC began research on optical fiber communications in 1967, and in 1968 it announced a joint development of an optical fiber, called "SELFOC," with Nippon Sheet Glass, the 2nd largest sheet glass maker in Japan. SELFOC was a glass of multiple contents. Later, Corning Glass Works developed an optical fiber made of quartz. SELFOC is now being used widely for lens material for micro-optics.

In February, 1971, shortly after the announcement by Corning Glass Works, Nippon Telegraph & Telephone Public Corp. (NTT) launched research on optical fiber communications with the establishment of an optical fiber research team in its Electrical Communication Laboratory. In the U.S., Bell Laboratories of the AT&T Group developed a MCVD (Modified Chemical Vapour Deposition) method by improving the CVD method of Corning Glass Works. The optical fiber made by the MCVD method has a less transmission loss than that of Corning. In May, 1975, NTT began joint researches on optical fibers with Japan's top three cable makers – Furukawa Electric, Sumitomo Electric Industries and Fujikura Cable Works and developed a VAD (Vapour Phase Axial Deposition) method.

An optical fiber is a fine glass fiber (core) covered with a glass tube (clad) of lower refractive index. The beam that passes through the core will not go outside the core thanks to the principle of total refraction. In the MCVD method silica gas (to be made in core), added by germanium and other compounds to adjust the refractive index, is blown in the quartz tube (to be made in clad) and is deposited inside the tube by heating. The soot preform thus made is heated again to make transparent preform. A fine optical glass fiber is made by drawing a preform.

In the VAD method developed in Japan, core material gas in blown and deposited to the lower end of a glass rod. By lifting up the rod, core is developed. The core thus made is put in the clad tube to form a preform. The size of the preform made by the VAD method can be made far larger than that of the MCVD method. This means a longer optical glass fiber can be drawn by the VAD method.

In Japan, optical fibers are being made by both methods. For the MCVD method of Corning, Furukawa Electric in 1978 became the sole licensee in Japan, and other makers have taken sub-licenses from Furukawa. In fact, both methods are undergoing rapid advances in technology. In 1979 an optical fiber having the world's lowest power loss of 0.2 dB per kilometer was made under the VAD method. This fiber can transmit 95% of the beam to a receiver a kilometer away. In 1980, a 100-km single mode optical fiber was made by the VAD method.

Optical fibers are classified as a graded index type and a step index type by the distribution of refractive index, and as a multi-mode type and a single mode type by the transfer characteristic of beam. In the graded index type, the refractive index of the core changes gradually from its center to the outer direction. This keeps the transmitting speed

of beam constant and transmitted information clear. The core is about 50 μm in diameter. In the step index type, the refractive index of the core is uniform. Recently the graded index type fiber is used more frequently than the step index type. The core for the single mode type is about 10 μm in diameter. This type fiber keeps the aberration of information-carrying beams to a minimum. This is suitable for long-distance transmission. The fiber of the single mode type is difficult to make and the VAD method was the best. Therefore, Japan was the first to commercialize the single mode fiber.

In 1973 Furukawa Electric and Fujitsu concluded a contract with Corning Glass Works for joint research in optical fiber cables and optical fiber communications system. These moves contributed to a rapid advance in Japan's optical fiber communications technology. Furukawa supplied a large quantity of optical fiber cables to Corning to be used for the construction of an optical fiber communications system in Canada.

In 1972, Sumitomo Electric Industries developed a double coated optical fiber cable with the primary silicone resin coating and the overlay nylon coating on the optical fiber, and granted its license to Corning Glass Works.

In optical fiber communications, the beam that carries information is produced by LED (light emitting diode) or LD (laser diode). Optical modem, a modulation equipment to change electric signals into light signals and vice versa, and various other equipment are necessary. Japan is at the world's top level in communications and electronic equipment for non-military use, and this has benefited Japan in speedy development of optical communications equipment. The rise in international competitiveness has brought about many export contracts.

Challenge to New Era

In Osaka's satellite town of Higashi-Ikoma, a large scale experiment, claimed to be the world's first of its kind, is now under way to develop a visual information system using optical fiber cables. The experiment is of the Highly Interactive Optical Visual Information System (Hi-OVIS) being conducted by the Visual Information System Development Association under the guidance of the Ministry of International Trade and Industry (MITI).

To develop this type of system, both MITI and the Ministry of Posts and Telecommunications created associations in 1972. Since their purpose was the same, they were merged into one association in June, 1973. The association is joined by electric appliance makers, electric cable makers, broadcasting companies, banks and other information-related businesses. It selected the test site, designed the system, and developed and installed necessary equipment and facilities before starting the laying of optical fiber cables in the site in October, 1977. All the facilities were completed in July, 1978. Then, the association asked 158 households in the area to become monitors and installed terminal equipment, which are linked with the central facilities by way of sub-centers, along with ten terminal equipment at public facilities. The system went into operation in July, 1978.

Since the Hi-OVIS uses optical fiber cables, the data transmission capacity is extremely large, and full two-way communication is possible. This totally differs from the CATV (Cable Television), which uses coaxial cables. The terminal equipment of the monitor incorporates a terminal adapter, a key-board, a TV-camera and a microphone and can be connected with a TV set. The central facilities are equipped with a broadcasting system, a video system, a still picture system, a central computer, etc. The monitor not only sees specified programs on the TV set but also can call for other programs or information and also take part in the programs using a TV camera or a microphone.

In the production of the optical fiber communications system for the Hi-OVIS, Sumitomo Electric Industries and Fujitsu played a major role. An LED of the 0.85-μm range is used for the light source; the light sensing element is PIN Photo Diode; the optical fiber has a core diameter of 150 μm and a clad diameter of 350 μm; the external diameter of the fiber is 0.7 mm; and the main line of the cable has an external diameter of 17 mm with 24~36 fibers bound inside, while the subscriber's cable has an external diameter of 13 mm with two fibers. The cables used in the system total 44 km in length and the fiber length totaled 350 km. The broadcasting facilities were manufactured mainly by Matsushita Electric Industrial, while the computer was made by Fujitsu. Fuji Telecasting Co. cooperated in broadcasting techniques.

The Hi-OVIS is a new experiment. A number of equipment had to be developed to meet its requirements. The software for broadcasting and operations is all new. All is being developed in the course of experiments. This is a challenge to the new era. With the start of the test operations, a system evaluation committee was established. The overall operations are reviewed and assessed annually, and the results are reflected on the test operations.

The evaluation report prepared in March, 1930, gives full particulars of both the hardware and software of the system. It states that all the equipment and facilities continue normal operations and that the foundation of the system has been laid. It also says that the system is useful for the formation of a community and can make great contributions to the life-long education and welfare of community members. The association has received many

inquiries about the experiment of the Hi-OVIS from overseas, and many visitors have come to see the operations of the system. Following this Japanese system, plans to conduct similar experiments are now under way both at home and abroad.

The current operational experiment will continue until March, 1983. Then, work will begin to develop a proven system, which will proceed to a commercial system to be established in the future. The Hi-OVIS can also be applied for an industrial information system within an enterprise or an industrial complex or for an educational system.

Inroads into Telecommunications

The optical fiber communications system has been exported to be used for telecommunications purposes Japan, however, is lagging behind in its commercial use, since the telephone network is already advanced in the country. On the other hand, it is obvious that the present telephone network will be inadequate sooner or later to meet the rapidly growing demand for data transmission. It is quite understandable that no sooner had NTT learned the development of optical fibers by Corning Glass Works than it began research on the subject.

While continuing basic research, NTT launched, in 1978, experiments of optical fiber communications for practical use in a 21-km distance in Tokyo. It is now carrying out a long-distance, large-capacity experiment and medium-range, medium-capacity experiments for practical use.

The former experiment began in October, 1980, in the outskirts of Tokyo by linking an 18-km distance with an optical fiber cable of the single mode type. The experiment is now continuing in an 80-km distance. Adopted for the light source is a laser beam of the 1.3-μm range produced by an InGaAsP semiconductor. The information transmission speed is 400 Mb/s. A single optical fiber of the kind now in use can handle 5,760 telephone channels at a time. It will be used for a trunk line linking major cities.

In the medium-range, medium-capacity experiments, optical fiber cables of the graded index type are used. They are being conducted in Tokyo, Kyoto, Nagasaki and nine other cities where optical fiber communications are being tested between telephone exchanges or relay stations 6~ 13 km apart. The light sources used are laser beams of the 0.85-μm range produced by GaAlAs semiconductor and of the 1.3-μm range produced by InGaAsP semiconductor. The transmission speeds are 32 Mb/s and 100 Mb/s, respectively. This series of commercial experiment began in March, 1981, and on December 3, a test channel in Chiba near Tokyo was linked with the ordinary telephone network. Since then, similar linkups have taken place in Tokyo and other cities. On January 21, 1982, NTT announced its plan to install additional optical fiber cables, with a total length of some 2,000 km, at 31 districts in its network in fiscal 1982.

In another move, NTT announced in May, 1981, that it had succeeded in tests of an optical fiber undersea cable laid in the seas off Izu Peninsula near Tokyo. The tests were designed to lay the optical fiber cable between islands or through straits. The light source was a laser beam of the 1.3-μm range and had a data transmission speed of 400 Mb/s. Notable in the tests is that a light relaying device worked satisfactorily in waters 700 m below the sea level. The feat was the first of its kind in the world.

Kokusai Denshin Denwa Co. (KDD), Japan's overseas telephone and telegraph monopoly, plans to launch a series of tests on a 50-km optical fiber undersea cable in March, 1982, off Ninomiya Cable Landing Station, central Japan, which is the terminal of the Pacific undersea cable to Japan. Optical fibers are suitable for the undersea cables, which are required to carry a large volume of information to long distant places at high speed. Since the power loss in transmission is small, the use of optical fibers can extend the distance between relay facilities underseas where maintenance work is very difficult. KDD is now engaged in research in this field and plans to lay a Trans-Pacific optical fiber undersea cable in the late 1980s.

Wide Applications

In March, 1978, Tokyo Electric Power Co. and Kyushu Electric Power Co. built some 6-km optical fiber communications lines between electric power plants and substations, respectively. Unlike the ordinary electric wire, the optical fiber is immune from electro-magnetic interference and enables the installation of an optical fiber cable right along a super high tension power transmission underground cable. Other power companies followed suit in adopting optical fiber communications for data transmission and control purposes. The electric power industry, so far, has most widely adopted optical fiber communications for practical use in fields other than the public telephone and telegraph system.

In February, 1979, Sumitomo Electric Industries and Idemitsu Industries, a leading petroleum company, jointly developed a composite cable of the electric wire cable and the optical fiber cable, first in the world. A 4-km composite cable was laid between a refinery and an oil storage facility for the electric power supply and controlling and telecommunications purposes.

In November, 1979, NEC completed an optical fiber communications system linking the mainframe computer with eight data stations in Wakayama Steel Works of Sumitomo Metal Industries. It was the first full-scale system for

two-way communications by a single optical fiber cable. The optical fiber cable free from electro-magnetic interference is suitable for the communications system in factories where a web of power lines and other electric circuits are laid across. It is also good in oil refining facilities and petrochemical plants where there are dangers of explosion induced by electric sparks. Various research institutes and educational facilities were also relatively quick in introducing optical fiber communications.

At the end of 1980, Fujitsu and Furukawa Electric jointly completed a large-scale information network, called "Research Information Processing System" (RIPS), which would link nine research institutes of the Agency of Industrial Science & Technology, Ministry of International Trade and Industry, with its head office. The research institutes are now under construction in Tsukuba Academic New Town, Ibaraki Prefecture, north of Tokyo. The big mainframe computer, FACOM-M2000, installed in the head office, is linked with each institute by an independent line and a common ring line — both using optical fiber cables. The system will eventually be a network linking about 3,000 terminal units. The total length of optical fiber used in the system is about 350 km. Thus it is an unprecedentedly large communications and data processing system for research purposes in the world.

Around 1978 optical fiber communications began to be used by transportation facilities. Osaka and Kobe municipalities reclaimed man-made islands in the Seto Inland Sea at the same time and built computer-controlled new transit systems. Both systems employed optical fiber communications to link monitoring TV cameras at stations with the central control offices. To transmit many TV pictures simultaneously, WDM (Wave-length Division Multiplexing) systems using four different wave lengths were adopted.

For Hanshin Expressway an optical fiber communications system was completed in the summer of 1981 to monitor traffic conditions and transmit data to the control office. Data are sent to the control office 35 km away without using a relay facility by the laser beam of the 1.3-μm range.

The Transit Bureau of Sapporo in Hokkaido developed a voice-responsive optical data transmission system for subways in cooperation with Nippon Signal Co. and Matsushita Communication Industrial Co. and put part of the system into operation in December, 1981. The system totally controls the exit gate, the automatic ticket punching machine, the fare adjustment machine and other equipment by linking them with the control office by optical fiber cables. For example, if the term of a season ticket expired, a synthetic voice tells the user that the ticket is out.

NEC developed a short-distance optical data communications system, called "NEOLINK," and its applications are being studied jointly by NEC and Hokkaido University. The system, using LED as its light source, has a built-in optical modem, and it has been used widely for NC machine tools.

Optical fibers have also been used in gastro-cameras, and other medical instruments. A bundle of many optical fibers can transmit images to a distant place. Optical fibers can also be used for lighting and other industrial purposes.

Optical fibers have extremely wide-ranging applications, and application technology is rapidly advancing day by day. To promote the development of optical fiber communications technology and its applications, 11 major electric appliance and cable makers jointly promoted to establish the Optoelectronic Industry and Technology Development Association. The association was formed in July, 1980. The promoters were Fujikura Cable Works, Fujitsu, Furukawa Electric, Hitachi, Matsushita Electric Industrial, Mitsubishi Electric, Nippon Electric, Nippon Sheet Glass, Oki Electric Industry, Sumitomo Electric Industries and Toshiba. Besides these 11, many other firms have joined the association.

According to the association, the numbers of optical systems shipped yearly by Japanese makers from 1974 to 1980 were 3, 6, 23, 27, 47, 102 and 110, respectively. These amounted to 318, of which 34 were exported. Of the total, 106 were delivered to electric power companies (including 8 exported), 54 to manufacturing plants (3 exported), 38 to educational and research institutes (3 exported) and 36 to public communications facilities (19 exported). These systems vary widely in scale. In terms of the volume of optical fiber cables used, public communications facilities are the largest group of users of the systems.

According to a survey by the *Nihon Kogyo Shimbun* (Japan Industrial Daily), makers of optical fiber communications equipment and optical fiber cables are all pushing greatly expanded production plans. Their production plans for fiscal 1981 and 1982 are as follows:

Equipment Manufacturers	FY1981	FY1982
	(in ¥100 million)	
Nippon Electric	100	150
Fujitsu	50~60	100
Cable Manufacturers		
Sumitomo	50~60	100~120
Furukawa	24~25	50
Fujikura	20	40
Hitachi	15	25~30

Dainichi-Nippon	5	10
Showa	2	4

With the exception of Dainichi-Nippon, all these makers plan to export more than 50% of their products.

Big cable makers are manufacturing not only optical fiber cables but also optical modems, optical fiber links, LEDs, semiconductors and other parts and materials for optical fiber communications. They can also take orders for small- and medium-sized optical fiber communications systems. Sumitomo Electric Industries has grown into Japan's top maker of gallium-arsenide compound semiconductors. Meanwhile, Fujitsu is making optical fiber cables. It is noteworthy that electric equipment makers and cable makers have begun doing business in each other's field. This is because advances in optical fiber communications technology are so fast that manufacturers need to handle the entire system if they want to survive competition in technological development.

Toward Even Higher Technology

In October, 1981, NTT announced that it had developed a super high performance semiconductor laser of the 1.5-μm range. KDD also announced a success in the development of a similar product. NTT and KDD achieved the world's first successes in pursuit of the same goal through separate development efforts.

In the development of systems for long wave length ranges above 1 μm, the system of the 1.3-μm range is especially advanced, because the loss of power in the optical fiber is low in the range and because the wave forms of signals are quite steady. It had been known that the power loss in transmission of the 1.5-μm range was minimum and about half the amount of the 1.3-μm range. And, two years ago KDD succeeded in an experiment of continuous operation of a semiconductor laser of the 1.56-μm range in the ordinary room temperature for the first time in the world. But when the semiconductor laser was operated at high speeds to transmit a large amount of information, many different wave lengths close to the 1.56-μm wave appeared and disrupted the wave form of the signal. Therefore, efforts were made to develop a semiconductor laser that would produce a uniform wave length even at high speed operations. Both NTT and KDD attained the goal by devising new structures of the semiconductor.

The newly developed semiconductors can double the relay span in optical fiber communications compared with that of 1.3-μm range. This is a great advantage for the optical fiber undersea cable. For the practical use of the products, it is necessary to grade up their dependability. But they have definitely brought us closer to the ideal of optical fiber communications.

NTT is now developing the "Information Network System" (INS), a highly advanced data transmission system employing optical fiber technology to replace the conventional telephone network. In the system, new network would carry not only voice, like telephone conversations, but also images of facsimile and computer data. NTT is also developing a small facsimile for home use and other products, while conducting commercial tests of telephone communications by using optical fiber cables. NTT aims to build a new highly-efficient communications network of a system which will employ fiber optics-applied digital technology, instead of the current analog technology. In fiscal 1984 NTT plans to launch an experiment of INS at a model district to be designated in suburban Tokyo.

The Agency of Industrial Science & Technology designated the development of an optical measurement and control system as a national research & development project. To promote the project, the "Engineering Research Association of Optoelectronics Applied System" (OAS) was established in January, 1981, by the earlier-mentioned Optoelectronic Industry and Technology Development Association and its 11 promoters as well as Fuji Electric, Shimadzu and Yokogawa Electric Works.

Research funds totaling ¥18,000 million are to be spent for the new project during the 8-year period started in fiscal 1979. In the project, studies will be made on three subjects – optical element technology, functional sub-systems and total systems. Optical elements to be taken up are lasers, optical fibers, optical sensors, optical actuators and optical circuit elements. Sub-systems will include high-speed picture data sub-system, high-quality picture data sub-system, high-speed process data sub-system, composite process data sub-system and data control sub-system. As to the total systems, plant, enterprise and social systems will be studied in the project. The Optoelectronics Joint Research Laboratory, established under OAS, is engaged in the development of basic technologies of "opto-electronic integrated circuits" – integration of optical elements and electronic elements.

The Optoelectronic Industry and Technology Development Association has undertaken research and development of the total systems of the project and also research on the standardization of opto-electronic devices, which is assigned by the Agency of Industrial Science & Technology.

The VLSI Technology Research Association, created in 1976 to establish technology for future generation computers, has achieved spectacular results and attracted the attention of the world. An even large research and development system has just begun activities to advance opto-electronic technology.

Electric technology created modern civilization, and the social structure of today is based on electric and electronic technologies. Now, opto-electronic technology is emerging to form a new industry. The optical fiber communications industry cannot remain merely part of the information industry. It is a new industry that is bringing renovations in the social structure. In the futuristic industry, Japan is at the world's top level. But the future of the industry is too great, and so is difficult to predict, now.

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SCIENCE AND TECHNOLOGY

WHETHER ROBOTS WILL CREATE UNEMPLOYMENT DISCUSSED

Tokyo DIAMOND'S INDUSTRIA in English Vol 12, No 2, Feb 82 pp 38-42

[Text]

An international robot show, "AUTOMAN '83," is to be held in London in May, 1983. A relevant Japanese organization and manufacturers are now preparing to take part in the robot show. Robots which executed only part of man's work in the past are becoming major work force indispensable for factories. However, the wider use of industrial robots is closely related to employment problems. Although there is no pressing problem in Japan in this regard, the failure in the use of robots and in employment measures could create problems in the future. Let us introduce to our readers some examples of reactions to the adoption of robots from Japanese labor and management.

Contrast

The working group on information, computers and communications policies of the Organization for Economic Cooperation and Development (OECD) has been conducting research for the past three years on the influence of micro-electronics (ME) on productivity and employment.

In the course of the research and examination of the problem, the working group heard serious complaints from a majority of European countries that "robots will deprive workers of their jobs." In contrast, Japanese representatives said, "The influence of ME on employment has not become a serious problem in Japan." This remark seems to have surprised representatives from other countries who got the impression that the Japanese were likely to settle the problem skillfully, although the Japanese said there might be a problem in the future. More than that, Professor Hiroshi Inose of Tokyo Institute of Technology, one of the Japanese representatives, reported later that he and U.S. representatives "had eased

considerably" the pessimism of European countries by stressing the ME's effects of raising productivity and creating employment.

The All Japan Federation of Electric Machine Workers' Unions has compiled an interim report on the "Outlook for the Electric Industry in the 1980s." According to its inquiries, sent to member unions to collect data for the report, the introduction of microcomputers and robots has not produced serious effects on employment. A majority of the unions replied that there is "no change." Although some of them said employment was "reduced," almost the same number of unions reported an "increase."

Why was such a situation brought about? The number of workers in the Japanese electric industry dropped right after the first oil crisis. There were 1,400,000 workers at the peak time in 1973, but they declined by nearly 13% to the present 1,220,000. The drastic cut in the work force was covered by overtime work or a two-shift work system. Therefore, there is a feeling of busyness at factories even today. In addition, there is a tendency among workers to dislike dirty or dangerous work, raising the voices for stepped-up automation, including the use of industrial robots.

The Ministry of Labour started a two-year research in 1981 on the effects of ME on employment. The research was entrusted to a committee headed by Professor Shojiro Ujihara of Shinshu University. A preliminary survey was carried out in June, 1981, on the basis of figures for 1980, and 2,000 manufacturing plants in the country were inquired about the problem. The results of the research showed a rosy picture that "the introduction of NC machine tools and others, coupled with the expansion of production capacity and the increase in the booking of orders, maintained the employment level or curbed the margin of decrease in employment." It was also found that "the change in the types of job and the relocation of workers were carried out smoothly and there were only minor direct personnel cuts."

Rationalization of Production

The ME revolution centered on industrial robots has just begun. Since the robots will have added-value and increased efficiency year after year, the amount of work per robot, or its labor-saving effects, will go up steeply. The effects of the ME revolution on employment will gradually become appreciable, but, at the same time, it will be a condition necessary for survival of enterprises in this resourceless country and a weapon for them to win international competition.

Japanese enterprises are willing to increase labor productivity, rationalize production to lower costs and step up investments for labor and energy saving. Behind this is the rise in raw material costs. If the average price of products in the manufacturing industry in 1973 is set at 100, the price went up to 171, while the raw material costs reached 209 in 1980. It is not too much to say that the ME or the robot revolution first took place in Japan in order to cover this gap between the price of products and raw material costs. As a result, raw materials have come to be used more effectively than before. The annual rate of increase in raw material/productivity in the manufacturing industry was 0.5% a year during the period of fast economic development between 1965 and 1973. But the rate shot up sharply to 1.9% a year between 1973 and 1980.

It was also devised to absorb the ever-rising labor costs with the modernization of facilities (that is, automation and the introduction of industrial robots). Workers' wages

more than doubled from the 1973 index of 100 to 211 in 1980, whereas the price of machinery and other facilities increased from 100 in 1973 to only 143 in 1980. The ratio of wages to machinery and facilities increased from 100 in 1973 to 147 in 1980. In other words, there is a greater incentive to substitute capital for labor force. The incentive will become even greater from now on.

There is another reason for the wider use of industrial robots in Japan. That is the chronic shortage of skilled labor force. According to the Labour Ministry's survey on the demand and supply of skilled labor force, the ratio of shortage in the manufacturing industry as a whole rose from 6.7% in 1978 to 9% in 1980. The situation is more serious in such sectors as welding, resin molding and metal pressing, in which the shortage ratio reaches 13%. The shortage is higher in the types of jobs which workers tend to avoid as dirty work. The recent trends of young people to go on to institutions of higher education also led to the current situation. Although the shortage of skilled workers is acute in small- and medium-scale enterprises, about 20% of large enterprises also complain of such shortages. It is natural that a manager (the President of Japan Robot Lease Co., Shinichi Matsuda) deplores: "While the annual economic growth rate averages 5%, the rate of increase in labor force in the secondary industry is only 0.7% a year. At this rate, it is impossible to recruit new workers to make up for those quitting."

Industrial robots in Japan are being used, first of all, to cover the shortage of skilled labor force and to do dirty and dangerous work on behalf of workers.

Highly-efficient Robots

The use of industrial robots in Japan, as stated above, will continue until labor shortage in specific divisions is settled, and there cannot be any employment problem arising from the use of industrial robots. The problem is the introduction of robots purely for increasing productivity. Since they are for labor-saving purposes, a decrease in employment is unavoidable. And, the use of robots could ultimately lead to an unattended operation of plants.

For instance, Hitachi, Ltd. is carrying out a five-year plan to cut the number of workers in the assembly division by 70% by introducing industrial robots into 60% of the assembly process. Toshiba Corp. introduced FMS (flexible manufacturing system) centering on the use of robots into the entire production divisions in fiscal 1981 in an effort to cut production workers (now totaling 25,000) by about 10,000 in the latter half of the 1980s. The OECD's Japan Working Group has found in its survey that the number of workers will be reduced by the introduction of ME and industrial robots into the manufacturing divisions. To be affected are the makers of process control equipment, automated manufacturing machines, general office machines and equipment, equipment for commerce-related clerical work, equipment for the automation of railway station work, timepieces and electronic calculators. It was also found that the users of these machines and equipment are gradually reducing their dependence on skilled workers and employees engaged in simple work.

These industries are still developing industries. Stimulated by the harsh competition for the improvement of product quality, lowering of product prices and the development of new products, these industries will employ robots to increase production as a whole, while maintaining a certain

degree of employment-creating effects. Corporate managers say that personnel cuts in the production process will be carried out, as in the past, through the natural decrease in the number of employees or by changing the types of workers' jobs over a long period of time. But, as a matter of fact, nobody can foresee the future employment situation.

Demand for production-process work force from the machinery, electric and precision equipment industries will reach about 2,430,000 men in 1985, according to the average annual growth rate estimated by the Industrial Structure Deliberative Council. Considering the 1,880,000 workers in 1975, the increase will be very large. But the labor-saving effects of ME and industrial robots was not taken into account in making the estimates. OECD's Japan Working Group estimates that the introduction of ME and robots will have the effects of reducing the work force by the maximum of 480,000 and by the minimum of 210,000 by 1985. If this estimate is correct, the number of factory workers in the above three sectors of industries will increase only slightly or level off.

Separately from robots, estimates on the distribution industry comprising department stores and supermarket chains show that the diffusion of POS (point of sales) system will cut the work f by the maximum of 23,000 by 5. Since the number of employees in the distribution industry is estimated to increase from 260,000 in 1975 to about 283,000 in 1985, the increase is expected to be absorbed exactly by POS and other automation measures.

Thus, seen from the macroscopic viewpoint, the introduction of robots and microcomputers is not likely to cause a serious anxiety among workers about unemployment. But this is based on condition that the relocation and re-education of workers and companies' adaptation to new changes would proceed smoothly and a certain degree of economic growth and expansion of the industrial scale would continue from now on. If there emerge problems in these respects, the use of industrial robots might result in creating mass unemployment.

Worry

What is worried by many experts is the question of re-educating middle-aged and aged workers. Regarding this, there is a mood for giving it up. The national census (in 1975) shows that, of the male factory workers, those in the age bracket between 40 and 54 account for 20%. Above all, the ratio of workers over the middle age is high at 21% to 24% among metal machine tool workers, welding workers and metal pressing workers, who are believed to be the first to be affected by the progress in automation. This shows the fact that middle-aged and aged workers are subject to the effects on employment resulted from rationalization and automation in the production process. On the other hand, the ratios of the workers of those ages to the total number of information processors and computer operators are extremely low, accounting for 4% and 5.6%, respectively. The ratio of young workers is overwhelmingly high.

It is in this computer-related work, such as software, computer operation, engineering and maintenance, that ME revolution will drastically expand employment and that a decrease in the work force will be covered by robots. Therefore, employees over the middle age are likely to be driven further into a disadvantageous position, unless they are given chances for re-education.

According to estimates by the Labour Ministry's Employment Policy Research Council, the working population in 1990 will reach 61,400,000

(compared with 56,500,000 in 1980). Since those in employment are estimated at 60,300,000 in 1990, the difference, meaning the unemployed, will be 1,100,000. Now, let us apply the employees' distribution rates by sex and age in each industry in 1980 to those presumed to be in employment in 1990. Then, it becomes clear that the working population (supply), both male and female workers under the age of 55, will be below demand, while those over 55 will exceed those employed (demand). For one thing, aged workers will not be able to catch up with the changes in industries in the direction of knowledge-intensiveness. But the development of ME is so remarkable that there may emerge foolproof computers or ME systems which can be easily operated by anyone. Then, there may be a possibility of chances being given to aged or disabled employees who are generally poor mechanics.

ME Revolution

Orii Automation Machine Co., a specialized maker of automation machines for pressing in Isehara in the suburbs of Tokyo, developed industrial robots incorporating microcomputers a few years ago. As a result, the company with about 100 employees needed to increase the number by 20 to 30 during the past year. More than half of the new recruits were university graduates. In addition, university graduates were assigned to the manufacturing workshop because the installation of robots and after-sale services need to be done by those engaged in robot production.

This maker gives financial assistance to employees who buy "personal computers." About half of the employees study software by using their own personal computers at home. The pressing process, which is a basic process of manufacturing, requires skills and involves danger. In the past, it was difficult for small- and medium-scale enterprises to employ skilled workers, but the introduction of robots has settled the problem and eliminated the danger involved in the process. The company was able to increase employment, successfully adapt itself to the recent trends toward receiving higher education, give employees education and training and contribute to the disaster prevention on the part of users. What the company is doing might be a good example of the future-oriented ME revolution.

Undoubtedly, the ME industry in the broad sense of the word will touch off an expansion of employment at the level of small- and medium-scale enterprises. OECD's Japan Working Group estimates that the number of information processors alone will reach the maximum of about 796,000 in 1985, compared to 130,000 in 1980. Demand for operators of punching machines and electronic computers is also expected to increase at the same pace. An overwhelmingly large number of companies consider that the employment for automation-related jobs will either remain at the present level or increase over the next three years, when industrial robots and NC machine tools will be introduced at an increasing speed.

Is it too optimistic to conclude, at this moment, that Japan will be able to do everything smoothly with regard to the increased use of robots? At least, it seems unlikely that the introduction of robots in Japan will cause mass unemployment and incur serious social unrest about employment. Then, how is Japan going to avoid the possible emergence of unemployment? "On the basis of the Japanese-style management, labor and management may join hands to attain the highest productivity in the world and gain further international competitiveness, thereby exporting un-

employment to other parts of the world through the massive exports of Japanese-made industrial robots." This is the fear harbored by representatives of member countries of the OECD's ME commission. And this is an important problem which Japan, too, must consider seriously.

Is Robot Production Profitable?

Moves for exports of industrial robot production technologies have been accelerated. Hitachi, Ltd., Japan's largest electric and electronic equipment manufacturer, has already concluded with two U.S. companies and a British company, including General Electric of the U.S., for exports of robot production technology. Mitsubishi Heavy Industries, Ltd. gave license to an Australian manufacturer, while Dainichi Kiko Co., Ltd. is providing its technology to a British company. In addition, Fujitsu Funac Ltd., a subsidiary of Fujitsu Ltd., is expected to conclude a similar contract with a British maker.

At home, a number of foreign engineers are visiting robot manufacturing plants almost every day. Reflecting such a situation, stock prices of robot producers have been on the rise.

However, robot production does not always seem to bring large profits to the maker. For example, Kawasaki Heavy Industries, Ltd., the top maker in this field, began commercial production of industrial robots in 1968 but suspended the production on the way due to sluggish sales. It was about three years ago that the company resumed robot production after clearing cumulative losses caused by the robot business failure at the initial stage.

Oil crises on two occasions seem to have required a long time before Kawasaki was able to get on the right track in the field of robot production. Kawasaki's robot sales are estimated at about ¥7,000 million, while its overall sales stand at around ¥750,000 million a year. This means that it will take more time before the company gets full scale merits.

In view of increasing popularization and spread of industrial robots, many manufacturers have been entering this field of business. At present, a total of some 150 companies are engaged in the production of industrial robots. Japan Industrial Robot Association forecasts that Japan's robot production will total about ¥300,000 million in 1985, while it reached ¥78,400 million in 1980. A private economic research institute estimates the production value at even ¥500,000 million in 1985.

Sooner or later, robot producers will get merits accrued from mass production. But considering such a large number of participants in robot production and expected harsh competition among themselves, profits may vary with producers. In addition, the development of high-performance robots will require a huge amount of money. It is, therefore, unlikely that all the robot manufacturers will enjoy thriving business.

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SCIENCE AND TECHNOLOGY

NTT PRESIDENT PROPOSES OPENING TERMINALS TO PRIVATE SECTOR

Denationalization Proposal

Tokyo NIHON KEIZAI SHIMBUN in Japanese 20 Jan 82 p 1

[Text] Nippon Telegraph and Telephone Public Corporation (NTT) has followed its announcement of plans to completely open to private enterprise the business of communications terminals, including telephone receivers, by making it known that it intends to reorganize its structure and concentrate all terminal-related divisions into a "private terminals business division." NTT expects to operate this division as an independent profit-making entity, and has made 1983 the target date for its establishment. It is anticipated that this division will have some 50,000 personnel. That means that the overall structure of NTT will be broadly divided between a network division, with the telephone exchange, long distance circuits, and the like, and a terminals division, with telephone receivers, facsimile machines, and the like. These will become dominant, quite beyond comparison with the small, money-losing, data and telegraph divisions. The Provisional Committee for the Investigation of Administration is presently considering whether to continue the organization of NTT as it is or to denationalize it, and NTT's autonomously determined "large divisions" policy will necessarily have an impact on future discussions of the administrative structure of NTT within the committee.

NTT President Shindo Ko has made it known that "basic telephone receivers" (the first receiver installed by a subscriber), alone excluded from the offer for private participation in the terminals business made by NTT last year, will also be opened to private enterprise. Thus the entire terminals field will be opened to competition from the private sector, but, in fact, there are complaints from the private sector that by making the terminals division financially autonomous there will be open competition between NTT and private enterprise.

Within NTT up to now the business window and maintenance personnel of the telephone office, the administration division, and so on, have been equal with those of the network and terminals divisions, and, on the grounds that differentiation would be difficult, their finances have not been kept separate. However, President Shindo has directed that personnel, structure, and finances must be completely separated, so as to give priority to competition with the private sector, and this has become settled as NTT policy.

The area taken in by the newly established private terminals division will cover telephone receivers, facsimile machines, PBX (private telephone exchanges), and

all other kinds of terminals connected to telephone circuits. As there is no manufacturing division, all terminals installed will be purchased from outside, but subsequent maintenance of terminals installed by the user will be included.

NTT will take charge of maintenance of well over 50 million telephone instruments over the whole country, including, besides the installation of some 200,000 new instruments a year, the transfer of about 300,000. Furthermore, income from terminals other than basic telephone instruments, such as PBX (14 billion yen) and telephone facsimile machines (2 billion yen), amounts to 170 billion yen (in all cases as of 1980). When these are included, even after allowing for the reduction in the installation of new equipment due to the entry of private competition, the overall income would give birth to a giant "terminal specialist firm" of 1 trillion yen.

On the human side, this new division will field some 50,000 personnel, as a lower limit, from among the 330,000 of which NTT is comprised in its competition with private enterprise.

Debate Over Proposal

Tokyo NIHON KEIZAI SHIMBUN in Japanese 21 Jan 82 p 3

[Text] A positive statement by Nippon Telegraph and Telephone (NTT) President Shindo concerning the problem of denationalizing NTT, now being studied by the Second Provisional Committee for the Investigation of Administration, has recently attracted much attention. The new form of NTT as presented by President Shindo, who came from the private sector, is as a half public, half private special legal entity like Japan Air Lines or KDD (Kokusai Denshin Denwa), with the data communication division becoming an independent private corporation. It might be said that Shindo's idea has taken the wind from the sails of the committee. However, careerists in the Ministry of Posts and Telecommunications and NTT who wish to preserve the structure of NTT are bewildered by the pace of Shindo's activity. It seems that Shindo's idea will not be realized easily.

"Why is President Shindo coming out with a succession of concrete denationalization proposals?" (an NTT manager) "Does President Shindo understand that his own words are gradually wringing the neck of NTT?" (a ministry leader) President Shindo's latest statement has provoked cries of "we cannot fathom his real purpose," not only within the ministry but within NTT also.

All of this is since President Shindo, who had originally said, "All will be decided by the provisional committee; the persons concerned should say nothing," himself began at the end of last year to make known a succession of his own ideas concerning the denationalization of NTT. President Shindo first presented a group of three ideas being studied within NTT: 1) to turn NTT into a fully private corporation like the American AT and T (American Telephone and Telegraph), 2) to make it into a special legal entity combining public and private capital like Japan Air Lines or KDD, or 3) to maintain its status as a public corporation, but in a form close to a private corporation, unfettered legally and budgetarily

and requiring as little governmental permission to act as possible. Next, he suggested that among these three proposals the Japan Air Lines form was the most suitable, and then, on the 14th, he presented the idea that the data communication division should be separated from NTT and made an independent private corporation.

President Shindo seems to have reached a different judgment from the thinking within the ministry and NTT. Above all, he sees that the Suzuki cabinet is not retreating from the denationalization, to some extent, of the administrative structure of NTT, which follows from the general trend to reform the administration, which is taken as an overwhelming mandate. Consequently, the best approach is to adopt a posture of being prepared for denationalization. Moreover, with the present public corporation structure, even minor matters in the budget are subject to determination by the Diet, and when they wish to inaugurate new services they are restricted by regulations and the need for ministry approval, so that whatever they may wish to do they are tied hand and foot. President Shindo, who came from private enterprise, has complained that "vigorous management is impossible." In this instance the idea that it would be beneficial to gain the vigor of private enterprise by escaping these shackles has directly led to the denationalization thesis, it would seem.

There is also a selfish aspect to Shindo's thinking. The data communication division is a burden on NTT's management, as it has lost money from the beginning. With the separation of this division from the main body of NTT, it would retain as its responsibility business which should expand greatly over present levels, such as the high-level information communication systems (INS systems in which telephones, facsimile machines and data communications are installed in conjunction), which are under development as the 21st century successors to the telephone, and circuit service for communications circuits installed by private enterprise. One can see that included among his considerations is the aim of transforming the conservative atmosphere within NTT through denationalization.

Also, there are those who think that President Shindo's views are influenced by a desire to win credit for the chairman of the Second Provisional Committee, Tsuchi Hikaru, whom he regards as a mentor. If NTT is transformed into a half public and half private special legal entity, the new corporation would have capital of 1 trillion yen, and authorized capital of 3 trillion yen, according to NTT studies, and would be the largest company in Japan, surpassing the Tokyo Electric Power Company, with 650 billion yen. The contribution of this to the revolution in administration and finance would be great, hence the attention of the Second Provisional Committee.

President Shindo has recently shown a tendency to present his own views on denationalization in opposition to the Second Provisional Committee. To that extent he has legitimized before the committee the arguments concerning the denationalization problem within NTT that have been stirred up by the pace of Shindo's own activities. However, at this juncture one also sees the start of bickering among the conservative career employees of the ministry and NTT and, as we approach a climax, it seems that the intensity of the debate has been raised a degree.

9898
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SCIENCE AND TECHNOLOGY

MHD GENERATOR 'ETL MARK VII' COMPLETED

Tokyo TECHNOCRAT in English Vol 14, No 11, Nov 81 pp 46-49

[Text]

The Electrotechnical Laboratory of the Agency of Industrial Science and Technology has recently completed an MHD generator "ETL Mark VII" and has installed it at the Takasago Test Center in Hyogo Prefecture. Open cycle MHD generation is a compound system that directly generates power by passing at high speed, combustion gas plasma, obtained from fossil fuel and burned at high temperatures, through a power generation channel placed in the powerful magnetic field (Fig.1) and also to use exhaust heat for steam turbine power generation (Fig. 2).

The total heat efficiency can be greatly improved to over 50 percent, compared with about 40 percent for usual steam power generation. The MHD generation system has the great advantage of directly using coal combustion gas and has importance in increasing power generation efficiency and providing means for overcoming reliance on oil as a source for electric power.

Figure 3 provides an overall system diagram of the newly developed MHD Mark VII generator and Fig.4 shows the layout. The main facilities are various and include supply units for fuel, oxygen, air, and seed, cooling water facility, burner, accelerating nozzle, power generation channel and load unit, copper/iron magnet, excitation power supply, diffuser, high-temperature duct, low-temperature duct, electrical dust precipitator for seed collection, low temperature catalyzer denitration unit, silencer, chimney, operation measuring control unit, and data processing unit.

The burner consists of a pilot burner, a subburner, and main burners. The pilot burner is used for igniting the subburner by making the flames longer by burning in an air-shortage condition in the burner cylinder through LPG air combustion. The subburner effectively provides the remaining heat of the power generation channel and high-temperature duct, and also seed and sulfur dioxide during ordinary operation. The subburner is equipped with one mixed-air nozzle for oxygen, sulfur dioxide, and seed centering around it, and five fuel nozzles around it. Fuel burns mixing with oxygen jetted out and circulating in the surroundings with steam atomizing.

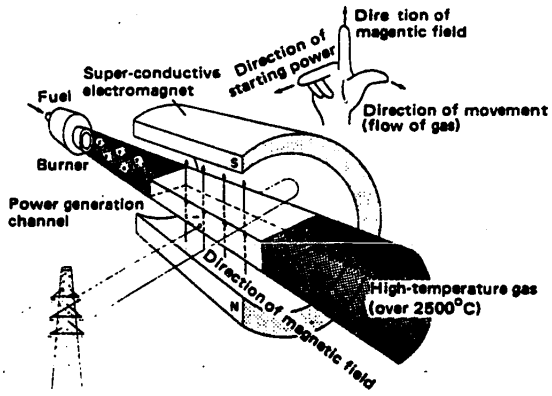

Fig. 1. Principle of MHD Generation

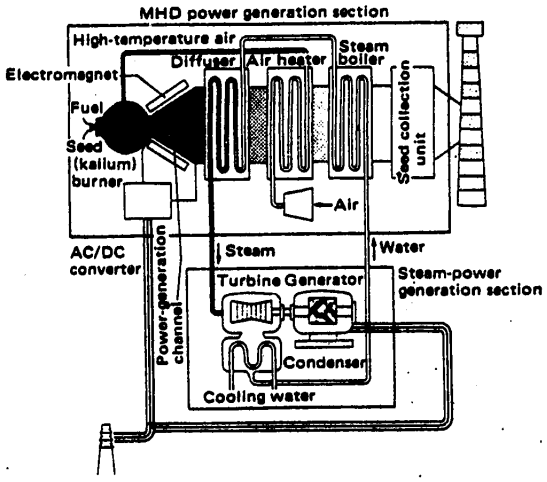

Fig. 2. Conceptual Diagram of MHD Generation Plant

There are three main burners mounted and fuel is made into a mist in a two-fluid spray system that uses air as the misting medium. Two oxygen nozzles for main combustion and two air nozzles for adjustment of gas temperature are mounted at a tangent and they improve a mixture of fuel

and oxidizer by making combustion gas have a circulating flow and lengthening retention period. The main portion is structured with a water-cooled wall, the inside of copper and the outside of stainless-steel.

The accelerating nozzle accelerates combustion gas plasma

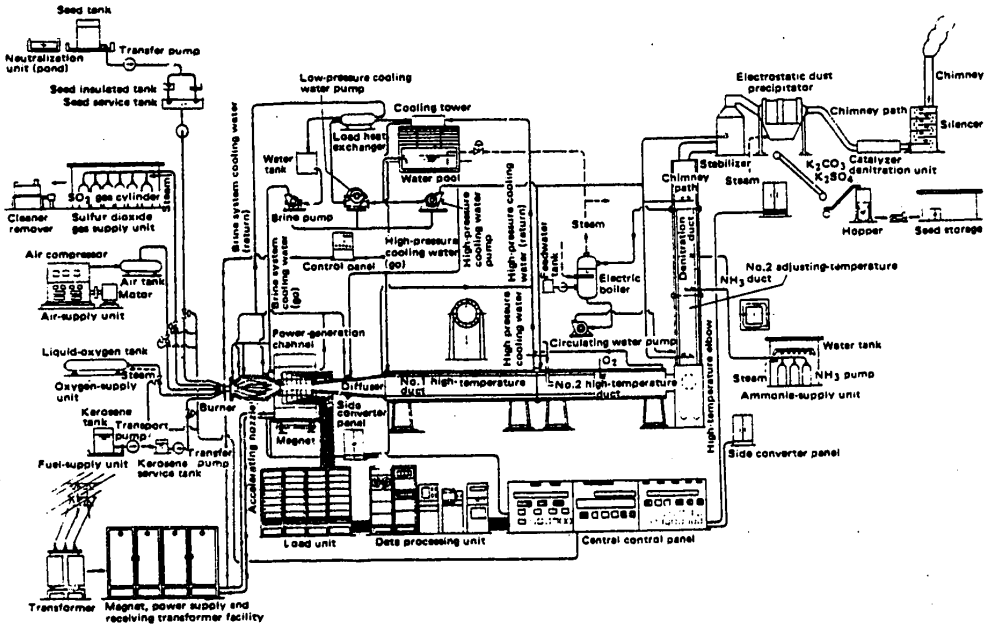

Fig. 3. Systematic Diagram of MHD Mark VII Generator

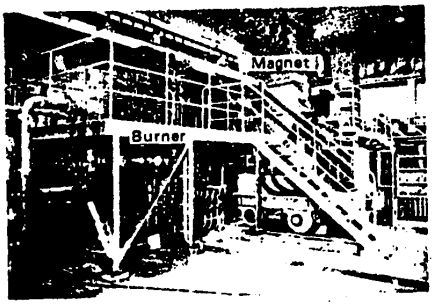

Photo 1. Burner and Magnet

Photo 2. Power Generation Load Unit (Load Switching Switch)

generated in the burner and moves it from the burner exit section 220mm in diameter, to the power generation entry section measuring 220x90mm^2. Construction is of water-cooled copper.

The first channel used for experimental power generation consists of an insulated wall of an alumina-coating peg and a water-cooled metal electrode wall (Fig.5). The entry section of the channel measures 220x90mm^2 and the exit section is measures 280x90mm^2. The total length is 1,600mm. Dimensions of the effective power generation portion are 217x75mm^2 for the entry, 266x75mm^2 for the exit, and 1,248mm long. The electrode pitch is 20.8mm, electrode logarithm 60, electrode width 9.4mm insulated wall width between electrodes 10mm, and base width 0.7mm. Anodes of stainless steel (SUS 304) and cathodes of copper tungsten (CuW) are used as electrode material in the same manner as the generation channel of ETL Mark V.

The power generation load unit provides a load resistor to consume electrical output of the generation channel and performs switching of Faraday and diagonal generation, and increase or decrease of load resistance to measure generation characteristics.

The iron magnet generates a maximum flux density of 2.5 Tesla in space with a gap of 240mm between polarities and 1,200mm long. For experimental convenience, the magnet itself and its stand can be divided into two, right and left, structually. The stand can move on a rail up to about 2m.

Photo 3. Overall View of Inside Laboratory

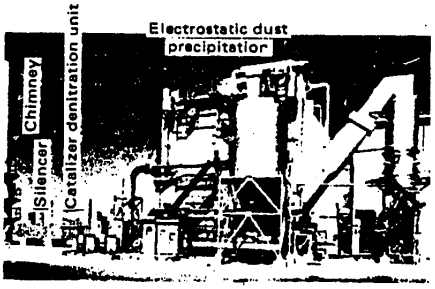

Photo 4. Exhaust Gas Processing Equipment

It weighs about 90 tons and excitation power supply outputs 685x2,700A (D.C.).

The diffuser moves from the exit section measuring 280x 90mm^2, of the generation channel, to the entry section 560mm in diameter, of the back current high-temperature duct and it is a cone duct to recover combustion gas pressure.

The high-temperature duct consists of the first and second high-temperature ducts and a high-temperature elbow. The first high-temperature duct is used, with an air-phase reaction, to dissolve and reduce NOx concentrations in combustion gas generated in the burner. It is constructed with water cooling comprising fireproof materials fitted inside, having a total

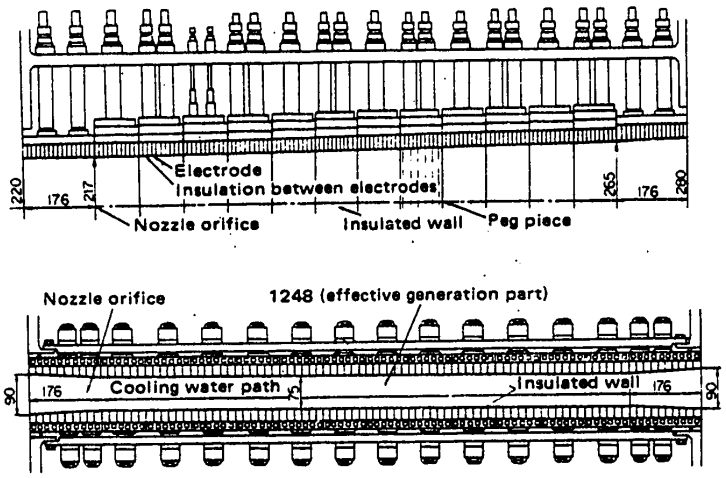

Fig. 5. No.1 Power Generation Channel

length of 10m and a thickness of 90mm. The combustion gas temperature is about 2,200°C. The second high-temperature duct is used to decrease combustion gas temperature with a water spray and to completely burn any unburnt portions of combustion gas, through the injection of oxygen. It is constructed with water cooling, partly comprising fireproof materials fitted inside, having a total length of 10m and a thickness of 90mm. The combustion gas temperature is about 1,300°C at the exit. The high-temperature elbow is used to bend combustion gas current in a right angle for its connection to the low temperature duct. The elbow is constructed with sufficient thickness of fireproof materials fitted inside in order to maintain higher wall temperature to prevent attachment or accumulation of seeds in combustion gas.

The low-temperature duct consists of a temperature adjustment duct at the upper current part and a denitration

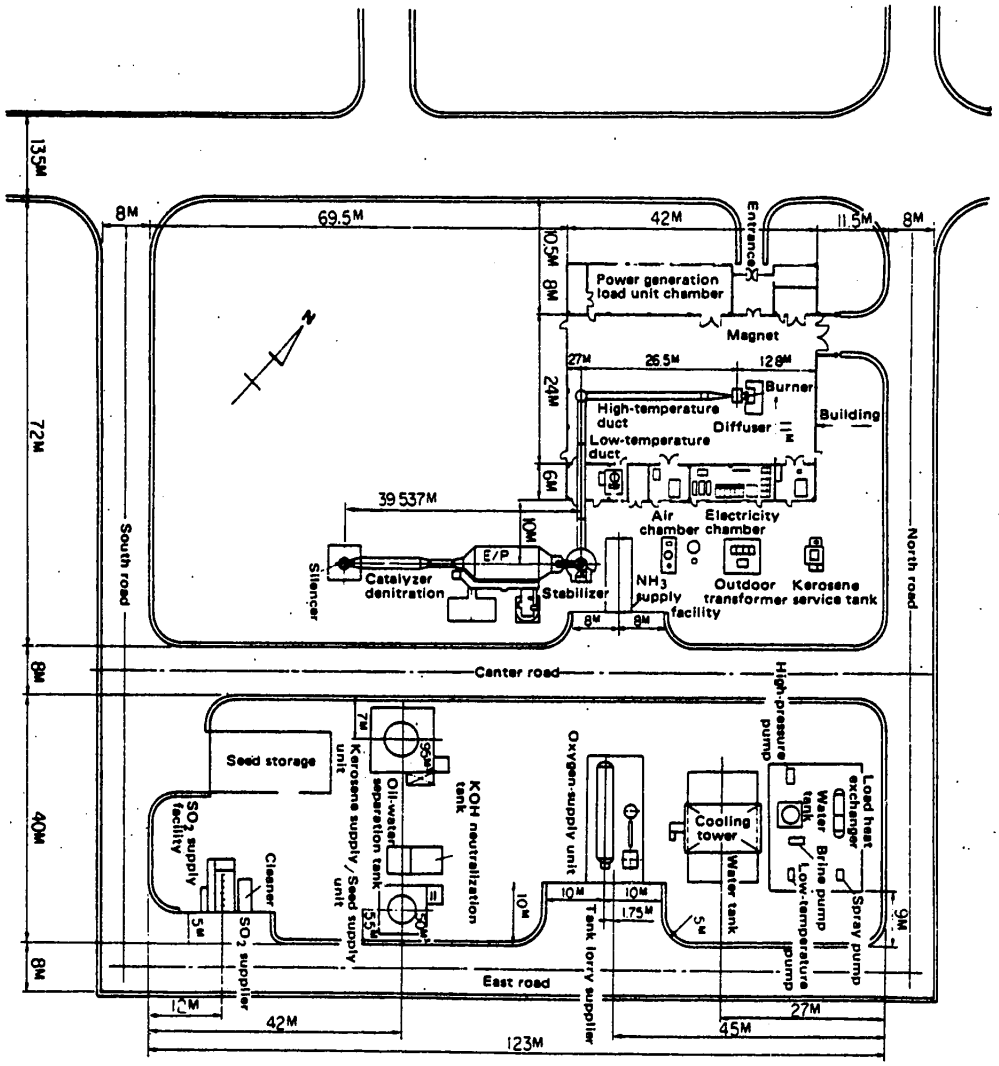

Fig. 4. Layout of Takasago Test Center

duct at the lower current part. The temperature-adjustment duct is used to adjust combustion gas temperature using a water spray, in order to obtain maximum denitration efficiency in the denitration duct. The total length is about 7.5m and the combustion gas temperature ranges from 1,300 to 1,050°C. The temperature-adjustment duct is constructed of a welded

water-cooled tube wall and passes circulating water from the steam generator to collect heat. The denitration duct is similar to the temperature-adjustment duct structurally, but it injects ammonia gas instead of a water spray and performs non-catalyzer denitration at high temperatures to decrease NOx concentrations.

The electrostatic dust precipitator is used to collect sulfuric acid kalium powder that is generated by the reaction of seeds with sulfur in the combustion gas. The precipitator clears the concentration of dust and SOx that are for exhaust gas control. NOx concentration is further decreased to below 200 ppm by the low temperature catalyzer denitration unit.

According to the Electrotechnical Laboratory the experimental study of the Mark VII gneerator is scheduled as follows:

(1) Adjustment of all system devices (April and May)
The overall adjustment will be made to the Mark VII generator.

(2) 1st experiment of power generation (June)
20-hour experimental generation will be made after adjusting trial operation (combustion test) to accumulate various experimental data.

(3) 2nd experimental power generation (September)
Experiment for power generation will be made aiming at 100kW/200 hours to accumulate data on durability of the generation channel.

(4) 3nd experimental power generation (November)
Based on the results of the previous experiment, parts of electrodes and insulated materials will be replaced for 100-hour experimental generation.

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SCIENCE AND TECHNOLOGY

HIGH-PERFORMANCE LOGIC VLSI

Tokyo TECHNOCRAT in English Vol 14, No 11, Nov 81 pp 54-55

[Text]

Nippon Telegraph & Telephone Public Corporation (NTT) has recently developed successfully, the highest level "Logic VLSI" in the world, which has about 20,000 gates on a chip of 1 cm^2, and which can calculate with 32 bits. Thus, a new VLSI processor using this Logic VLSI will possibly be introduced in 1983, and it can be said that the success of this VLSI has made one step forward to realize plans for the Information Network System (INS), one of NTT's new goals.

In developing a Logic VLSI, the problems to be overcome are higher integration, multiterminals, low power consumption, and shortening of the design period. Success has been due to adopting a CMOS technique with a minimum 2-μm linewidth, superfine processing techniques, and automatic design technique. As a result, the improved points are ½ in minimum linewidth, and about 1-½ time in integration, compared with data previously published.

The electronic exchange board (DEX) and the information processing system (DIPS), which have been developed and introduced by NTT, use processors in their central units, and development of the Logic VLSI, which constitutes the heart of the processor, will possibly be applied to the VLSI processor, and thus will contribute to developing processors, smaller in size and at low cost.

Because NTT's new goal -- , INS -- requires a higher network performance, merging electrical communications and information processing, a large number of performance processors will be necessary, and thus, this VLSI will contribute significantly to development of INS, which is now undergoing planning using a model system in the Musashino-Mitaka area of Tokyo.

The main features of the new Logic VLSI and the VLSI processor are as follows:

1. Main Features of Logic VLSI

(1) By using CMOS techniques with a minimum 2-μm linewidth, it can calculate with 32 bits, have high integration with a maximum of 20,000, and have low power consumption of 0.75 W. It also has 200 terminals.

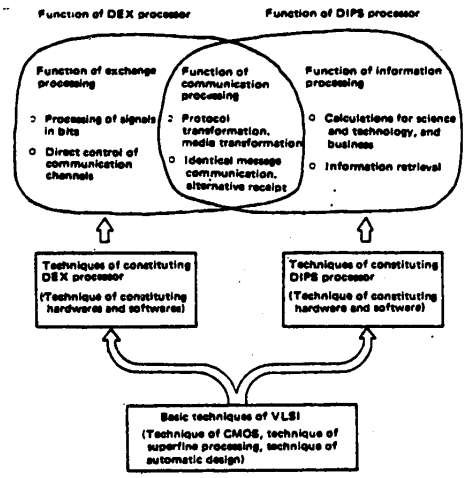
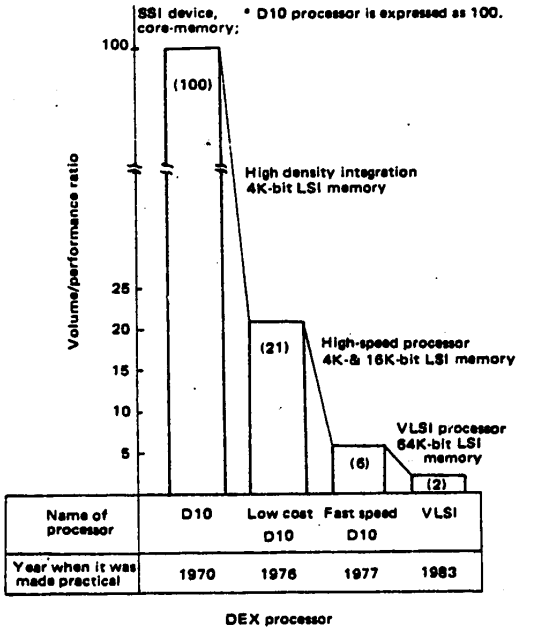


Fig. 1. Relation between Basic Technique of VLSI and Function Sharing of VLSI Processor

(2) By selecting combinations of common basic circuits (logic cell), many types of Logic VLSI's for DEX and DIPS can be made efficient and economic.

2. Main Features of VLSI Processor

(1) VLSI's processors for DEX can be used economically in a wide range of applications, smaller telephone exchanges handling a few thousand subscribers only, to those handling fifty thousand or more subscribers, by combining a number of processors in needs with an exchange's size.
(2) The VLSI processor for DIPS is a minimum scale type in the DIPS' series, having the functions of current DIPS, such as multiprocessor, high-level communications control, various processing and connecting functions with peripheral apparatus, and further, new functions, such as switching of power supply, handling operations, and diagnostic testing from a remote station.
(3) The software programs for both processors are the same as previously.



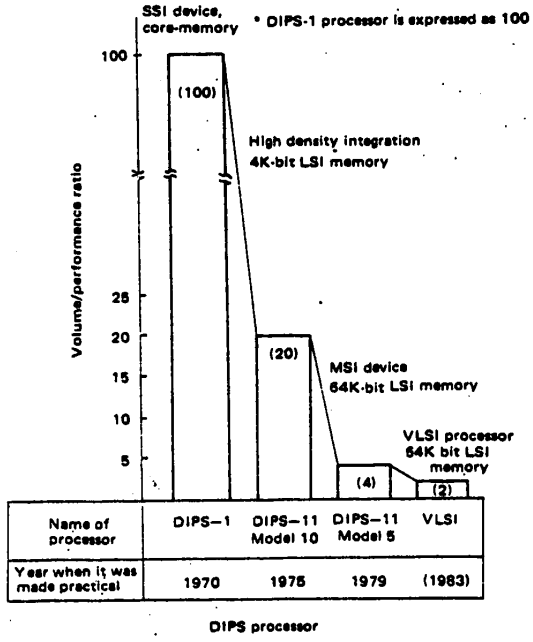


Fig. 2. Volume/Performance Ratio of DEX DIPS Processors (Yearly Changes of Small Size and Cost Reduction)

CSO: 4120/171

SCIENCE AND TECHNOLOGY

MATERIALS: RESEARCH OF BIONIC SYNTHESIS (1)

Tokyo TECHNOCRAT in English Vol 14, No 10, Oct 81 pp 37-42

[Text]

At present, biotechnology is highlighted as one of the technologies for the next generation. The Agency of Industrial Science and Technology, Ministry of International Trade and Industry (MITI), has proposed from FY 1981 a new item called 'Research and Development of Basic Technology for Industry in the Next Generation," and as one subject, has taken up biotechnology (budget for FY 1981: ¥675-million), naming the following three as prime development tasks:

1 Bioreactor for industrial use
2 Technology of cultivating large amounts of cells
3 Technology for utilizing rearranged DNA

However, since the 1970s, the agency has been engaged in research and development related to biotechnology as "Research of Bionic Synthesis". Here we introduce "Research of Bionic Synthesis" for FY 1981, as compiled by the Agency of Industrial Science and Technology.

Research of Bionic Synthesis"

Research of bionics, including application of the function of organisms to engineering and the creation of materials having organic functions, has basic concepts effective for solving various problems, such as information handling, labor-saving, etc. which are fields that are expected to make, rapid progress from now. To this end, while securing close research cooperation from research organs outside this agency, we will positively proceed the researches.

1. Research with Reference to Technology for Physical Measuring in Organisms

(1978–1982) Mechanical Engineering Laboratory (Special Study)

Targets:

A noninvading and efficient method for measuring various physical characteristics of systems of organisms and body fluids to be developed and related data processing system to be established. Further, as application to engineering and medical science, there is need for establishment of automatic diagnosing technology, sensors for robots, rehabilitation technology, and technology for measuring the speed of a blood flow.

Contents:

(1) Research of electric and dynamic characteristics of soft tissues

Data of the electric and dynamic characteristics of organs in a physiological state have been collected, at the same time, an apparatus enabling measurement of electric characteristics in the microwave zone of an organism, has been developed.

(a) Elucidation of dynamic characteristics: The oscillation characteristics and hardness of organs in a physiological state were measured and position-wise and case-wise data collected.

(b) Development of an apparatus for evaluating electric and dynamic characteristics: An apparatus and a probe for measuring the dielectric characteristics of an organism in the microwave zone were developed.

(c) Elucidation of electric characteristics: Measuring the dielectric characteristics of organs of organisms and classification per case were carried out. Image analysis of NMR (nuclear magnetic resonance) of the organs was carried out.

(d) Examination of safety: The invading states in a rat, of various organic materials, were examined and organism adaptability was evaluated.

(2) Research of optical measuring technology of a blood flow

Measuring of 2 – 3 animals was carried out using a Laser Doppler method, basic experiments investigating the correlation between blood flow rate (physical amount) and the state of organisms were carried out and consideration was also made with reference to the measuring limits and problems of the apparatus used.

(a) Measuring of blood flow under transparent tissue of an animal: Analysis of correlation between the organism control function and variation of blood flow rate.

(b) Measuring of subcutaneous blood flow: An apparatus for measuring subcutaneous blood flow of an animal was made on an experimental basis. And experimental consideration of the precision and measuring limits of the apparatus was made.

(c) Application of technology for measuring blood flow: Development of necessary attachments at each measuring position was carried out.

(3) Research of three-dimensional measuring technology of the structure of an organism

A practical apparatus for measuring the shapes of limbs was developed, and at the same time, junction of the measured results of the shapes with NC processing technology was continued.

(a), (b) Manufacture of an apparatus for measuring the shapes of the limbs: A practical-type apparatus for measuring the shapes of limbs utilizing a position sensor and a laser spot was constructed based on an improved Moiré-type method.
(c) Software: Based on data obtained by the aforesaid apparatus, software describing a curved surface was developed, and at the same time, a system for connecting this to NC processing was developed.
(d) Technology for fabricating an artificial limb socket: Based on actual measured results of the shapes of limbs, an experiment for reproducing such shapes was carried out.
(e) Evaluation of the adaptability of an artificial limb socket: Data concerning distribution of internal pressure of an artificial limb socket were collected, and at the same time, evaluation of the adaptability of the socket was examined.
(f) Technology for fabricating an artificial joint: The possibility of indicating a bone-like shape by a contour line image was examined.

Progress:
(1) Research of electric and dynamic characteristics of soft tissue

FY 1977: In "The material strength characteristics of an organism system" (Tokken), the electric and dynamic characteristics of hard tissue and a part of soft tissue were elucidated.

FY 1978: The dependence on the frequency of sonic speed of ultrasonic waves and absorption damping rate in soft tissue were examined, position-wise and case-wise classification was made, at the same time, a probe for measuring the viscoelasticity of an organism which was clinically usable, was fabricated on an experimental basis. FY 1979: Measuring of the dielectric spectrum of soft tissue and an apparatus for handling information of an organism were developed. FY 1980: Elucidation of electric and dynamic characteristics of specimens of organs and development of an apparatus for measuring kinetic physical properties, capable of measuring an organism were carried out.
(2) Research of technology for optically measuring a blood flow

FY 1977: In "Optical information handling in a compound eye" (Tokken), transfer of superfine granules in an organism was measured using a Laser Doppler method and basic data for applying the method were obtained. FY 1978: A Laser Doppler apparatus for measuring blood flow was fabricated on an experimental basis, and the measuring method, measuring precision and optimum wavelength were examined. FY 1979: Measuring of the flow rate of the blood flow at fixed positions (tail and fin of a fish) was carried out, a Doppler signal handling apparatus was constructed on an experimental basis and a simple preliminary experiment for measuring weak light by the Foton Counting method was carried out.

FY 1980: Measuring of distribution of flow rate at each position of organisms (tail and fin of a fish and mesentery of a

rat) was carried out and the response to stimulus of variation of flow rate was examined. And a weak light data processing apparatus was fabricated on an experimental basis. As the optimum position to be measured, a blood vessel under transparent tissue was selected.

(3) Research of technology for three-dimensionally measuring the structure of an organism.

FY 1979: Examination was made concerning measuring a curved surface shape, and at the same time, a curved surface measuring system based on Moiré's method was developed.

FY 1980: Improvement to the curved surface measuring system based on Moiré's method was made, and at the same time, designing of a practical curved surface measuring system was completed.

2. Research Concerning an Enzyme Reactor

(1979–1983) National Chemical Laboratory for Industry (Special Study)

Target:

In recent years, in along with the rapid development of biochemistry, development of research concerning reactions of biochemical methods to chemical synthesis and related technologies, has been strongly requested by industrial circles. To meet this request, development of technology for applying a biochemical method to synthetic chemical industries was made a target.

Contents:

By a reactor using a hollow system or a molecular sieve membrane, the relation between a substrate (especially long-chain fatty acid) and transfer of a substance was examined, and further, examination of a composite enzyme system reactor was started. As such an enzyme system, the composite enzyme system of the previous fiscal year was used, using mixed fatty acid, such as fish oil, containing highly unsaturated fatty acid as a material, prostaglandin was synthesized.

Progress:

Improvement of an enzyme reactor and construction of a hollow reactor on an experimental basis were carried out, data for development of a composite enzyme reactor for synthesis were obtained, and at the same time, the actions of various enzymes to unsaturated fatty acids for synthesis of prostaglandin and the influence of additives were clarified.

3. Research Concerning Production of an Active

Substance of an Organism Utilizing the Function of the Organism

(1980–1983) Fermentation Research Institute (Special Study)

Target:

Utilizing the unique function of a creature, a novel active substance of an organism was sought, whose biochemical production technology was developed to attain energy saving and high advancement of technology for preparing fine chemicals, and at the same time, contributing to human welfare was aimed at. As specific targets:

(1) Elucidation of an enzyme function control substance (phosphodiesterae-obstructing substance) and development of its field applications.

(2) Search for a microorganism producing a hormone action-related substance by the use of animal cultured cells and development of production technology by a microorganism.

(3) Development of D-peptide decomposition enzyme and synthetic enzyme, and development of synthetic technology for D-amino acid-containing peptide by an enzyme reaction.

Contents:

(1) Development of an enzyme function control substance

The structure of phosphodiesterase-obstructing substance produced by a newly found microorganism was analyzed by a method such, as analysis using a machine or tool.

(2) Search for a microorganism producing hormone action-related substances

Examination was made about production conditions and separation and refinement of a blood pressure-reducing substance obtained in the previous fiscal year.

(3) Development of technology for production and separation of enzyme decomposing D-peptide

(a) Examination was made about production conditions for enzyme decomposing D-peptide by a microorganism obtained by separation and selection from nature. (b) The influence of temperature, ion strength and kind of enzyme (mainly molecular weight) exerted over aqueous two-phase distribution was analyzed.

Progress:

(1) During the previous fiscal year, a microorganism producing a substance obstructing phosphodiesterase was discovered and it was possible to examine culture conditions and therefore, completely refine this obstructing substance.

(2) In an ordinary research, culture conditions for the system of animal kidney cells were examined and by these cells, a method of examining a hormone, such as vasopressin was established. From FY 1980, as a special study, a hormone examining method by radioimino assay method was examined and separation and search for a bacillus producing a blood pressure control substance was carried out.

(3) In FY 1980, search for a bacillus decomposing peptide containing D-amino acid was carried out and it was possible to separate two kinds of bacilli. With reference to an aqueous two-phase distribution method, examination was made about the influence of the kind of polymer and pH exerted over the distribution coefficient.

4. Research Concerning Engineering Synthetic Utilization of Enzyme Functions

(1980–1984) Fermentation Research Institute (Special Study)

Target:

Enzyme reactions are to be systematized engineeringly to develop high-degree utilization technology to provide applications to the chemical engineering and medical industries. More specifically, development of the following technologies is being aimed at:

(1) Preparation of an ion selective membrane having a novel function

(2) Development of general enzyme fixing technology by the above ion selective membrane and its novel application

Contents:

(1) Examination of a process for preparing a membrane substance having an ion exchange function was carried out.

(2) Examination was made of general fixing conditions for enzyme urease by the above membrane substance.

Progress:

In FY 1980, by using p-chloromethyl polystyrene as a starting material and working thereon ethylene diamine and trimethyl amine, it was possible to prepare a polystyrene derivative containing quaternary amine. Next, using the same derivative, it was possible to make urease into the state of microcapsules by a drying method in a liquid.

5. Research Concerning Development and Processing Technology of an Active High Polymer of an Organism

(1978–1982) Research Institute for Polymers and Textiles (Special Study)

Target:

In order to develop an engineering process utilizing the function of an organism effectively in the energy-saving field, a continuous chemical process at room temperature, by fixing of an active high polymer of an organism is to be designed.

Cotents:
(1) Research of development of an active high polymer of an organism

As a model of a functional high polymer, a composite unit of nickel borate and polyvinyl alcohol or polyvinyl pyrrolidone was selected and in order to raise catalytic activities, optimum production conditions in a colloidal state having a large surface area were sought, and at the same time, stabilization was attempted. Further, with reference to a liquid membrane using a copolymer containing vinyl adenines, its function as a reaction place was elucidated. And, the influence by a liquid crystal exerted over the asymmetric synthesis reaction to be carried out in a cholesteric liquid crystal solvent, was examined with the possibility of realizing the structure of an organism-like function being sought.

(2) Research of processing technology by fixation

An apparatus having a filter paper-type fixed carrier with a large surface area, was used and a continuous enzyme reaction experiment at a high-flow rate was carried out.Further, a composite apparatus capable of carrying out a nonaqueous enzyme reaction was constructed on an experimental basis, and using the already made fixed carrier, a basic experiment for processing was carried out.

Progress:
(1) Research for development of an active high polymer of an organism

Various metal complex-type polypeptides were synthesized to evaluate the active function of an organism and the oxygen transporting function of a cobalt-histidine complex was ascertained. The catalytic effects of a hydrophobic liquid membrane were recognized. (One patent application was filed on the basis.) The dependence on the temperature of a liquid crystal of the cholesteric series and a cholesterol liquid crystal was clarified to ascertain change as places for the reaction.

(2) Research for processing technology by fixation

It was ascertained that the adsorption activity of enzyme by aminoacetalized, sulfonated and ion complexed polyvinyl alcohol was high (three patent applications were filed on the basis) and the properties of a fixed membrane by optical cross-linking was analyzed. It was ascertained that an adsorption-type carrier adsorbed a large amount of enzyme by the surface treatment with fine fiber, establishment of a simultaneous enzyme reaction and filtration system incorporated with a filter paper-type carrier, using the same, was carried out (one patent application was filed on the basis).

6. Research Concerning a Material of a High Polymer Having a Pharmacological Action

(1980–1984) Research Institute for Polymers and Textiles (Special Study)

Target:

The contribution of medicines to medical welfare and securing of resources is very great. This research is characterized by utilizing properties inherent in a high polymer possessed by an organism and a synthesized high polymer, and development of materials of a high polymer having a pharmacological action from the two aspects of the synthesis of a molecule having a pharmacological activity, and synthesis of a high polymer helping a pharmacological activity was carried out.

Contents:

(1) Research of a high polymer for slowly releasing medicines

(a) Research of a high polymer chemically connecting a medicine: The hormone activity of a water-soluble high polymer bonding somatostatin was measured and the relation between the bonding method and the activity was examined.

(b) Research of a high polymer physically retaining a medicine. The medicine stabilizing action and it slow release of cyclodextrin becoming a cross-linked high polymer were examined. Further, the cross-linking conditions were examined.

(2) Research of a high polymer having a pharmacological action

(a) Research on the synthesis of peptide having a pharmacological activity: As polypeptide, high in activity, a somatostation derivative was synthesized and its activity was measured. The evaluation of recognition of an indispensable metal ion in an organism of biscyclopeptide containing a synthesized non-protein amino acid and a basic amino acid, was carried out.

(b) Research of synthesis of a high polymer having a pharmacological activity: The cancer inhibiting action of a maleic anhydride – vinyl ester copolymer bonding 5-fluorouracil and nitrogen mustard, was examined.

(3) Research of a high polymer having a pharmacological action and a capacity of recognizing the affected part

The mark recognizing capacity (for example, gathering to the affected liver) possessed by latex, was examined.

Progress:

(1) Research of a high polymer for slowly releasing a medicine

(a) Research of a high polymer chemically bonding a medicine. Somatostatin was bonded ionically to a water-soluble high polymer and the strength of bonding was measured.

(b) Research of a high polymer physically retaining a medicine: The medicine stabilizing capacity of cyclodextrin was measured.

(2) Research of a high polymer having a pharmacological action

(a) Research of polypeptide having pharmacological activity: Somatostatin having a hormone action was synthesized by a solid-phase method and biscyclopeptide having an ionofore (phonetic) action was synthesized by a liquid-phase method.
(b) Research on the synthesis of a synthetic high polymer having a pharmacological activity: It was studied to bond a maleic anhydride – divinyl ester copolymer to 5-fluorouracil, a cancer-inhibiting drug.

7. Research of an Adsorption-Type Artificial Kidney Material and Its System

(1981–1984) Research Institute for Polymers and Textiles (Special Study)

Target:
In order to contribute to medical welfare and the information industry's technology, for the purpose of developing a material for adsorption-type artificial internal organs and a blood component sensor, a material having a particular function of adsorbing or responding to organism components and its system was studied.

Contents:
(1) Research on an adsorbing material of organism components and its system
A composite high polymer material combining polyhydroxy ethyl methacrylate (PHEMA) with various materials such as an inorganic adsorbent was prepared and the selective adsorbing capacity to specified electrolytes such as inorganic phosphorus was examined to seek the compatibility with an organism of these composite materials.
(2) Research of a blood component sensor
In order to control reaction between leucine amino peptide and a substrate, an experiment centering around pH control was carried out.

Progress:
In the special research conducted until FY 1980, a human body function substituting system was studied and the following results were obtained:
(1) A plasma separator was developed to obtain the possibility of realizing an adsorption-type artificial kidney, and at the same time, direction of development concerning novel absorbing materials was found.
(2) Research of an artificial internal organ circuit was carried out and knowledge of a material having thrombus resistance was obtained.
(3) In a research of an adsorption system initiated from FY 1978, an adsorbent to a poisonous substance, such as ammonia, was developed. A research entitled "Research concerning separating technology of organism components" at the

expense of the Special Research Promotion Adjustment Fund of the Science and Technology Agency, was carried out in FY 1979 and 1980. In "Special research concerning energy of an organism" conducted until FY 1980, new knowledge was obtained about the electric potential of an organism membrane. Also, an oxygen electrode aimed at urea and GPT was fabricated and made into a sensor.

8. Research Concerning an Information Handling System of an Organism

(1980–1990) (Electrotechnical Laboratory (Special Study)

Target:

This research will solidify the basis of development of the information handling technology and measuring technology of a high degree, in the next generation, by elucidating the mechanism of an excellent information handling function possessed by an organisn.

Contents:

(1) Research of acceptance and conversion technology of information obtained by visual sense

For the purpose of separating the visual stimulus process from the outer knot to the inner knot of the visual cell, the feed-back process from the secondary neuron to the visual cell, the electric potential of a single cell of the rod visual cell and the pyramid visual cell, were measured, and the response of this visual cell to an optical stimulus was examined. Also, a computer simulation of the electric potential generating membrane of the visual cell, was carried out and the photoelectric conversion function was considered.

(2) Research on stimulating membranes of an organism

Of proteins constituting the stimulating membranes of an organism, cellular bone proteins, such as a very small tubular microfilament are considered to control the function of generation and dissemination of stimulus were noticed and the physiological functions of these proteins were elucidated in detail.

(3) Research on formation of an organic imitation place and revelation of the function

The change of structure of membranes, such as ribosom, taken place when a peculiar interaction is carried out between molecules in the medium and an organism by simple ribosom and a lipid membrane abnormally accumulated, was closely examined.

(4) Research on the function of a composite neuron group system

For the purpose of clarifying a highly reliable transmission mechanism due to the parallel and cooperative information handling of a composite neuron group:

(a) The effective computer utilizing method to the analysis of system data of an organism when it has a large capacity,

was established. (b) The algorithm extracting interdependence in terms of space and time of the system at the time of applying an impulse to the activity of the neuron group, was developed.

(5) Research in terms of information system of the function of an organism

(a) The perceptual interaction of a motion diagram and a still diagram was examined using an optical illusion diagram.

(b) The function of information handling of neuron cells in the visual nerve system, was examined from the viewpoint of space frequency analysis and the evoking eyeball motion.

(6) Research on the responsive characteristics of color sense structure

For the purpose of elucidating responsive characteristics of color sense structure necessary for establishing the predicting form of a visible color of a colored matter under optional illumination conditions, the following researches were carried out.

(a) The stimulus presenting portion of an apparatus for experimenting with a reactive color response was developed.

(b) The responsive characteristics to the strength of a stimulating light of outer knee-shaped cells of an organism, was extracted.

Progress:

This research attempted to elucidate the function of an organism as an organically connected information handling system from FY 1981, on the basis of achievement of the "Research concerning the information handling function of an organism" completed in FY 1980.

(1) Research on acceptance and conversion functions of information perceived by the visual sense

In the "Research on responsive functions of the visual sense system," color signal transmission characteristics of horizontal cells and the background optical effect to the accepting field of bipolar cells were made clear, and at the same time, antagonism (reciprocity) of a color signal and space information in the accepting field of the visual sense of both the cells, were considered and a feed-back signal to the visual cells from these cells, was confirmed.

(2) Research on the function of a stimulating membrane of an organism

In the "Research of information handling function of an organism," for the first time in the world, breeding of squids in a water vessel was carried out successfully, making possible a constant supply samples of good quality, and at the same time, it was elucidated that the phenomenon of nerve stimulus was of the same type as the phenomenon of laser oscillation. Further, restructure of the nerve was realized.

(3) Research on formation of a synthetized organism imitation position and revelation of the function

In the "Research on the physical properties of organism-related substances," a model liquid crystal of an organism was

developed and structural change of the liquid crystal along with ion and intermolecular interaction, was made clear. A lipid unimolecular membrane was formed and the relationship of the surface electric potential with the structure of the membrane was examined.

(4) Research on the function of a composite neuron group system

In the "Research on the modeling of the function of a nerve group," a multicompact electrode apparatus was developed, making it possible to record simultaneously, the acting electric potential of the neuron group, three-dimensionally distributed and existing locally in the local and microwave zones. In FY 1978–1980, a learning nerve model capable of systematically describing characteristics concerning acquisition of learning, had been proposed and analyzed.

(5) Research on function of an organism in terms of an information system

In the "Research on a system of information handling function of an organism," chronic experimental technology of a cat was established. The edge emphasizing action of a diagram was proved by the neuron cells of a cat. Using Pockendorf's diagram, perceptual interaction of a still diagram and a motion diagram, was made clear.

(6) Research on the responsive characteristics of the color sense system.

From the visual evoking brain wave, a response in the opposite color was extracted for the first time in the world. A nerve joining model concerning color adaptability was devised, and further, a nonlinear color-adaptable model was developed. This model made it possible to systematically predict various color preceiving phenomena hitherto regarded as independent.

CSO: 4120/171

SCIENCE AND TECHNOLOGY

MATERIALS: RESEARCH OF BIONICS SYNTHESIS (2)

Tokyo TECHNOCRAT in English Vol 14, No 11, Nov 81 pp 40-45

[Text]

9. Research on Adaptability of a Synthetized Polyamino Acid Composite Membrane to a Material of the Outermost Cutis Layer

(1978–1983) (Industrial Products Research Institute) (Special Study)

Target:

For securing cutis for grafting, much time and labor is required and considerable human and material investment is also required, in addition, it is said that there is a problem in storage of such cutis over long periods. Therefore, for covering damaged areas of the cutis outermost layer and protecting the areas until the epithelium reclaims thereon, development of a wound-covering material of a composite membrane, composed of synthetic polyamino acid was made the target.

Content:

(a) An experiment for examination concerning the adaptability as a material for the cutis outermost, of a composite polyamino acid/vinyl polymer membrane carried out in the previous fiscal year, was continued. Namely, a composite membrane of a Teflon vinyl polymer, etc. was synthesized, having physical properties such as permeability of saccharide, electrolyte, oxygen and aqueous vapor, as well as strength and elongation, and was measured.

(b) As a polyamino acid membrane, a carbobenzoxylidine-benzyl glutamate copolymer membrane and its composite membrane were synthesized, the relationship between the copolymer composition and making it hydrophilic is made clear, and measurement of the same as in (a) was carried out to examine aptitude as a substitute for the cutis.

Progress:

During the period from FY1973 to FY1977, "Research concerning the synthesis of a high polymer membrane having a physiological action and a permeating membrane" was carried out. Making an amino acid polymer which was the

closest to protein, constituting an organism was made the object, whose membrane-forming property and permeability were explained. In the first year of this research, FY1978, as a chemically treatable polyamino acid membrane, membranes of polymethionine membrane, polybenzyl glutamate membrane and a leucine-benzyl glutamate copolymer were taken up, and making only one surface thereof, hydrophilic properties were studied. Structural analysis was also carried out. In FY1979, with reference to membranes obtained by making one surface and two surfaces thereof, hydrophilic, their strength, elongation, permeability of oxygen and aqueous vapor as well as solute, were measured to examine their functions as substitutes for the cutis. In FY1980, for the preparation of a composite membrane of a vinyl polymer and polyamino acid, a plasma treatment was carried out to improve bondability.

10. Research on Fluorine-Containing Functional Materials of An Organism

(1974–1981) (Government Industrial Research Institute, Nagoya) (Special Study)

Target:

A fluorine chemical manufacture using fluorine chemistry, has already been studied and developed extensively, as a life science-related industry, especially, concerning research and development of materials for functions organisms based on fluorine-containing organic compounds, to which attention has been paid. For example, development of fluorocarbons as artificial blood (oxygen transporting liquid) and research on the synthesis of fluorine-containing amino acid derivatives, anticipated to have physiological activity, at present attract attention.

This laboratory has heretofore been engaged in research of fluorine chemistry, whose achievements have been highly evaluated in and out of Japan, making such achievements as the basis, research is being driven forward, such as the synthesis of materials for artificial blood and physiologically active compounds, playing a guiding role for the further development of Japan's fluorine chemistry and industry as well as life science.

Content:

(1) Synthesis of fluorocarbons

Perfluoroalkyl substituted adamantanes were synthesized by electrolytic fluorination of adamantanes having halogenated alkyls or fluorination by high-degree metal fluoride. The characteristics of the perfluorocarbons obtained were compared with those of previously synthesized materials and their evaluation as artificial blood was carried out.

(2) Synthesis of fluorine-containing surface active agents

Surface active agents of the perfluoroalkyl group series containing phosphorus and nitrogen were synthesized and the various properties of fluorocarbon emulsions (emulfication

rate, distribution of particle size, turbidity, etc.) of these surface active agents were measured. Further, the performance of materials for artificial blood as emulsifiers was sought, and at the same time, these agents were compared with nonionic fluorine-containing surface active agents in respect of emulsifying properties and the results were studied.

(3) Synthesis of fluorine-containing amino acids

By introducing the perfluoroalkyl group to the imidazol ring of histidines, synthesis of fluorine-containing amino acids, each having a physiological action, was carried out. Also, the synthesis of fluorine-containing derivatives of histidines and urocanins that, are metabolic intermediates in an organism was attempted.

Progress:

Based on the technology and results accumulated by the research of fluorine chemistry at the laboratory, research concerning materials for the function of a fluorine-containing organism was carried out. Namely, in the research on the synthesis of fluorocarbons as materials for artificial blood (oxygen transporting liquid), in FY1974, perfluorocyclo-alkanes were synthesized by an electrolytic fluorination method, in FY1975, trifluoromethyl substituted perfluoro-cyclohexanes were synthesized, in FY1977, a chain-like perfluoroether was synthesized, in FY1978, long chain perfluorocarbon ethers were synthesized, FY1979, perfluoroadamantane was synthesized and FY1980, per fluoroalkyl adamantane was synthesized. In research on the synthesis of fluorine-containing surface active agents, in FY1974, an addition the reaction of fluroalcohol, fluorocarboxylic acid and ethylene oxide was also carried out, in FY1975, addition reactions of perfluorocarboxylic acid, amid perfluorocarboxylate and ethylene oxide were carried out, in FY1976, addition reactions of fluorine-containing alcohols having various structures, a fluorine-containing carboxylic acid derivative and ethylene oxide were carried out, in FY1977, addition reactions of a fluorinated ester and amines were carried out, in FY1978, a fluorine-containing surface active agent was prepared by a 1:1 addition reaction of long-chain fluoroalkyl and ethylene oxide was carried out, in FY1979, a multimolar adduct was synthesized by a similar reaction, and in FY1980, fluorocarbon emulsions were prepared by these nonionic fluorine-containing surface active agents and their behaviors as emulsifiers were elucidated. In research on the synthesis of fluorine-containing amino acids, in FY1974, fluorine-containing alanins were synthesized, in FY1975, fluorine-containing phenyl alanins were synthesized and in FY1976, alanins, each having a fluorine-containing furil group were synthesized. In FY1977, a fluorine-containing amino acid precursor was synthesized, in FY1978, amino acid having a fluoropyridine group, a fluorophenyl group or a fluoroalkyl group was synthesized, in FY1979, examination of a process for synthesizing fluorine-containing amino acid via oxazole, and the synthesis of amino acid having a substituted polyfluorophenyl group were carried out, and in FY1980, the synthesis of a valine derivative containing a polyfluoroalkyl group and the synthesis of amino acid having a pentafluoro-

phenylthyroxy group were carried out. In FY1977–1980, an entrusted research concerning a material for fluorocarbon oxygen transporting liquid was carried out at the Medicine Faculty, of Osaka University.

11. Research Concerning Blood Compatibility of High-polymer Material and Application to Artificial Internal Organs

(1978–1981) (Government Industrial Research Institute, Osaka) (Special Study)

Research Concerning the Medical Evaluation of Thrombus Resistance of a High-Polymer Material, an Antithrombosis Substance and a Line-Soluble Substance Fixing Material

(Chemical Research Department of National Osaka Hospital) (Entrusted Study)

Target:

Artificial internal organs are now contributing to life saving of many people, however, there are still many unexplained points to be solved. The first such important point is that a high-polymer material for artificial internal organs should be resistant to thrombosis. This research will examine the problem of blood coagulation by a high-polymer material to establish the guiding principle for development of an antithrombosis material, and at the same time, improve the thrombus resistance of existing materials and additionally, develop a new dialysis system, such as an artificial kidney, wherein lies the target.

(1) Research on surface characteristics of a material and blood compatibility

The surface structure of a material, interaction of physical properties and blood components, and the physical properties of a material for making it into heparin, must be made clear to obtain the guiding principle for developing antithrombosis material.

(2) Synthesis of a material compatible with blood and its application to artificial internal organs

(a) By a surface polymerization method, and a surface modification method, an antithrombosis material will be developed. (b) By research of a polysaccharide composite membrane. a new dialysis system will be developed.

Content:

(1) Research on surface characteristics of the material and blood compatibility

(a) The interaction of a material's surface and blood components: The surface characteristics of materials different in thrombosis-forming capacity, and adsorption of plasma protein, are measured using mainly, a spectroscopic method. And adhesion of the thrombocyte and change of the shape are observed by both optical and electron microscopes. The measured results of the two are compared and examined to

collect the correlation between adhesion of the thrombocyte, adsorption of protein, and the kind of material. (b) With reference to materials, making a matter into heparin (covalent bond method, electrovalent bond method) different in thrombus resistance, bonding density and content, the elution behavior (safety) of these bonded heparins were examined and the relation with the thrombus resistance was collected.

(2) Synthesis of a material compatible with blood and its application to artificial internal organs

(a) Synthesis of a composite antithrombosis material: Applying surface polymerization and surface modification treatment methods, thrombus resistance is improved, and various tubes were made and experiments using animals with these tubes were carried out to evaluate the aptitude as a blood circuit material. (b) Research on a dialysis system having a new function: Based on the analyzed results of a very small amount of urine components obtained in the previous year, the practical evaluation of a polysaccharide composite membrane as an artificial dialysis membrane was carried out.

Progress:

(1) Research on the material surface and the blood compatibility

In FY1978, for research of the surface structure of a material, SEM, ATR infrared methods, and a Raman total internal reflection method were employed to examine the surface structure. Especially, concerning the Raman total internal reflection method, a measuring technique was established. A Flocel (phonetic) system for a microscope was made on an experimental basis to examine the relation between the flowing conditions of the thrombocyte and plasma, and the adhesion of the thrombocyte. In silicone rubber becoming heparin by a covalent method, increase of the density of heparin bond increased the retaining strength of heparin and good thrombus resistance was shown in an organism. In FY1979, using the Raman total internal reflection method, a double-layer sample was measured, the measurable surface thickness was examined in detail. The basic capability as a surface measuring method was established. With reference to 7 kinds of high-polymer material and 6 kinds of plasma portion, the adsorbed amounts of protein were measured and their relationship with thrombus resistance was examined. With reference to quaternary basic polymers, their cation contents and the underwater dissociation behavior of anion complex of an acid coloring matter and the polymers were made clear. In FY1980, using a Fourier infrared internal reflection spectroscopic method, the adsorbed amounts of plasma protein and lipid were measured and their relation with the kind of material was clarified. With reference to matter grafted to polyethylene, the hydrophilic degree, distribution of graft chains and adhesion of thrombocyte, change of the shape and relationship thereof with thrombus resistance were examined.

(2) The synthesis of a material compatible with blood and its application to artificial internal organs

In FY1978, a high-polymer film was impregnated with many compounds, thereafter, a glow discharge treatment was

carried out and the relationship of the film with the thrombus resistance was examined. And from a polyethylene graft copolymer, a high-polymer complex was synthesized. The membrane-making conditions of a chitoson membrane were examined, a membrane excellent in solute permeability was obtained and the relationship between the membrane structure and the permeable characteristics was clarified. Siloxane having a polar substituent was synthesized and various properties thereof were examined.

In FY1979, a flow discharge treatment method was examined and the relationship between thrombus resistance of a sample and the treated effect was examined. The safety of the synthesized high-polymer electrolyte complex was tested to ascertain that it was sufficiently stable. A composite membrane of the chitosan fibrous active carbon series was prepared, and permeability and adsorbing capacity were examined. Two kinds of silicon compound, each having a polar group, were selected and a low molecular weight polymer was obtained therefrom.

In FY1980, it was shown that 1,2-polybutadiene material subjected to a glow discharge treatment was improved in thrombus resistance and there was no deterioration of the substrate. The thrombus resistance of a high-polymer electrolyte complex was evaluated in an organism. And it was made clear that graft acrylamide to polyethylene was especially significant in thrombus resistance. The analysis of urine components was carried out and it was clear that cellulose membrane and chitosan membrane differed considerably in permeability and adsorbing properties.

12. Research Concerning Development of Biochemical Pulping Technology

(1980–1983) (Government Industrial Research Institute, Shikoku) (Special Study)

Target:

As pulping methods, until now there have been, roughly, only two kinds, namely, a mechanical pulping method and a chemical pulping method. From the viewpoint of effective utilization of unused natural resources, it is necessary to newly add to these a biochemical pulping method. An object of this research resides in establishing the basis of applied technology to nonwood fiber out of a biochemical pulping method. The most important material of nonwood fibers, is bast fiber, which is used for making high-class paper. Therefore, this research aims broadly, at searching for the kind of bacillus producing an enzyme system effective for pulping bast, using such bacillus in overcoming a slow reaction rate which is a shortcoming possessed by the enzyme, and searching for a new biochemical pulping system for making pulp having paper-making characteristics comparing favorably with chemical pulp.

Content:

(1) Research on technology for producing a pulping enzyme

In order to advance the productivity of the enzyme of Bacillus sp. GIR-277, separated and identified at this laboratory, using a physicochemical method, various species were produced. A ten-fold productivity of the present productive capacity of enzyme was aimed at.

(2) Research on pulping technology

Continuous to the previous fiscal year, optimum pulping conditions were sought centering around the relationship between the amount of enzyme and the degree of pulping.

(3) Evaluation of biochemical pulp

The physical properties of a pulp sheet and paper-making characteristics were examined and evaluation was also made concerning the correlation between pulping conditions and physical properties of the resultant pulp sheet. Again, comparison with pulping by Erwinia enzyme was carried out.

Progress:

Of a group of bacilli having affinity with alkali, there was what produced a pectin-decomposed enzyme and as a most powerful productive bacillus, Bacillus sp. GIR-277, was obtained. This bacillus produced lyase pectate by alkali culture. By examining culture conditions from various angles, it was possible to increase the enzyme productive capacity to 5–10 times. And it turned out that a pulp sheet comparing favorably with chemical pulp sheet was obtained by either Letting's (phonetic) method or an enzyme method.

1. Research on Visual Sense Function and Simulation

(Study in FY1981) (Mechanical Engineering Laboratory)

The nerve structure of a composite eye visible system is being examined, and at the same time, application of the image handling to the medical zone will be explained.

(1) The nerve structure of the information handling mechanism in the composite eye visual sense nerve system will be analyzed.

(2) The treating method for automatic detection of focus at the liver and RI image, will be established.

2. Research on Energy Conversion Organism-like Functional Material

(Study in FY1981) (National Chemical Laboratory for Industry)

From an organism having high activity and a stable energy conversion system, an energy conversion element is to be extracted and incorporated in a stabilized artificial membrane,

and as an artificial energy conversion element, an aggregate of various coloring matters and electronic carriers is to be prepared and the energy conversion function of artificial membranes incorporating the aggregates (lipid membrane, liquid membrane) is to be examined.

3. Research of Organism-like Reaction Transporting Membrane

(Study in FY1981) (National Chemical Laboratory for Industry)

Based on previously conducted research concerning preparation of an artificial organism membrane, first of all, an efficient separating membrane, especially a membrane which could separate a substance similar to an organic substance, is to be developed. In a carbonic acid fixing reaction, a reaction synthesizing a low molecular weight organic acid having about 4 carbon atoms from CO_2, is to be examined and in research of an artificial enzyme, oxidized, then a reduced enzyme model is to be prepared and its functions are to be examined.

4. Research on Stability of Spherical Protein and Three-dimensional Structure

(Study in FY1981) (Research Institute for Polymers and Textiles)

By changing the annular state of spherical protein, such as an enzyme, conditions for enabling enzyme to maintain the enzymatic activity and its structure at a high degree at high and low temperatures, is to be sought. In this fiscal year, saccharide peculiarly bonding to this protein will be added mainly to a lysozime solution to measure the change of the bonding constant by temperature and the influence given by the bond formed over stability to heat of the structure of a high degree of lysozime will be sought.

5. Physical Properties of a Nucleic Acid and Its Utilization as a Functional Material

(Study in FY1981) (Research Institute for Polymers and Textiles

Various characteristics of a nucleic acid fragment will be clarified from the study of its physical properties, and at the same time, creation of functional groups utilizing these

characteristics will be attempted. In this fiscal year, the interaction of a nucleic acid fragment and a substance of a different kind will be studied and its application as a high-polymer material for selective separation will be examined.

6. Research on Interaction Between a High-polymer Interface and Cells

(Study in FY1981) (Research Institute for Polymers and Textiles)

The interaction of cells and protein with a high-polymer interface is being investigated in connection with the physical properties of the material surface and acquisition of the basis of the material designing in separation technology of cells and protein, development of an antithrombosis material and culture technology of cell, is aimed at. In this fiscal year, the adsorbing behavior of the thrombocyte with reference to natural and synthetic high polymer material whose surface characteristics are controlled and the connection between the adsorbing behavior and the surface physical properties, such as surface energy and surface electric charge, are being sought systematically.

7. Fixation of Membrane of an Organism and Its Selective and Active Transport

(Study in FY1981) (Research Institute for Polymers and Textiles)

For the purpose of realizing utilization of the selective and active transporting functions of various metal ions possessed by the membrane of an organism, fixation of the membrane of the organism to a high-polymer material, is being attempted. To that end, formation and culture of plotoplast of a microorganism and bonding between plotoplasts and bonding to a lipid membrane is being attempted to seek their stabilized conditions. Further, they will be synthesized, and bonding to high-polymer materials is to be examined.

8. Research of Constitution of a Chemical Sensor for Organism-imitation Organic Membrane

(Study in FY1981) (Research Institute for Polymers and Textiles)

A creature has the capacity of detecting and discriminating very small amounts of chemical substances as taste and smell. It is also known that a creature reveals the function of accepting chemical information and converting it to an electric

signal and handling such signal at a level of the membrane of the organism. This research aims at artificially reproducing this chemically accepting function and utilizing a reproduced function as a chemical sensor. In this fiscal year, a method of forming a thin membrane using an organism substance and the change of physical properties shown by the thin membrane in the presence of a chemical substance will be examined.

9. Synthesis of Cyclic Peptide and Its Substrate Discriminating Capacity

(Study in FY1981) (Research Institute for Polymers and Textiles)

The balance of the interaction between the ligand of an organism and the indispensable metal ions in the organism, is one of the important factors indispensable for maintaining life. In this research, as a simulating compound of the ligand of an organism, cyclic peptide will be synthesized and the substrate discriminating capacity to a low molecular weight compound is to be made clear. In this fiscal year, using cyclic peptide having a discriminating capacity of various cations of elements in Groups I and II of the Periodic Table obtained in previous fiscal year as an object, the structural chemical conditions for revealing the discriminating capacity, is to be examined and consideration will be made about the molecular design and functional design of the novel cyclic peptide.

10. Structure of Hydrogel and Its Compatibility with an Organism

(Study in FY1981) (Research Institute for Polymers and Textiles)

The structure of hydrogel of the PVA series will be analyzed and the basic data for developing a new material compatible with an organism will be obtained. In this fiscal year, based on the results obtained in the previous fiscal year, the interaction between body fluids of an organism and gel will be evaluated from an *in vitro* experiment by serum and an *in vivo* experiment at the *camera oculi anterior* of a rabbit including the peripheral tissues of the organism. With reference to vinyl pyrrolidone graft gel to PVA, organism compatibility will be examined by pouring into a vitreous body.

11. Research of Nerve Circuit Network

(Study in FY1981) (Electrotechnical Laboratory)

With combination of nerve knots at the abdomen with those at the brain, side and feet, a pair of cells having direct bond are to be confirmed by staining in cells, an electrode for measuring stimulus will be inserted, and the transmission characteristics between the two cells will be examined using a transient memory.

12. Research of Complementary Function of Rod and Pyramid Visual Cells

(Study in FY1981) (Electrotechnical Laboratory)

The eye's spectroscopic sensibility control function, ranging from seeing in a bright place through seeing in a dark place via seeing in a dim place, will be examined and the complementary function of both the pyramid and rod visual cells attained in bright/dark adaptation, will be clarified.

13. Research of Numeration of Sense of Smelling

(Study in FY1981) (Electrotechnical Laboratory)

As research of numeration of the sense of smelling by the induced electric potential, the concentration of a smelling substance reaching the nostrils, will be precisely determined and especially the technology of detecting and filtering a bad smell will be developed to carry out advancement of brain shape analysis. On the other hand, a molecular, physiological basic research will be carried out concerning the initial process of accepting the sense of smelling.

14. Research on Weighing Mode of Perceptual Judgment

(Study in FY1981) (Industrial Products Research Institute)

Development of the weighing model of human perceptual judgment and scrutiny of its practical nature will be studied. By this, quantification and prediction of perceptual judgment characteristics will be made easy, at the same time, the results will be made data for establishing the psychological measuring method for designing and evaluating industrial products and making the method instrumental.

15. Physiological and Engineering Research on Control Mechanism of Voluntary Action

(Study in FY1981) (Insutrial Products Research Institute)

The control mechanism of cooperative activity of muscles in fundamental actions of man will be clarified using physiological and engineering methods, and based on these data, the fundamental characteristics of obstacles to motion are to be obtained, and at the same time, basic data is to be obtained aiming at the welfare of handicapped persons in functions of locomotion and development of electronic instruments necessary.

16. Research of Information Handling Mode in the Central Nerve

(Study in FY1981) (Industrial Products Research Institute)

An orientation reaction related to signal detection and the action of memory and learning related to extraction of the characteristics of a signal will be physiopsychologically sought to elucidate the nerve mechanism and a way for engineering applications of these vital functions by simulation using a mathematical model, will be opened.

17. Research of Visual Sense Mechanism

(Study in FY1981) (Industrial Products Research Institute)

Of the visual sense mechanism, the mechanism of color sense and eyeball motion will be examined. With reference to the color sense, quantification for the industrial utilization of color and development of a new measuring technology is to be carried out. With reference to the eyeball motion, examination will be made concerning development of a machine for measuring eyeball motion, measuring and examination of two-eyeball motion at the time of space perception, and progressive characteristics of the eyeball motion system including congestion of infants and those with open eyes to obtain basic data for development of welfare instruments for medical use.

18. Research on Transmission of Information of Sensation

(Study in FY1981) (Industrial Products Research Institute)

Through the comparative study of information handling modes of the sensation system, the handling modes peculiar to the respective sensations, will be made clear. Further, based on these data, basic data for aiming at development

of electronic instruments for welfare and medical care of physically handicapped persons, is to be obtained.

19. Research of Decomposition and Inactivation of Biohazards

(Study in FY1981) (Government Industrial Development Laboratory, Hokkaido)

The decomposition mechanism of nucleic acid-related substances by oxidizing agents is to be examined in the initial fiscal year.

20. Synthesis of Elastomer of Polyurethane Series and Application of Such Elastomer to Materials for Medical Use

(Study in FY1981) (Government Industrial Research Institute, Osaka)

Ethylene oxide – propylene oxide block copolymers having various molecular weights and different in polyethylene oxide content are to be used as a diol component in synthesizing novel polyurethane ureas by reaction between diphenylmethane diisocyanate and ethylene diamine, and the mechanical properties, dynamic properties (viscoelasticity) and water contents of these ureas will be examined, and at the same time, their coagulation resistance outside an organism will be evaluated. And the influence of the molecular weights of the diol component, polyethylene oxide content and molar ratios in reaction between diol and diisocyanate exerted over these characteristics are to be examined in detail.

21. Research of Information Handling of a Blood Vessel Image

(Study in FY1981) (Government Industrial Research Institute, Chugoku)

As a basic study for elucidating the physiological function of the blood circulation system, the analytical method of measuring the diameter of the blood vessel two-dimensionally from the blood vessel image, will be examined.

CSO: 4120/171

SCIENCE AND TECHNOLOGY

BRIEFS

CURB LSI EXPORTS TO U.S.--The government has called on semiconductor manufacturers to "use discretion" in exporting large-scale integrated circuits (LSI) to the United States, a Ministry of International Trade and Industry (MITI) official said Friday [12 February]. The MITI served the notice separately on Hitachi, Nippon Electric, Fujitsu, Mitsubishi Electric, ODI Electric and Toshiba after the U.S. National Semiconductor Industry Association began pressuring Washington recently to curb imports of 64-kilobit ram (random access memory) chips from Japan. Japanese products currently account for an estimated 70 percent of the American market for 64-kilobit ram chips. The official said the ministry has no statistics on the export of the 64-kilobit type to the United States. He added, however, that Japan was a net integrated circuite (IC) exporter to the United States, if by a narrow margin, in the first 11 months of 1981. The official said Japan's IC exports to the United States in the January-November 1981 period totaled 63.9 billion yen ($272 million) worth, compared with 63.4 billion yen ($270 million) worth imported from the United States in the same period. [Text] [OW161001 Tokyo THE DAILY YOMIURI in English 13 Feb 82 p 1] [COPYRIGHT: Daily Yomiuri 1982]

POLICY ON COMMUNICATION SATELLITES--Tokyo, 16 Feb (JIJI Press)--The Quasi-governmental Nippon Telegraph and Telephone Public Corp (NTT) has fixed its policy of orbiting its large-capacity communications satellites using the space shuttle of the U.S. National Aeronautics and Space Administration (NASA). Japan's communications satellites for practical use have hitherto been launched using domestically-produced rockets. NTT, the nation's telecommunications monopoly, will seek approval of the space development council before making a final decision on this score. Under NTT's plans revealed so far, it will blast off a one-ton communications satellite with a capacity of 25,000 telephone circuits in fiscal 1988 and a four-ton satellite with a capacity of 100,000 circuits around fiscal 1992. Japan's fiscal year starts in April. NTT also plans to link via these satellites telephone stations exclusively for long-distance calls to be set up in each prefecture by putting up antennas of four meters in diameter on the roofs of these stations. Another factor behind NTT's emerging policy of launching large-capacity communications satellites is its strong wish to advance into data communications business. [Text] [OW161451 Tokyo JIJI in English 1436 GMT 16 Feb 82]

TURBINE ORDER FROM PRC--Tokyo, 3 Feb (JIJI Press)--Mitsubishi Heavy Industries Ltd announced Wednesday that it has received an order for a 300 million yen (about 1.3 million dollars) compressor-driven steam turbine from China's National Technical

Import Corp the turbine with power output of 20,000 kilowatts will be placed in an ammonia plant in Anhui Province which produces 1,000 tons of ammonia per day. This is the 24th such turbine the Chinese corporation has ordered from the Japanese company. [Text] [OW040931 Tokyo JIJI in English 1332 GMT 3 Feb 82]

VIBRATION ABSORPTION MATERIAL--What is claimed to be the world's highest vibration absorption material has been developed by Nippon Electric Co (NEC), a major Japanese maker of electric appliances. A company spokesman said it is a ferrite complex material whose vibration suction is some 100 times more than steel and aluminum and will be effective for noise prevention. The material is a mixture of grain condition ferrite ranging from 0.1 to 10 microns and polyester resin and its corrosion resistance is very high against acid and alkali. It can be processed freely like steel and aluminium, he said. The spokesman said that by using a vibration proof pad made from the ferrite complex material, it is effective in production of ultralarge scale integrations (LSI), assembly of precision malchinery and inspection of optical microscopes. The company will shortly produce the pad at a subsidiary, he said. He also said that the company has been developing vibration-proof material, using a large amount of regenerated ferrite available as byproducts for use in roads, railway roadbeds and bridges. [Text] [OW221441 Tokyo MAINICHI DAILY NEWS in English 20 Feb 82 p 5] [COPYRIGHT: Mainichi Daily News, 1982]

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