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POLITICAL AND SOCIOLOGICAL

ANTI-JAPANESE SENTIMENT SAID SPROUTING IN CHINA

Tokyo MAINICHI SHIMBUN in Japanese 6 Mar 81 p 8

[Article by special correspondent Imada, Beijing]

[Text] Anti-Japanese sentiment is sprouting in part of China. The direct cause for the rekindling of this sentiment was related to the question of who was responsible for the second economic reorganization centered around the stoppage of Baoshan Steel Company construction. However, in view of the historic anti-Japanese sentiment and the leaders' embarrassment surrounding the modernization, its future development should be of no small concern.

Although the Chinese Government has officially stated that "the responsibility" for cancellation of the plant importation "rests entirely with China," it has not sufficiently explained the actual situation to its people. As a result, one leftist-controlled Hong Kong newspaper accused Japan of "immoral commercial practices." And among the Japanese tourists are some "ugly Japanese" who go out souvenir hunting spending money like water, or who make fun of women and thus hurt the feelings of the Chinese people.

Baoshan was made victim during the third meeting of the fifth National People's Congress. During the meeting, although many representatives pointed out the unfavorable location, excessive investment, insufficient preparation by the government authorities, and the wastefulness as the causes for failure, there were some who held that "Japan played a trick on China with Baoshan by not making any reparation" and "Japanese design was unreliable."

About this matter, the (then) Deputy Prime Minister Li Xiannian spoke to the Japanese delegate: "We who made a too hasty decision are to blame for the Baoshan problem." However, when a similar question was raised by either people's representative or the reporter, the domestic newspaper printed only the question without explanation.

When the decision was made to discontinue the second stage construction project at Baoshan, the commercial firms and maker circles in Beijing were led to believe that "Japanese sold an unnecessarily large unit just to make money" and "Baoshan was chosen as the site in spite of its unfavorable location because it was advantageous to Japan." Those engineers who were drafted from various parts of China to Baoshan to work on the project and were now discharged because of a reduction in the scale of the project also tended to blame Japan for their dissatisfaction.

And it was the foreign press and newspapers which set the fire for this mood. When Okita, representing the Japanese Government, was visiting China, the western press reported Okita as saying "China was pampered" in Beijing. Upon hearing this, some of the cadres not only lost confidence in Japan but began to harbor anti-Japanese sentiments, which led to the criticism of Japan by a Hong Kong newspaper. The Japanese press association has never heard this kind of speech by Okita at any one of the public appearances made by him.

The problem was further complicated by the entanglement between the awakening of anti-Japanese sentiment and China's current domestic political situation. Dissatisfaction toward the leadership, resistance toward the modernization policy, and denunciation of its failure may have emerged in the form of anti-Japanese sentiment. This possibility should not be overlooked.

According to a western analysis, the domestic inflation under the new economic policy has risen 2-3 times and the lives of the masses are threatened. The term "Japanese devil" which was used during the period of anti-Japanese struggle is said to have cropped up again in the underground publication of the anti-system group. Japan is denounced for "playing a trick on China to waste Baoshan while the masses suffer from inflation as a result." Moreover, the loan made by the Japanese Government to the Chinese Government has been painted as "an aid to be used as a lever against the present system, an aid with plenty of strings attached, an excuse to take away oil and coal from China."

Ill-mannered Japanese Tourists Are to Blame

The situation in Japan has been more frequently introduced to China in recent years through t.v. and various publications. To those who view these, apart from pure concern and admiration toward Japan, the anti-Japanese sentiment is made even more complex by a great display of Japan's showy material life and the memory of past Sino-Japanese relations is revived. Some young people criticize Japanese prosperity as "a comfortable life earned by an economic animal at the expense of other nations."

To be sure, the greater majority of the Chinese people express genuine friendship toward Japan. However, among the recent Japanese tourists were some who, no sooner than setting foot on Shanghai, asked the Chinese guide to make arrangements for female companionship, saying "you should have some around here," and were thus frowned upon by the Chinese.

The anti-Japanese criticism centered around Japanese imperialism once carried out vehemently during the period of the Cultural Revolution has been hushed since 1972 when the two nations normalized diplomatic relations. Especially after the fall of the "gang of four" and today under the open door policy, we may say that we are enjoying a Sino-Japanese "honeymoon" period. However, if we take this "honeymoon" mood in too much of an easygoing manner, we may come to be surprised by a terrible retaliation.

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MILITARY

EXPERT RAPS GOVERNMENT OFFICIALS' ARGUMENTS ON 'DEFENSE'

Tokyo MAINICHI SHIMBUN in Japanese 8 Jan 81 p 5

[Article by Masato Kitamura, political affairs reporter, MAINICHI SHIMBUN: "Defense Debates Without Substance"]

[Text] In the year's time since I was assigned to cover the defense issue, in extraordinary sessions of the Diet and the budget review process I have encountered many of the arguments surrounding this topic--the Soviet menace, Japan's responsibility as a member of the Western camp, early attainment of the "medium-term Operations Estimate," balance between welfare and defense appropriations, etc. Although I have been a part of all this, I somehow get the feeling these are all arguments without substance. I haven't really thought out as to why I feel this way, but one reason is that there is always the problem of each person having a different image of what constitutes an "emergency situation."

Consider, for instance, what might occur were war to break out. If you look at this from the point of view of the military, some fairly concrete assumptions can be made and accordingly preparations should be made to be able to respond quickly [in time of emergency]. However, what would a textile worker do in such a situation? Would he get on the commuter train and go to work as usual, or would he take his family and head for the mountains?

In the NATO countries, as a general principle the average citizens are not to leave their homes, and accordingly construction of emergency shelters is being encouraged by their governments. Military tactics are also based on this premise. Japan does not necessarily intend to imitate this, but it is no different in that the starting point of defense must be to what degree will the average citizen protect his own life and property. After all, isn't the very basis of the defense forces belief that they will defend themselves and their fellow countrymen? Even now, with regard to the threat of Japan being invaded, debate has centered around the capabilities and quantities of

> armaments and defense expenditure figures. But under the present condition whereas the average citizen who has very little interest in asking themselves "what are we to do at times of emergency?", the situation can be likened to that the horse is being put before the cart.

Let's cite several examples of the arguments of those who believe that the Soviet Union is a "threat" to us. The first occurred during debate in the Upper House Special Committee on Security at the recent Extraordinary Session of the Diet. A Diet member was cross-examining the Defense Agency about the recent incident of fire aboard a Soviet nuclear submarine and then the problem of Soviet submarines passing through Japanese territorial waters.

A Novel-like Hypothesis

The gist of the examination was, "What was the response of the Maritime Self-Defense Forces to this violation of Japanese sovereignty?" The Defense Agency explained the details of events from the time of the outbreak of the fire aboard the submarine till the time it left Japanese territorial waters headed towards the Japan Sea, including the posture of the defense forces and the fact that even though a rescue helicopter was dispatched, the Soviets refused any assistance. The Diet member was still not satisfied. Posing a hypothetical situation almost straight out of cheap war novel he said, "Consider what would have happened if the Soviets had tried to attack us by pretending to have an accident?" The Diet member then proceeded to scold the laxness of the Defense Forces.

Among questions regarding the build up of Soviet ground troops in the Northern territories, another Diet member, stressing that Soviet troops could easily invade Hokkaido asked, "Why hasn't the Defense Agency deployed sufficient forces around Nemuro City?" Others insist that "Japan can rely on no one else" to protect its ships traversing the world, beginning with tankers headed from the Middle East.

In any event, these discussions are based on the simplistic judgment that military action by the Self Defense Forces is not so unrealistic, and is in fact very possible in the near future. However, if you just imagine the country's domestic situation at such a time, you would understand that it is not just a matter of how the military should act.

Suppose that Japan had forcibly stopped the Soviet nuclear submarine. The Soviet Union would have strongly criticized Japan while claiming the right of innocent passage, and it might have even dispatched warships off Japan. Even if they didn't attack, just by arraying warships around us, the people would feel that the "black ships" [of Commodore Perry] had come once again. In Japan today, the people's entire life style would not be able to stand this kind of tension for very long.

Invasion Debate "For Military Only"

A Soviet Union invasion of Hokkaido is one scenario of the Ground Self-Defense Forces. Staff members of the Northern Region General Staff say, "Over the years, orders have come down that very nearly amount to a desk top strategy." In other words, response actions have been developed although in a piecemeal fashion. However, no one has addressed the problem of what Hokkaido residents should do at such a time.

If a military clash were to begin in northern or eastern Hokkaido, not only the people of Hokkaido but the social and economic activities of the entire country would be thrown into great confusion. Notwithstanding, there has been no mention by any legislative body in the country of appropriating funds to construct shelters for the people. The possibility of a Soviet attack is matter-of-fact to the military, but to the average citizen it is incomprehensible.

The idea that the Japanese Maritime Self-Defense Force and the United States Navy could maintain the security of Japan by guarding oil tankers is sadly mistaken. Even if they succeeded in protecting some tankers to Japan, the amount would only be a fraction of that necessary to maintain the normal lifestyle of the people. Moreover, a situation where this would be necessary would be nothing less than World War III, and it is difficult to believe that the oil-producing countries would be able to produce today's amount of oil in that event.

Maximum emphasis should be placed on protecting sea lanes and the perimeter of Japan. It was in this area that the security of Japan was recently breached. However, debate of the defense of sea lanes only without considering the overall situation demonstrates an incomplete "image" of emergencies.

"Emergencies" are discussed only from a purely military standpoint, and looking at it in terms of the people, or civil defense, is largely forgotten although the word is brought up from time to time. According to one dictionary of military terms, civil defense is defined as follows: "Organized activity by the non-military aimed at preserving the life and property of the people from enemy military attack, protecting the public buildings, facilities, industry, and culture, and planning for rapid recovery. This activity is predominantly performed by civilians under the direction and planning of the central and regional governments."

Why Civil Defense Comes Last

If the government is truly concerned about speedy improvement of the Self Defense Forces' equipments to be able to respond to an emergency, why is it that "civil defense" keeps being put on the back burner?

Chief Cabinet Secretary Miyazawa, tying this into his proposal of the Comprehensive National Security Ministerial Conference said at the Extraordinary Session of the Diet, "As public opinion matures, the time will come to discuss civil defense." The problem is how do you tie in the judgment that it is all right to be so lackadaisical about action for the people to protect their own lives and property with formulation of "defense postures for times of emergency" such as fighter "scrambles" and missile armament.

"Dues" Will Not Bring About Military Strength

Defense Agency Director Omura has said, "I don't think there is an imminent crisis of our country being invaded." If that is true, the main reason for the rush to build up the military has to be for Japan to assume its responsibility as a "member of the Western camp." The Western countries (particularly the United States) are pressing Japan to build up its military in order to protect the strategic superiority of the West by saying that regardless of whether there is an imminent crisis or not, the collapse of the balance of power between the East and West increases the possibility of invasion of Japan.

If you think along those lines, civil defense becomes secondary. The idea is that we will have to get along without civil defense while we pay our international "insurance premium" by strengthening the Self-Defense Forces.

However, if we proceed to strengthen the military only for the reason of paying our "insurance premiums" or "dues" in the Western camp, we will increasingly lose the support of the people. One person angrily related the following incident.

Ground Self-Defense Forces were dispatched on a rescue mission to a village where many houses had been buried by mudslides from torrential rains. Soldiers were very much in demand on the rescue mission and they were asked to "Come to our house" and "Help over here." The soldiers broke up into small groups and began shoveling. However, many of the villagers did nothing more than stand and watch. What kind of a situation is this--people standing around leaving everything to the soldiers even though it was their own village and their own stricken neighbors.

Leaving A Matter of Self-Defense to the Self Defense Forces

Extrapolating this to the military as a whole may be a little overboard. However, it is true that the attitude that it is all right to leave defense matters entirely up to the military has been increasing among the public. Recent opinion polls indicate that an overwhelming majority of people accept the Self Defense Forces. However, there is no data attesting that this acceptance is connected to the fundamental problem of what the individual is to do in a time of emergency.

"It is proper that we protect ourselves from invasion." "It is irresponsible for Japan to be the only democratic country avoiding its defense obligations." "As demonstrated by Afghanistan, you cannot let your guard down against the Soviet Union." Following along with these conclusions, agreeing to strengthen the military while overlooking the individual's responsibility is easily done. After all, even if some of the welfare budget is redirected towards defense costs, if the security of Japan is maintained by doing so, it is merely a matter of money.

However, the one circumstance in which the strength of the Self Defense Forces will definitely deteriorate is to follow that reasoning and get the idea that if we merely shell out the money someone will defend us. But it is the time of emergency when every one will be caught [in a situation to defend the country] whether they like it or not.

I personally would like to see the government and the political parties quietly conduct thorough discussions on the "starting point of defense." I also think the government should study taking a lead in "civil defense" to the point of promoting construction of underground rooms capable for use as shelters in all new schools. This is important because I believe the Self-Defense Forces will be nearly powerless without a solid foundation of defense consciousness among the people fostered by such means.

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SCIENCE AND TECHNOLOGY

NEWSPAPERS REPORT ON NEW ERA OF BIOTECHNOLOGY

Industrial Projects

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 1 Jan 81 p 3

[Text] "Biotechnology," that is, bioreaction technology, is one of the most important technologies to pave your way in the 1980's. Because of the prospects of extraordinary developments in chemistry, mining, medicine, fermentation, food, agriculture, etc, by using the biological phenomena of living organisms, the industry has launched development all at once. The objectives are not only the development of useful substances such as insulin, a therapy for diabetes, and interferon, a miracle drug, but also the establishment of a biochemical industry, a new process to save energy and resources through the industrial application of living organisms. Consequently, full-scale research and development has begun on the basis of a target focused on cell fusion, the mass culture of cells, gene splicing and enzyme application technology. It is, indeed, a new era of "biotechnology."

Government Organizations Also Hasten With Plans

The technology of using microorganisms is an old one. Examples include sake, beer, soy sauce, bean paste, etc. Not only these traditional technologies, but the world's top ranking fermentation industry were established in Japan based on these technologies producing amino acids, nucleic acids, enzymes, antibiotics, etc at low cost and high efficiency. Many substances produced by this industry, such as seasonings, glutamates, the digestive enzyme diastase, as well as the products of various lactobacilli, have already become part of our lives.

"Biotechnology" enables the production of products with high added values, such as insulin and interferon, by further developing this technology.

It involves finding useful substances created by cells of plants, animals, and microorganisms (insulin, interferon, antibiotics, genes, etc), mass-culturing the cells that produce those substances, and artificially creating useful substances by changing the genes and species involved in the production of useful substances. It is also a technique of extracting enzymes that are plentiful in cells for active utilization.

When this technology is developed, it will influence all sorts of industries: besides the mass production of new pharmaceuticals and food having complex structures that could not be manufactured before, it enables the shortening of conventional chemical reaction processes. Considering the incalculable influence this may have, there is the prospect of an industrial revolution.

Genentech Inc and Eli Lilly in the United States, which quickly saw the usefulness of this technology, established a mass-production technique for insulin, a drug for diabetes therapy, using gene splicing, one of the techniques used in this technology. On the other hand, Biogen S.A. of Switzerland led the world in its achievement of developing a mass-production technique for interferon, which is regarded as a "cure-all drug." The European Common Market (EC) decided to advance biotechnology by investing 10 billion yen in this venture over 3 years.

Therefore, in Japan, the Ministry of Education started a research program "basic analysis of the production of useful substances using biochemical reactions" in FY 81, in which the effective use of renin, peptide hormones, steroid hormones, lectins, and untapped resources is planned. The Science and Technology Agency is also planning to start studies on influenza vaccine, B-type hepatitis vaccine, and to build the high-level safety research facilities (experimental facilities with P4 level regulation which isolate man and bacteria) required for gene splicing. The Ministry of International Trade and Industry also made a budget request to the Ministry of Finance to promote biotechnology starting in FY 81. Thus, research and development supported by the entire nation is about to unfold.

Stimulated by such plans, private enterprises in such fields as chemical industry, pharmaceutical industry, and food industry have narrowed their targets and begun respective studies in order to establish a biochemical industry and bioindustry based on the development of biotechnology.

Specifically, the goal is to develop research expertise one by one in cell fusion technology, mass cell culture technology, gene splicing technology, and enzyme application technology. Since the Ministry of International Trade and Industry evaluates these technologies as "modern-day magic" and estimates a market scale of 3 trillion yen in the 1990's, enthusiasm for the enterprises is tremendous.

Mr A. Hanawa, director of the Central Laboratory of Unitika Ltd, states: "We hope to develop this research centered around enzyme development, as one of the major nontextile research areas." Mr K. Yokoyama, assistant director of Mitsubishi Petrochemical's central laboratory, says: "It is a research area that cannot be ignored for industrial growth."

At the life science research laboratory of Mitsubishi Chemical Industries, the plan is to "complete the recombinant DNA research facility (P3 level), where human cells can be handled, by summer." Thus, various corporations are steadily working to expand the research.

T. Tada, of the Department of Serology, Faculty of Medicine, Tokyo University, states: "Even immunity, which is the 'mystery' of life in overcoming illness, can be elucidated by freely using this technology." Thus, it is possible to use this technology as a means to open the way into the unknown.

However, there is a huge wall in developing this technology. That is, one must master molecular biology, which is the basis of this technology. For this reason, various firms, including Asahi Chemical Industry, Sumitomo Chemical Co, Sankyo, and Unitika, began dispatching research staff all at once both in Japan and abroad.

They must understand the phenomena of how microorganisms and cells operate in the ultramicroscopic world of "molecules." It has been proven already that the microorganism E. coli is several ten-thousandths angstroms in size, surrounded by cell walls of several hundredths angstroms, in which are contained nuclear genetic material, extranuclear genes (plasmids), various enzymes, and cellular fluids; and this information has been useful in the technical improvement of biotechnology. A gene is comprised of nucleic acids (deoxyribonucleic acid, DNA, and ribonucleic acid, RNA), and the nucleic acids consist of chemical substances (bases) adenine, cytosine, thymine, and guanine (uracil). Moreover, these bases form double helix chains. This knowledge is a discovery resulting from research in molecular biology, and such microscopic research fosters biotechnology.

Enzyme Development and Application

The enzymes are so similar in action to catalysts used in the chemical industry that they are called biological catalysts. Moreover, due to their superior reaction specificity, they have the characteristic of creating substances with 100 percent purity.

This characteristic is used in an apparatus called a bioreactor. It makes possible the synthesis of substances that were impossible to manufacture by conventional chemical or pharmaceutical industrial techniques. Furthermore, the chemical reaction is possible at normal temperatures and normal pressures, thus introducing an energy-saving process.

Professor M. Nozaki and his colleagues at Shiga Medical College accurately measured the quantities of glucose, uric acid, cholesterol, etc in blood by applying the reaction specificity of enzymes, and they are in the process of developing a bioreactor for diagnosis of illness. The principle is the application of a biochemical reaction in which hydrogen peroxide is produced when glucose oxidase is reacted with glucose. The hydrogen peroxide is combined with luminol and potassium ferricyanide, and the amount of hydrogen peroxide produced is measured to quantify the amount of glucose. In the cases of uric acid and cholesterol, enzymes that produce hydrogen peroxide with these substances are being sought. At present, quantities of three types of blood components are known.

In addition, they began developing a new fluorometric system by applying the fluorescent phenomenon found in the reaction of the coenzyme nicotinamide adenine dinucleotide (NAD) and hydrogen peroxide. Currently, a bioreactor capable of diagnosing diabetes is marked as a target for development. When this technique is completed, rapid diagnoses of various illness will become possible.

Furthermore, Mitsui Information Development, Sagami Central Chemistry Laboratory, and Toyo Soda are in the process of developing a peptide typewriter [sic] that produces useful proteins (enkephalin, insulin, etc) by freely combining 20 or more kinds of amino acids. Two of these will be completed in 1986 as the bioreactor research project of the Institute of Physical and Chemical Research.

The application of enzymes is not limited to these areas. Sagami Central Chemistry Laboratory is applying it to organic synthesis reactions. They are energetically developing drugs (beta-blocker, etc) of optically active substances with high added values from an intermediate obtained in the manufacturing process of glycerin from propylene. Kyowa Hakko also has developed a heat-resistant enzyme that can withstand a temperature of 50-60 degrees Celsius, and has begun using it in the new process of manufacturing malic acid from fumaric acid.

T. Ando, chief investigator of the Institute of Physical and Chemical Research, have developed an enzyme, nuclease SI, which is indispensable to recombinant DNA research. This enzyme cuts one-strand DNA, while DNA having a twisted or loop structure is excluded. It can also be used in studying genetic activity. Consequently, it is being used in genetic research all over the world.

Sankyo obtained a transfer of royalties for this enzyme from the Institute of Physical and Chemical Research and began marketing the product. They regard it as "a product with a prospect" (S. Minato, chief, Sankyo Yeast Second Research Laboratory). Ando, of the Institute of Physical and Chemical Research, also succeeded in isolating 23 different restriction enzymes from 70 different Bacillus subtilis strains.

Restriction enzymes are indispensable for establishing recombinant DNA technology or molecular biology; when a useful substance is found, the enzyme works to separate the genes that make up the substance. Thus it has become possible to take out a fragment of a gene that produces the useful substance by using these enzymes. In Japan, Takara Shuzo is the only manufacturer of restriction enzymes, and considering the fact that only 15 restriction enzymes are on the market, this is noteworthy. However, Takara Shuzo plans to produce 30 restriction enzymes before the end of the next year.

Enzymes having special uses are also actively being developed. Mitsubishi Petrochemical Co discovered thermophilic bacteria that inhabit hot springs and is developing heat-resistant enzymes.

Cell Fusion Technology

The biggest problem in biotechnology is to decide what to create. It is the consensus of the corporations that "it is too late to manufacture insulin and interferon." Their view is to leave the useful substances which are already known to government projects, and to discover useful substances independently so as to quickly mass produce on a commercial basis.

Cell fusion technology will enable them to create such useful substances. Fusion technology itself involves creating one cell from two different kinds of cells. It was developed by Y. Okada and others in the latter half of the 1950's. When cell-agglutinating media such as Sendai virus (HVJ) or polyethylene glycol (PEG) are mixed with two kinds of cells, the cellular surface is cut, the cells are united, and one cell having two nuclei (heterokaryon) is produced. When it completes cell division, a hybrid having some of the characteristics of two species results.

In other words, countless number of cells having characteristics of two species can be obtained. Professor Tada of Tokyo University is working to elucidate the immune mechanism of the living body, a way to cure illness by using this technique. He reports having manufactured antibodies against hormones and antibodies against interferon in vitro.

In addition to these achievements, he says: "We have established a technique to produce high purity interferon from lymphocytes and myeloma cells. We also discovered T-cell growth factor (TCGF) that accelerates immune mechanisms from the fusion of T-lymphocytes and myeloma cells and we are able to obtain it in nearly 100 percent purity. Since T-cells have a mechanism for killing cancer cells, 'conquering cancer' is also possible by using this technique."

At the life science research laboratory of Mitsubishi Chemical Industries, this technique is being used in genetic research involving mice that die 10 days from birth. As a result, they report that "antibodies that can be used for the diagnosis of illnesses can be easily prepared by using this technique."

Professor Tada states: "Since there is an almost unlimited number of lymphocytes with varied functions, they are a treasure chest of substances that can be very useful." Thus, this technology is most suitable for finding useful substances. Moreover, it is also possible to manufacture reasonable quantities of these useful substances, which means they can be provided for research and assessment when considering industrialization of techniques such as gene splicing or mass culture.

Mass Cell Culture

The cells which are created by using cell fusion technology and produce useful substances cannot be used directly. It is necessary to cultivate the cells in large quantities. In the fermentation industry, 10 million to 10 billion microorganisms per cubic centimeter are grown on a scale of several kiloliters. For the mass culture of E. coli and yeast, the conventional culture method used in the fermentation industry is sufficient for their proliferation, but human cells or renal and hepatic cells of animals do not grow so easily. In that case, needless to say, it would be meaningless to create cells that produce useful substances.

In addition, it would be impossible to collect enough cells to study the characteristics of the useful substances and achieve the goal of developing something. Naturally, no improvement in technique would be forthcoming in biotechnology. The serum of bovine fetus offers a solution to these problems. "Five to 10 percent serum is necessary in the medium to grow cells" (K. Sameshima, manager of the production and technical division of Kyowa Hakko). The amount of serum obtainable from a fetus is small. Therefore, in Japan, where livestock farming is not widespread, we must depend on importation from overseas. Thus, naturally, there is a restriction in the quantity.

For this reason, it is necessary to establish the following three technologies: discover the growth factors for the cells present in the serum of the bovine fetus, develop substitutes that have the same function as the serum, and develop a culture apparatus in which cells can be cultured to high density in the same container." (Sameshima)

Since we now know that the growth factor is a kind of hormone, there are prospects for establishing these technologies.

Recombinant DNA Technology

Mass culture technology rapidly manufactures cells and bacteria that produce useful substances. As a result, structures of cells and bacteria have been greatly elucidated. When the tools of molecular biology are applied, it will become possible to learn which part of the cellular and bacterial genes produces the useful substances. By inserting that gene fragment into the extranuclear gene of E. coli, and returning that into the E. coli, the bacteria begin to produce the useful substance. Since the mass culture technology of E. coli has already been established, numerous useful substances are now obtainable.

This is the technology that offers the means to produce useful substances in large quantities. Mass production technology has been established for insulin, interferon, growth hormone by Biogen (Switzerland), Genentech (U.S.A.), and Eli Lilly (U.S.A.). The development of vaccines will be initiated during this fiscal year by the Science and Technology Agency.

Research in recombinant DNA technology has been carried out for most useful substances which are known. Therefore, the corporations have turned their eyes to the development of mass production technology for enzymes which have high utility value and are difficult to obtain. For example, two kinds of heat-resistant enzymes have been discovered at Mitsubishi Petrochemical from Thermus thermophilus, HB8. There are microorganisms that live in hot springs enduring a temperature of 90 degrees Celsius. Enzymes in those microorganisms also have heat-resisting properties. Since they are very strong and long-lasting enzymes, their utility value is also high. In chemical reactions, the higher the temperature, the better the yield. The heat-resistant enzymes discovered by Mitsubishi Petrochemical lead to such development of enzymes.

When it becomes possible to produce heat-resistant enzymes in large quantities by using the recombinant DNA technology, building a chemical plant with superior selectivity and without any byproduct would no longer be a dream.

Scholars' Views

Tokyo MAINICHI SHIMBUN in Japanese 1 Jan 81 pp 44, 45

[Report on conversation between Dr H. Yukawa, a physicist, and Prof I. Watanabe, "leading molecular biologist" and author, with an introduction by T. Maeda, editor in chief, Osaka main office, MAINICHI SHIMBUN]

> [Text] The technology of manipulating life, that is, the application of life science, is advancing at such a speed that our imagination or speculation cannot keep up. It has become possible to mass produce growth hormone, insulin, interferon, etc. by genetic recombination of E. coli. On the other hand, however, it has become possible that such artificially synthesized

microorganisms may threaten the ecosystem of the earth. At this rate of progress, even a cloned human may be produced. Will the technology develop even to the point, shaking the foundation of human value, of artificially leaving only superior human beings? Is there danger of a brake on the genetic manipulation technique mankind has come to hold in his hand in the latter half of the 20th century becoming ineffective? Dr H. Yukawa clearly expressed his opposition to atomic and hydrogen bombs from the standpoint of a physicist; and Professor I. Watanabe spoke as a leading molecular biologist who had already expressed his concern in a book entitled "Last Moment of Man." I would like to present their conversation for guidance in the new year. (Introduction by T. Maeda, editor in chief, Osaka main office, MAINICHI SHIMBUN)

Watanabe: Life has been regarded as the realm of God that cannot be manipulated by man. However, molecular biology has succeeded in analyzing life as nothing but phenomena in physics and chemistry. By applying their principles, business ventures have appeared which even manufacture, for example, human insulin or interferon by manipulating bacterial genes in vitro. There were even frequent telephone inquiries from stockbrokers to the conference hall of the molecular biology meeting held in Kyoto in December. Molecular biology has certainly become a common affair (he laughs). However, elucidation of the genetic code and its application have just begun, and no great changes of consequence have occurred yet.

Yukawa: Long ago, physics, chemistry and biology were different fields of study. Then, during the 1920's to 1930's, atomic structures and properties were revealed, and it became possible to explain chemical principles by physical theories. It was around 1950 when biology, especially life phenomena, was explained by chemical and physical theories.

Watanabe: Yes, it was because the helix structure of DNA, the essence of genes, were explained by Watson and Crick in 1953.

Yukawa: It is difficult for us, physicists, to understand the circumstances of how the DNA structure controls man and influences his functions.

Watanabe: To put it crudely, a man is essentially determined by the genetic information contained in DNA. It has been found that man's characteristics, and even certain diseases, are determined by genes copied from parent to child. However, it is not understood how living organisms such as man, having splendid genetic information, appeared. It is a great mystery. Therefore, the matter is not so simple as just being able to synthesize a new organism by cutting and splicing genes.

Yukawa: However, since genetic structure is known, it appears that a very simple organism can be synthesized even at this stage.

Watanabe: No, it won't do. Living organisms have a long history of evolution and selection, and only those organisms having favorable combinations of genetic information have survived. How to combine the genes to create a new organism is not yet known to us. We are totally ignorant regarding what is life.

Yukawa: That's the part that is difficult for us to understand. If one wishes, why can't different organisms be created one after another....

Watanabe: That cannot be done. It is difficult enough to create even an organism identical to that currently existing. It can be said that we are totally ignorant regarding the creation of an organism with a new combination of genetic information. A living organism is still something which was given to us, in a form of DNA. We know only in what form proteins are made from DNA and what is the nature of the information in DNA.

Yukawa: I understand.

Watanabe: Therefore, if a certain DNA is inserted into E. coli by means of gene splicing, that part can be made. However, it is still E. coli. A new bacterium cannot be made.

Yukawa: Is that so?

Watanabe: There is a possibility that it may be made accidentally. But that chance is very small. Parts can be made by genetic manipulation, but when slightly larger genes are spliced, they cannot exist as a living organism. The chance of creating a monster is very small.

Yukawa: Is that true even in the case of a very simple organism?

Watanabe: Yes, it is. The combination of genetic information is rather more complex in simple bacteria. We can read thousands of codes arranged in DNA, but we cannot completely decode their significance. We lack such overall knowledge; only the technique of cutting and splicing genes has progressed. That is nothing but the ability to make part of an organism. For example, if a plant having an enzyme that uses nitrogen from the air to make ammonia can be made, it will grow without nitrogen fertilizer. If we can double the efficiency of photosynthesis, the greater part of the energy problem can be solved. Genetic engineering is considered to be the ace of the next technological innovation. Yet, we do not understand the conditions needed for existence of a single living organism. In that respect, biology has not reached the level attained in physics.

Yukawa: Yes, in that sense, it is very different from physics. So, although there are various things to be concerned about in genetic manipulation, it has not come to such a revolutionary stage as that.

Watanabe: That fact became known only recently. Even the experts were very concerned until 4 or 5 years ago. However, for the present, they say that we do not yet possess that knowledge. This does not mean, however, that we can do anything we please.

Yukawa: Yes, I understand.

Watanabe: It is a different problem, but test tube babies and surrogate mothers are already present in other countries. Research on borrowing the womb of a different animal, for example, having a cow bear a kid, is also making progress. It may come to involve man. However, in this case, the baby being born is a human being. It is a man created from human sperm and ovum, and only the environment is different. There is an ethical problem, but human life is not being manipulated.

Yukawa: Will a new organism be created in the near future?

Watanabe: I think it's too soon for that. There is a method called cell fusion as one possibility, as in the case of an experiment fusing a human cell and a mouse cell. However, even when fusion is accomplished, the human chromosomes (collection of genes) are gradually lost from that cell. Even then, if the nucleus of that cell is exchanged with the nucleus of a mouse ovum, an individual mouse having fragments of a human chromosome may be produced.

Yukawa: However, when such organisms multiply, one wonders if a mixture between man and mouse will appear.

Watanabe: It does not work that simply. A mouse has a group of chromosomes that have a perfectness for forming a mouse. Even if a man's genes are inserted, they will be incorporated only as a part at best. Moreover, in the present state of social conscience, if a researcher were to conduct that sort of experiment, some criticism would be expected, so it is avoided.

Yukawa: Yes.

Watanabe: However, my idea is that it is all right to carry out those experiments as long as the results are always published. Research should progress by keeping the general public informed of the status of academe.

Yukawa: That is necessary. When matters are kept secret, more and more unfavorable things are done.

Watanabe: Yes, when work is conducted in secret, people suspect it is dangerous. If not, people outside the field do not anticipate danger from the beginning and will allow researchers to work and publish their results. Whether they have the research stopped depends on the results.

Yukawa: That way of thinking is different from our, laymen's, judgment.

Watanabe: In the case of recombinant DNA, Dr Paul Berg called for a temporary moratorium on the experiments in 1974. Among scholars, it was intended to suspend the work for a while because of the lack of available knowledge. But, this was interpreted by laymen as meaning that it is dangerous research since the scholars themselves decided to stop. The goal was mutual understanding, but it came out the wrong way. Consequently, the apprehension of the general public regarding the manipulation of life is considerably different from the scholars' view.

Yukawa: However, in the case of physics, the experts were thinking that terrible uses of physics did not have to be considered for a while until nuclear fission was discovered. They thought that the peaceful use of atomic energy, or atomic and hydrogen bombs, would not materialize right away. However, laymen were concerned that such things might come true because of their lack of clear understanding. In actuality, when nuclear fission was discovered, the situation changed suddenly and the unexpected happened. Experts such as Dr Watanabe may consider that there is no immediate danger, but unexpected things can occur in the academic world.

Watanabe: Therefore, I believe that the world outside the researchers should be kept informed about the state of research. The fear that genetic manipulation might be used militarily as in germ warfare could very well come true. It is likely that military experts in various countries are already thinking of that possibility.

Yukawa: Changing the subject, life is mysterious. In other words, there is the principle of uncertainty in physics, and I thought that there might be similar uncertain elements in biological phenomena also. But, according to your explanation, that is not the case. Since the spiral staircase structure of genes was revealed, unexpected results in a reverse sense have appeared, haven't they?

Watanabe: In life phenomena, because there are no uncertain elements, advances are made in a technological direction as in genetic engineering. On the other hand, the significance of genes, or the origin of life as to how a multicellular organism such as man results from a fertilized ovum, are not yet known. Even more important is the problem that the human brain and the mental sphere cannot be determined by genes alone. It is slightly different from uncertain elements, but in the case of the human brain, acquired factors such as environmental factors, education, and study make a difference. Parents and children have common genetic elements, but because of the differences in social environment between the generations of parents and children, even brain functions change. It means that life phenomena cannot be determined by genes alone. Uncertain elements of life in that sense are possible.

Yukawa: Will we have a cloned man?

Watanabe: Technically it is possible. The book ["Birth of a Cloned Man"?] published 3 years ago was a hoax, but scientifically it is not impossible. Speaking from a standpoint of purely scientific interest, if, say, 10 identical men could be created, we could study from their birth what sort of education creates what kind of man. Things such as the kind of deformation resulting from environmental changes could be determined.

Yukawa: However, in the case of man, the valuable asset is his individuality, or that each has his originality.

Watanabe: Yes, yes.

Yukawa: Talk of being able to make identical creatures is very distasteful. What it boils down to is that even if it could be done, we wouldn't want it done.

Watanabe: But... Dr Yukawa, even if individuals had identical genes, they would be different if the information were provided differently, wouldn't they?

Yukawa: No, even if individuality is different, if their environment is similar, they would end up similar beings. Whether or not true originality of man can exist there is a very serious problem.

Watanabe: You are saying that it is better to have different human beings even if the environment is the same?

Yukawa: That's right.

Watanabe: You are saying that it is better to have only one you.

Yukawa: Yes, naturally. That is what a man is. However, at the same time, those having their own originalities live together as good friends. That is the ideal state. I mean it's a nuisance for science to grow so much that it destroys that state.

Watanabe: What I meant was that scientific analyses would be possible if cloned men were produced. I do not think it would be a favorable thing for the world to create such men. Swerving a little from the subject, it is said that only superior men will eventually remain through the process of selection. But, in fact, I suspect that not so superior men may survive. At any rate, men who are not so superior have more power (he laughs).

Yukawa: We don't know how that will be (he laughs).

Watanabe: It does not pay to use superior men, so it is better to create men that are easier to use. Men who are not so superior create men they can use, and the deterioration is perpetuated.

Yukawa: It is a different subject, but I don't think politicians and military men are such superior men. However, rulers, Hitler or even Napoleon, regarded themselves as wise. And that was the great misfortune.

Watanabe: Now, it is my belief that genetic manipulation involving other than men may be allowed. Problems such as food and energy will gain a certain degree of help through the use of this technology. But for men, we should decide to limit the application only to medicine such as the curing of genetic diseases. The ethical problem can be avoided if we decide not to use it in creating superior men.

Yukawa: However, I am not that optimistic. Medicine can take various forms. Even if we know a drug for genetic disease can be manufactured, simply put, there are still problems in that the side effects are not fully understood and may appear.

Watanabe: From the standpoint of medicine, it is natural to aim for a cure, especially in the case of genetic diseases where almost no therapeutic method exists.

Yukawa: That's true. It is obvious that there is a good side to it.

Watanabe: Therefore, aside from the question of actually using the technique, wouldn't it be necessary to conduct research after all? I question putting everything that is risky in a package and labeling it an ethical problem.

Yukawa: ....

Watanabe: Instead, the work should proceed step by step while keeping the world informed. But concerning genetic manipulation, everybody gets very emotional....

Yukawa: That is to be expected, when the problem involves men.

Watanabe: However, this problem is taking place even before genetic manipulation occurs. For example, abortion of a fetus with bad genes as found through amniocentesis (fetal diagnosis) is advised. An ethical problem is in fact arising before occurrence of genetic manipulation, and I wonder why that is not made an issue....

Yukawa: There is the previous example in the field of physics that the experts were not careful enough and the laymen's fears came true. We cannot say that the laymen's fears will not come true in molecular biology, either.

Watanabe: Speaking about the technique of genetic manipulation, it did not begin from purely military technology as in the case of the atomic bomb. Second, as you pointed out, there are strict regulations in the field of basic science such as the Japanese guidelines before commercialization. However, those regulations are being relaxed more and more. That is a problem.

Yukawa: You said a new organism cannot be created. But new microorganisms are in fact being synthesized. I wonder why such organisms were developed.

Watanabe: However, thoughtful molecular biologists have become mystics believing that life is something given.

Yukawa: Is that right?

Watanabe: It may be said that they have returned to mysticism, having the mystery of life before them.

Yukawa: That may be so now, but they may change to not believing in mysticism in the future.

Watanabe: The arrangement of genes and the technique of manipulating them have been discovered. The problem is that they could not help but become mystic believers of life in the next step. It will be quite some time before they come out of that stage.

Yukawa: If I may persist, in physics, electrons and neutrons have forms absolutely identical as though fitted in a mold. This is a big mystery. In the case of biology also, there may be some laws like a mold. It is difficult to believe that the process of identical DNA's being formed is an accident.

Watanabe: We do not know about that. It is probably because of our ignorance. Unlike physics, where the theory of relativity and quantum theory have been conceived, molecular biology is still a shallow science which has not attained that level.

Yukawa: Yes, that feeling is strong even in the layman's view.

Watanabe: Life science still has no technique by which it can leap to a different level of another dimension. Although I believe that a living organism cannot be created as yet, I cannot exclude the possibility that it can be made by accident. However, in my position, I cannot take an antiscientific stand by speculating about a risk. In any case, it will be developed with caution. Moreover, it is necessary to have the general public understand the state of research.

Yukawa: Regardless of pessimism or optimism, it is important to eliminate secrecy as much as possible.

Watanabe: I believe we should formulate a system that can be understood by people outside the field. In addition, the connection between researchers and industry is becoming a problem in Europe, the United States, and Japan. Since we are in a world where artificial microorganisms are patentable objects, we must form a system at a national level to advance basic science in genetic engineering.

Yukawa: Secrecy is certainly a dangerous thing.

Watanabe: The atomic bomb was a secret in physics, wasn't it?

Yukawa: The entire large-scale research was enveloped with great secrecy. Such a thing has been experienced in physics.

Watanabe: In the case of genetic manipulation, it is necessary to exchange information freely worldwide and to formulate international guidelines. It is also important that the experts and those outside the field cooperate. We should consider the types of system to be formed to that end.

Yukawa: I agree.

Watanabe: The problem of scientific openness is an especially important subject with respect to genetic engineering. There is the problem, however, that we cannot get public interest or concern unless we cry wolf.

Yukawa: But I do think it's dangerous. You seem to be much more optimistic about it than I am (he laughs). However, I know there is a problem that the hazard of genetic manipulation is reported in exaggerated terms to the public.

Watanabe: It is significant that you pointed it out. When only the risk is exaggerated, we in research tend to deny it and become optimists. Just and earnest information are necessary.

Yukawa: In that respect, the role of journalism becomes an issue. It is not enough to report only the new facts and sensational issues.

Watanabe: Yes, the problem of relating science to society is what troubles us the most. Specifically, to whom should we explain?

Yukawa: There is a meeting of scientists called the Pugwash Conference. In those meetings, I am always speaking of the ideal of a world federation. But such a simple principle as utopia that brings peace to mankind is not understood by the scientists. They don't understand the grand concept that wars are foolish. This is surprising. They narrowmindedly leave society's problems to the social scientists. This trend is stronger among the scholars of advanced countries. I strongly warn them that it should not be that way. Only a very small number of them have the vision of a world federation. The problem is simple, but many of them don't even bother to think about it.

After almost 2 hours of conversation, Dr Yukawa said to Prof Watanabe: "It ended up being too pessimistic for a New Year's talk," to which the latter responded: "No, you have always been concerned about the future of molecular biology. I was prepared for an even more severe admonishment." Dr Yukawa's voice brightened, despite his long illness, as he said: "I would like to talk to you more freely another time." Finally, the heavy statement "unexpected events do occur in science (more than people imagine)" ended the conversation.

Hideki Yukawa--Professor emeritus of Kyoto University and Osaka University. Recipient of the Nobel Prize and the Order of Culture. Born in Tokyo in 1907. Graduated from the Faculty of Science, Kyoto University. Held positions as assistant professor of Osaka University, professor of Kyoto University, visiting professor of Columbia University, and director of the Institute of Basic Physics, Kyoto University. He developed the theory of elementary particles using the famed neutron theory. Through the seven-man committee for the appeal for world peace and other means, he expressed a positive view for banning nuclear weapons, etc and has warned sharply about the handling of science and technology.

Itaru Watanabe--Professor, School of Medicine, Keio University. Born in Matsue City in 1916. Graduated from the Faculty of Science, Tokyo University. Held positions as a professor of the above faculty and at the Virus Research Institute of Kyoto University. He quickly recognized the need to study life phenomena at the biochemical level in Japan, established the Nucleic Acid Research Society in 1949 together with F. Egami and A. Shibatani, and became a pioneer in molecular biology in Japan. He founded the Japanese Society of Molecular Biology in 1978 and has been serving as the president since then.

Enzyme Research

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 13 Jan 81 p 1

[Text] Textile companies such as Unitika and Toyo [boseki] Spinning Co began working in earnest in the biochemical field, where enormous development is expected in the future. While the textile business continues to be slow, various firms are striving to strengthen the nontextile field centered around film and resin, but there is no prospect for extraordinary growth in the future. Thus, they are focusing on the biochemical field as the pillar of support for the industry 10 or 20 years from now. Currently, industrialization of medicine and test chemicals using unique enzymes is advancing rapidly. They are hopeful that new commercial products bringing high profits will be produced in the near future.

Toyobo and Unitika Are in Front

Toyobo first began studying enzymes in the mid-1960's. Enzymes were used to treat the wastes from pulp, rayon raw material. However, the active use of enzymes in the biochemical field and commercialization began in 1972. Products were developed for food processing such as tenderizing meat, refining sake, etc, as well as a test chemical for measuring uric acid. However, due to the small demand, this did not lead to large profits.

Therefore, the company turned its eye to blood-related businesses. Together with Shimadzu Seisakusho, it developed the ["Diaspat"?] blood analyzer, and will start marketing it in earnest in 1981. An analytical agent using Toyobo's enzyme is used for the system, which can analyze the complex composition of blood into 24 categories quickly and simply. In addition, it is hurrying to commercialize enzymes that react with cancer-specific proteins produced by cancer cells. If this can be commercialized as an analytical agent, it would contribute greatly to the early discovery of cancer.

On the other hand, Unitika shifted its emphasis to the development of the nontextile field in the early 1970's. As a starter, it gathered some 10 people having experience in fermentation, food engineering, and synthetic chemistry, and organized a project team with the objective of "application of microorganisms." They were sent for study in wide areas both in Japan and abroad in order to solidify the structure for discovery of useful enzymes and their commercialization.

Unitika's achievements in this basic field were appreciated by the Research and Development Corporation of Japan, and it was commissioned to develop material for medical use which does not cause thrombus easily by fixing urokinase (an enzyme with a thrombolytic action) on the surface of macromolecular polymers such as nylon. In addition, under commission from the same corporation, it is advancing commercialization of an "adenosine triphosphate (ATP) regenerating enzyme," which will become the basis of a revolutionary new technological development called a bioreactor for bringing about a biosynthesis reaction through engineering. Commercialization of this enzyme at Unitika is the most advanced in the world, and it is considering building a pilot plant in 2 to 3 years.

Kurashiki Spinning Co has been expanding chemical products, engineering, and information development as the three major lines of the nontextile division. In order to develop a fourth line, it recently established a "nontextile development group." This group is studying the industrialization of biochemistry along with electronics, energy conservation, etc.

The textile industry in Japan has repeatedly recommended shorter operating hours and a cutback in production equipment. And it is also behind in expanding into the nontextile field. For this reason, various textile firms quickly got into the biochemical field, which is believed to represent the coming era, and are striving for stabilization of the industry. Many areas of biochemistry have not been touched anywhere in the world. Consequently, there is a possibility that the Japanese textile firms, which have not had much chance in the past, may take a leading role.

Chemical Industry Applications

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 1 Jan 81 p 15

[Interview with E. Suzuki, president of Mitsubishi Chemical Industries]

[Text] Various chemical companies are turning eager eyes toward biotechnology, which is the field of industrial application of high-level functions inherent in living organisms. When this technology is developed, it is said that the chemical industry will change into an energy-saving, resource-saving industry, and new chemical substances which could not have been manufactured previously will be manufactured at low cost. The formation of a promotional structure is spurred especially by government and civilian efforts proceeding hand in hand under the slogan, "Catch up with the United States, which is ahead, and surpass it." E. Suzuki, president of Mitsubishi Chemical Industries, which is the "banner holder" of the private sector, talks eagerly of the "era of biotechnology," stating that "the development of biotechnology will have such great influence that it may be called a 'revolution' in the chemical industry." He has been steadily advancing research and development in the field. We asked about his outlook for 1981 and beyond.

Research and Development Make Progress in Biotechnology

Question: Interferon and gene splicing have recently been attracting attention, and biotechnology will be a field that draws increasing interest after 1981....

Answer: In short, biotechnology is a comprehensive technology covering the industrial application of high-level functions inherent in living organisms. Specifically, it includes production of new substances such as interferon, which is eagerly awaited as an effective drug against cancer, application of gene splicing technology to convert manufacturing processes to save resources and energy, cell fusion and mass culture techniques, and bioreactors which apply biological reactions to industry. Plant breeding and biomass are also included in biotechnology, and it may be called an "innovative technology" that encompasses all industry, including computers. There is even speculation that it will become a 3-trillion-yen market in the 1990's.

Question: In the field of genetic engineering, activities of Euro-American industries are being reported.

Answer: Unfortunately, the level of Japanese technology is running behind the Euro-American countries. This is abundantly clear if you look at Japanese patents related to genetic engineering, which is in the limelight today. Of the 24 cases registered, three-fourths of them are patents from overseas. Once important patents are held, the Japanese side is helpless. In many cases, world demand is met at the stage of accomplishing mass production, whether it is a new drug or new substances. As regards biotechnology, we cannot compete using the method of technical importation and improvement, in which Japanese industry has been skilled. Therefore, it is necessary to promote the industry together with the government, and not industrial circles alone.

Question: How would the chemical industry change with the implementation of biotechnology?

Answer: Reaction processes in the chemical industry are mostly carried out under conditions of "high temperature and high pressure." Thus, many problems exist in the energy and environmental aspect. If these processes are replaced even partially by biochemical reactions carried out at "normal temperature and normal pressure," the effect will be enormous. Distillation and separation processes are now carried out by heating, but look at the stomach and the skin of the human body. They are not heated. If such biological functions can be applied, a "revolution" will take place in the chemical industry. The biochemical processes occurring repeatedly in the human body hold endless possibilities.

Question: Speaking of life science, Mitsubishi Chemical Industries inaugurated a life science research laboratory in a corporate system in 1971. What kind of developments are being considered for the future?

Answer: Commemorating the 10th anniversary of the founding of the life science research laboratory, we are making plans to hold an extensive scientific lecture symposium. We would very much like to invite Nobel laureate chemists. From the beginning, the life science research laboratory had the objective of contributing to the welfare of mankind through basic research into the life phenomena. Its achievements have borne fruit in the commercialization of "isomerized sugar," etc. Using the work of the past 10 years as the foundation, in the future we intend to promote activities in the application phase. The fact that the former vice president, M. Niwa, was appointed as the new director, holds the promise of joining the corporate management spirit anew to the "ivory tower" concept. We are eagerly waiting to see more and more products on the basis of industrialization from now on.

What will emerge?

Some people call biotechnology "modern-day magic." The elucidation of biochemical reactions in progress in the human body or in other living organisms has been advanced. As a result, their application to industry is being investigated. Among them, only genetic engineering is rapidly being highlighted, and it has fanned an interest in biotechnology linked to the development of new drugs.

However, cases of actually arriving at the level of commercialization, such as insulin commercialization, at the test plant stage in U.S. industry are few. A technique for converting a process by using gene splicing is also being developed in Japan, but one may safely state that it has not come out of the laboratory and experimental stage.

Under such circumstances, Mitsubishi Chemical Industries, a pioneer in life science research, has pushed biotechnology forward as a business strategy and has begun working in earnest toward the goal of commercialization. The circumstance is such that we must keep our eyes open to see what will emerge in 1981, the 10th anniversary year of the life science research laboratory.

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SCIENCE AND TECHNOLOGY

PETROCHEMICAL INDUSTRY SEEKS OVERSEAS PROJECTS

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 5-10, 12-14 Jan 81

[5 Jan 81, p 8]

[Text] The [Japanese] petrochemical industry's overseas ventures have begun to show some new developments. In the past half year, plans to advance into such countries as the United States, Canada, and Australia have been hammered out in succession; the situation is that of a "rush," the first since the first half of the 1970's. Each plan puts the greatest emphasis on securing cheap natural gas as a raw material and furthermore concentrates on advanced countries which have fewer "country risks." In comparison with the past [policy of] setting up in oil-producing countries, [the new plans] show significant qualitative changes. This comes at a time when the world's petrochemical [industry] is entering a major shakedown period due to successive rises in the price of oil. It would appear that the strength of the [petrochemical industry] in the United States, which uses cheap natural gas as its major raw material, will increase even further, while the competitive powers of Japan and Europe, with naphtha as their raw material base, will decline. The ultimate goal of the new strategies planned by the Japanese petrochemical industry is characterized by a "boomerang effect," since they call for the restoration of international competitive power, both at "midstream" and "downstream," by bringing into Japan as raw materials basic chemical products produced abroad at low cost. The industry views this type of overseas venture as a trump card in its effort to open up [new] inroads for "Japan: The Nation of Chemical Industry," and shows its readiness to further spur its internationalization throughout the 1980's.

Heavy Investments in the United States and Canada

Mitsubishi Chemical Industries, known within the petrochemical industry for its cautious approach to overseas ventures, has radically changed its overseas strategy in the past half year. Following the decision to participate in the petrochemical project in Alaska, U.S., Mitsubishi Chemical also decided on a policy to actively engage in a petrochemical project in British Columbia, Canada, where it will represent Japan along with Mitsubishi Corporation. These are large-scale projects aimed at complete production, from basic raw material ethylene to various derivatives, and if they are realized they should serve as the company's crucial raw material supply bases.

The reason for the said company's "transformation" is that it "feels insecure about Japan's future petrochemicals," (Hiroshi Watanabe, managing director in charge of overseas [operations]) and it is "proceeding with surveys on the petrochemical projects in Alaska and in Canada with the idea of opening up routes of activity for the company's petrochemical division." (ibid)

Toyo Soda Manufacturing is facing difficulties as one of the enterprises that participated in petrochemical projects in Iran. Despite the increased expenses caused by the interruption of construction [work in Iran], the company recently revealed its intention to carry out a completely new chemical and petrochemical project in the United States. This involves construction of a large-scale plant for sodium hydroxide and intermediate raw materials for vinyl chloride, in cooperation with a local resources firm in Texas, the U.S. petrochemical center. An industrialization survey will be completed by spring.

"The petrochemical project in Iran is special. Just because we have it, this doesn't mean we should not make necessary investments [elsewhere]." (Takeshi Umino, managing director) For Toyo Soda, the venture in the United States is a necessary investment for survival and is based on the judgment that failure to invest in it would be tantamount to waiting idly by for death.

Thus far, the U.S. chemical products exported to Japan have come mainly in the form of "fine" (fine chemical products) and special products; however, the United States has picked up the offensive in the area of basic chemical products. It is said that last year, [U.S.] exports to Japan of raw materials for synthetic textiles and partially synthetic resins tripled from the previous year, when the increase was 1.5 times the year before. Because of such a sudden increase, it is reported that Chairman Horifuka of Asahi Dow recently "warned" the executives of Dow Chemical in the United States, with whom he has a close relationship as a result of their joint venture partnership, that if they "increase exports too hastily, they will meet fierce resistance in the Japanese market."

Outstanding U.S. Cost-Competitive Power

In the face of U.S. offensives, the world's petrochemical industries are now greatly shaken. [U.S.] synthetic resin has invaded the Southeast Asian market, which the Japanese petrochemical industry has regarded as its own backyard, and furthermore, basic chemical products with a high degree of wide application and mass-produced products have started to pour into the keep, the Japanese domestic market, in large volume.

The damage to Europe is greater. ICI, the world's fourth largest chemical producer and Britain's largest enterprise, showed a deficit of $24 million in the July-September period last year. This was ICI's first deficit since the company was established, and it had a great impact on British industries. The reason for this was that on top of the economic depression in Europe was added the offensive of the U.S. products, with devaluation of the dollar in the background, and this led to deterioration in the synthetic textile and petrochemical divisions. Many U.S. chemical manufacturers are leaving Europe and, contrarily, European manufacturers are increasingly moving into the United States to "hedge" their risks.

The price of ethylene, the primary raw material for petrochemicals, is slightly above 100 yen per kilogram in the United States and about 70 yen in Canada; in contrast, it is about 170 yen in Japan. There is an overwhelming difference in the cost-competitive power. This is because Japan for its raw material uses naphtha, whose price is increasing along with that of crude oil, while the United States uses cheaper natural gas as the raw material for 70 percent of its ethylene production, and the price of the rest--viz, naphtha--is regulated at a low level. In addition, cheaper costs for energy such as electricity have further added to the U.S. competitive power.

The Majors' Strong Determination To Invest

In the United States, crude oil price controls, started under the Republican administration in 1972, will be removed by October 1981. Thereby, it is forecast, the [American] price of naphtha, which is cheaper than the international market price, will gradually approach the international price. At the moment, however, price controls on natural gas, the major raw material, are expected to continue until 1985; therefore, the [U.S.] advantage in terms of cost will continue at least until then.

Within the Japanese petrochemical industry, most see that U.S. superiority will continue even after decontrol. There is the view that "if, like Japan, the chemical companies affiliated with the majors would use imported crude oil after decontrol, it would be a different matter; but since they will be using their own natural gas and oil, we ought to say that, in comparison with those who import, their advantage in terms of cost will continue." (Umino, managing director, Toyo Soda)

In the U.S. petrochemical field, those chemical companies that are affiliated with the majors already control high shares--slightly less than 60 percent of ethylene, slightly less than 80 percent of propylene, and from 30 to 40 percent in high pressure and medium-low pressure polyethylene; furthermore, they are prepared to activate new investments, and [in the process] they are arousing a precautionary attitude within Japan's [petrochemical] industry.

Reinforced Capability Depends on Overseas Projects

What would happen if the U.S. superiority in cost competition were to continue? Dow Chemical announced last November that it would begin exporting to Japan 500,000 tons of ethylene oxide (vinyl chloride intermediate raw material) which corresponds to 40 percent of the annual demand of the same in Japan. However, if this is realized it will greatly influence not only the vinyl chloride industry but also the entire chemical industry. This is because "in Japan, nearly 20 percent of the ethylene and over 30 percent of the chloride are consumed in the production of vinyl chloride. Therefore, if [production of] vinyl chloride becomes unnecessary, the balance of the entire chemical industry will collapse." (Shigenari Suzuki, managing director, Toa Gosei Chemical Industry, Co, Ltd)

Every chemical company has begun to move toward new overseas projects, after having read these large trends in the area of raw materials.

Petrochemical Industry's Major Overseas Projects

Country	Project name and location	Enterprises: Japan	Enterprises: Partners	Completion target	Products and production scale	Raw Material
Iran	Iran-Japan Petrochemical Project (Bandar Khomeini, on the Persian Gulf)	Mitsui & Co, Ltd, Mitsui Toatsu Chemicals Inc, Toyo Soda Manufacturing Co, Ltd, Mitsui Petrochemical Industries Ltd, Japan Synthetic Rubber Co, Ltd, Japanese Government	Iranian National Petrochemical Public Corporation	Started in 1973, but due to Iranian Revolution and the war, completion date uncertain	300,000 tons ethylene, 100,000 tons high pressure polyethylene, 240,000 tons sodium hydroxide, 60,000 tons medium-low pressure polyethylene	Naphtha, natural gas
Singapore	Singapore Petrochemical Project (Merbau Island, on the southern coast)	28 private enterprises headed by Sumitomo Chemical Co, Ltd and the government	Singamore Government (Phillips participates in derivatives)	Started in July 1980; operations to begin in 1982	300,000 tons ethylene, 120,000 tons high pressure polyethylene, 80,000 tons medium-low pressure polyethylene, 100,000 tons ethylene glycol	Naphtha
Korea	Honam Petrochemical (Yosu)	Mitsui & Co, Ltd, Mitsui Petrochemical Mitsui Toatsu Chemicals, Nippon Petrochemical	(Yosu) Petrochemical	Operations began in 1979	70,000 tons med-low pressure polyethylene, 80,000 tons ethylene glycol, 80,000 tons polypropylene	Naphtha
Saudi Arabia	Saudi Petrochemical Project (Al Jubayl, Persian Gulf)	54 private enterprises, including Mitsubishi Corporation, Mitsui Petrochemical Industries, Ltd, and the government	Saudi Basic Industries Public Corporation, Dow Chemical	End survey by about June 1981; sign joint venture contract in 1985; completion expected in 1986	500,000 tons ethylene, 300,000 tons ethylene glycol, etc.	Natural gas
	Saudi Methanol Project (Al Jubayl, Persian Gulf)	8 private enterprises including Mitsubishi Gas Chemical Co, Ind, and the government	Saudi Basic Industries Public Corporation	Expected to start in March 1981 and to be completed by the end of 1982	60,000 tons methanol	Natural gas
Canada	British Columbia Petrochemical Project (North Vancouver)	Mitsubishi Corporation, Mitsubishi Chemical Industries Inc, Mitsubishi Petrochemical Co, Ltd Asahi Glass Co, Ltd	Dome Petroleum, Canada Occidental Petroleum, West Coast Transmission	Expected to end survey within 1981; start construction in 1982 and complete in 1985	250,000-300,000 tons ethylene; 100,000 tons high pressure polyethylene; 300,000 tons ethylene dichloride or vinyl chloride monomer; 250,000-310,000 tons sodium hydroxide	Natural gas
Australia	Redcliff Petrochemical Project (Southern Australia)	Mitsui Toatsu Chemicals Inc, Asahi Chemical Industry Co, Ltd	Expected to be Dow Chemical Co	Survey ends in 1981-82; completion expected after 1985	Ethylene, high pressure polyethylene, ethylene dichloride, sodium hydroxide, etc. Scale of production to be determined after survey	Natural gas
Alaska U.S.A.	Alaska Petrochemical Project (Pacific Coast of Alaska)	Mitsubishi Corp, Mitsubishi Chemical Industries Ltd, Asahi Dow	Dow Chemical, Shell Oil, Shell Chemical, Dupont	End survey in 1981-82; expected completion in 1985	Total 450,000 tons of ethylene and propylene, plus various derivatives from above.	Natural gas
Texas U.S.A.	Texas Electrolytic Vinyl Chloride Project (Matagorda, Gulf of Mexico)	Toyo Soda Manufacturing Co, Ltd	Texas Gulf	End survey by March 1981; expect to begin	400,000 tons sodium hydroxide & 500,000 tons ethylene dichloride (estimate), vinyl chloride monomer and resin in the amount corresponding to above will be produced	Natural gas

"Ninety percent of the Japanese petrochemical plants are deteriorating. To revive them, is it more advantageous to improve them domestically or abroad? Domestically, we should deemphasize the 'scrap-and-build' [approach] and look to strengthening our capability in overseas projects." [Takeshi Hijikata, president, Sumitomo Chemical Co, Ltd)

"The basic chemical products of petrochemicals have lost their international competitive power. From now on, we have no choice but to expand in countries where we can obtain cheap natural gas and energy and where there are no country risks! As for domestic facilities, we must not strain ourselves but must seek to coexist so as to produce profits." (Seiichi Matsubaya, president, Mitsui Toatsu Chemicals, Inc)

The newly planned overseas projects share special features which can be called the "New Three Principles in Overseas Ventures." They are: (1) aim for elimination of naphtha as a raw material source and secure natural gas by any means; (2) in order to avoid country risks, establish projects in advanced countries; and (3) based on the premise that the basic products produced abroad will be brought back to Japan, more away from the present policy of concentrating on overseas markets.

In the first half of the 1970's, overseas ventures in oil-producing countries were, on the whole, carried out in the form of economic cooperation, with an eye on the crude oil "given" in return. As against this, it can be said that the new type of overseas venture is, for all intents and purposes, a strategy worked out to save the Japanese petrochemical [industry] from becoming extinct.

The Japanese petrochemical [industry] has a certain strength: "It has grown in a neat pyramid-shaped form. Its operation and quality of labor, both upstream and downstream, are the best in the world." (Hachiro Iyama, managing director, C. Itoh & Co, Ltd) If the basic chemical products can be secured stably and at lower prices, then it is not a dream [for Japan] to surpass the United States, as it has done in the steel and auto industries.

[6 Jan 81, p 10]

[Text] Since the latter half of 1980, the Japanese petrochemical industry has been continuously beset with problems both at home and abroad: a slackening in domestic demand and a tough battle in the export market.... In the background there lies the big problem common to the industry, that of international competitive power.

Defeat in the Southeast Asian Market

"We can compete sufficiently with the United States and Europe in the Southeast Asian market in the area of all-purpose resin products, such as high-pressure polyethylene, if the price difference is less than $50 a ton. Last spring, U.S. products stormed the market at a price under $1,000 a ton, while Japan was exporting at $1,100, and finally super-inexpensive products priced between $700 and $800 appeared on the market. The best Japan can do is to break the $1,000 barrier." (Staff member in charge of exporting all-purpose resins) "Early (last) fall, just as inexpensive U.S. products converged [on the market], Canadian ethylene glycol (EG) appeared. In one stroke, [the Canadians] lowered their price by as much as $100 per ton. Japanese salesmen turned deadly pale, and the so-called 'Canadian shock' still lingers." (An executive of an EG manufacturer)

Insofar as the Southeast Asian market has been recognized as "Japan's backyard," its defeat there has had a great impact on Japanese industry. Although Korea and Taiwan have begun to attain self-sufficiency in supplying petrochemical products, 20 percent of total Japanese production is still sold in the same market. [The problem] is not limited to the export market; basic chemical products such as styrene monomer, EO, and EDC (ethylene dichloride) from abroad are entering the Japanese market at a rapidly increasing rate.

The sense of crisis caused by the drop in competitive power is felt strongly in the area of "upstream products," where ethylene has a comparatively high rate of use, requires less processing, and yet is easily transportable. The EO industry says that it has hit "bottom," as "the operating rate of the entire industry has dropped by 50 percent from that of the previous year." "In order to produce 1 kilogram of EDC, an intermediate raw material for vinyl chloride, 0.6 kilogram of chlorine and 0.25 kilogram of ethylene are used. The cost of producing EDC in Japan is 75-80 yen a kilo, but vinyl chloride manufacturers can obtain imported EDC from America at 55-60 yen," says the vinyl chloride industry, stunned by the gap in prices.

Today, it is the United States which is sweeping the world's petrochemical market. Next to the United States, Canada is drawing attention. The United States and Canada principally use ethane recovered from natural gas as the raw material for their petrochemicals; on the other hand, Japan and Europe use naphtha. It can be said that "petrochemicals have entered the age in which we can expect a head-on collision between natural gas base and naphtha base." (Tetsuro Oba, director, Mitsubishi Petrochemical Company Ltd)

According to a survey conducted by the Japanese industry in the United States, 70 percent of the raw materials for petrochemicals come from natural gas, and 30 percent come from naphtha. In Japan, 96 percent come from naphtha, and in Europe, too, nearly 90 percent come from naphtha. When we compare the June 1980 price of ethylene, one of the basic chemical products, we see that it costs 110 yen per kilogram in the United States, 180-190 yen in Japan, and about 160 yen in Europe. We can say that this price gap derives from the difference in the prices of raw materials at the time of purchase. In the United States, for example, ethane, recovered from natural gas, costs 45 yen (1 kilogram) and naphtha 60 yen. Naphtha in Japan costs 84 yen, which is 7 yen higher than in Europe. Consequently, Japan is using the "world's most expensive" raw material. It is said that Canadian natural gas costs 30-40 percent less than that of the United States.

The prices of raw materials in the United States are outstandingly low among the advanced countries. This is because [the prices] are supported by "energy price controls." Beginning with the first oil shock, [prices of energy sources] were, one after another, incorporated into the commodity price control [system]. Since then, decontrol has taken place, but because crude oil, gasoline, and natural gas have a great impact on public demand, they are still controlled.

Hope Is for U.S. Decontrol

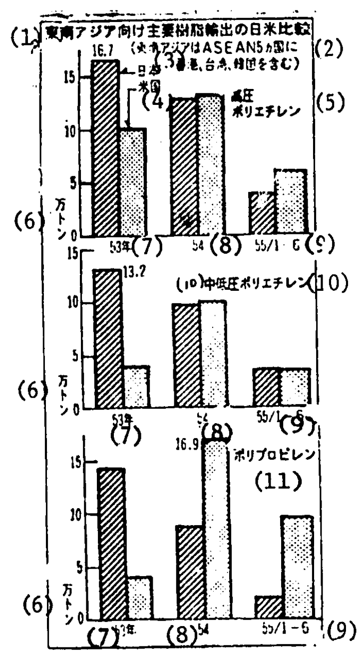
Although the United States continues to set prices which are considerably lower than the international level, there is worldwide oil conservation. With such a trend in the background, the United States has begun to abolish controls and adopt a policy of establishing "energy prices" comparable to those on the international level. This "decontrol" of prices is being eyed closely by the world's petroleum and petrochemical industries. Decontrol of petroleum prices, which started in June 1979, means that consumer price, established by the U.S. Government by pooling both domestic and imported crude oil, will be brought closer in stages to the international import price. The prices established by the government will be set every quarter, and decontrol will become effective as of 1 August 1981; thereafter, the prices will be determined in the free market.

For the first quarter of 1980, [U.S.] domestic crude was at $21.02, imports at $32.19, and the government-set price at $25.93. It is expected that by the end of September 1981, the gap between the import price and government-set price will be resolved. Decontrol of natural gas is expected to follow--sometime between 1985 and 1987.

"If U.S. raw material prices approach the international level, there is a chance that Japanese petrochemicals may win the competition. There is no prospect of increasing facilities for natural gas production beyond the present level, but those for naphtha will increase in the future." In this way, some Japanese petrochemical companies are hopeful that the price gap will be reduced after decontrol; however, it appears that those who pin their hopes on the work of others are in the minority.

"It is premature to judge that U.S. oil and gas [prices] would suddenly reach the international level after decontrol. The increase in U.S. [oil] prices will lead to the drilling of heretofore 'dormant wells' and, therefore the quantity of cheaper domestic crude oil will increase and the price hikes will be checked. In addition, chemical companies have secured their own wells and have moved into the area of resources. Consequently, the strength of the United States will be the same." (Toshio Iijima, managing director, Mitsui & Co, Ltd)

Since Japan has to import all of its crude oil, it is unavoidable that [the price] of naphtha will increase further as crude oil prices increase. The price of naphtha in Japan has more than doubled in the past 2 years. As a result, the fluctuation expenses in the production cost of ethylene have reached 80-90 percent; it is painful that [Japan's petrochemical industry] is so structured that it is directly responsive to price hikes in raw materials and fuel.



Key:

(1) Japan-U.S. Comparison of Major Resin Exports to Southeast Asia
(2) (Southeast Asia includes the five ASEAN countries, Hong Kong, Taiwan and Korea)
(3) Japan
(4) United States
(5) High pressure polyethylene
(6) 10,000 tons
(7) 1978
(8) 1979
(9) Jan-June 1980
(10) Medium-low pressure polyethylene
(11) Polypropylene

Desperate Search for Survival

In the area of derivatives, where high prices are paid for raw materials, and where competition is keen both at home and abroad, a desperate search for survival is now under way. If the differences in the cost of raw materials between [Japan] and the United States cannot be minimized, the situation will become even more serious.

The gap [in prices] is so large that Japan cannot hope to compete even in the competition for quality--the area in which we are good. Nor can we find any technological innovation which would eliminate such a gap." (Koji Kishida, director, Quality Control Department, Showa Denko K.K.) The situation is such that trading firms are advocating conversion from domestic to overseas production of ethylene-EDC, VCM (vinyl chloride monomer), methanol, EG, ammonia, and polyethylene products with low degree of processing.

The giant U.S. chemical companies, too, are boldly attacking Japan's weak points. "Dow would like to supply a large volume of EDC, VCM and sodium hydroxide. I believe this is significant for Japan's 'downstream' enterprises in terms of securing their competitive power." (R.W. Lundeen, vice president, Dow Chemical Company, headquarters). Thus [Dow] has already revealed its strategy of aiming exclusively at the Japanese market.

"The question of raw materials means everything to petrochemicals. I am flabbergasted when I hear the cost in America. We have no choice but to survive by choosing a way in which we can procure a cheaper material and produce final products (resin) where our technological strength lies." (Shintaro Odagiri, president, Shin-etsu Chemical Industry Co, Ltd)

Naturally, in addition to comprehensive petrochemical companies, such manufacturers of derivative products as Asahi-Dow and Toyo Soda Manufacturing Co, Ltd are also moving toward procuring raw materials abroad. The Japanese petrochemical industry emerged about 20 years ago; it is young and, at the moment, it faces a structural ordeal.

[7 Jan 81, p 9]

Ventures in Advanced Countries Is the New Rule

The chemical base projects which have recently surfaced in succession are all based in advanced countries surrounding the Pacific Ocean; these include the Alaska Project of the Mitsubishi Group and Asahi-Dow, the Canadian Project of the Mitsubishi Group, the Southern Australia Project of Mitsui Toatsu Chemicals, Inc and Asahi Chemical Industry Co, Ltd, and the Texas Project of Toyo Soda Manufacturing Co, Ltd. We may regard this as a result of reflecting upon the question of investment security brought about by the difficulties encountered in the Iranian Petrochemical Project, and upon the local conditions for transferring products back to Japan. "Aim for cheap natural gas and energy in the advanced countries around the Pacific Ocean!" is now becoming the new rule for the chemical industry of Japan in making overseas ventures.

"The principal premise of overseas projects is the availability of cheap resources and energies; however, we've had enough of those countries with country risks." (Executive of Mitsui-affiliated chemical company)

"As long as that kind of situation continues in the Middle East, it is only natural for our capital to move toward safer areas." (Kanao Nakamura, managing director, Industrial Bank of Japan, Ltd)

The "failure" of the Mitsui Group, headed by Mitsui & Co, Ltd, in the Iranian Petrochemical Project has clearly shown the Japanese chemical industry the danger of country risks. It is more than natural that chemical industry executives have recently begun to stress: "Absence of a country risk is a necessary precondition for overseas ventures" (Chairman Horifuka, Asahi-Dow), and: "Although securing cheaper raw material sources is indispensable, it must be done in stable countries." (Narinao Awawa, president, Mitsui Petrochemical Industries, Ltd)

A section of the Marunouchi district in Tokyo is commonly called "Mitsubishi Village." An executive of the Mitsubishi Group discloses his true intentions concerning the Saudi Petrochemical Project: "Saudi Arabia, too, has a country risk. Our project there is a national project, a part of Japanese petrodiplomacy, and the Mitsubishi Group is merely playing the role of a receptionist.

Therefore, in the case of the Saudi [Project], we are adopting a system whereby losses and gains are shared by the participating enterprises as a whole." He also adds: "We would like to put in our own efforts in Alaska and Canada so as to find a way out for the petrochemicals whose cost competitiveness has been declining." These statements tell us explicitly the differences in priority, as seen by the Mitsubishi Group, between the Saudi [Project] on the one hand and the Alaska and Canada [projects] on the other.

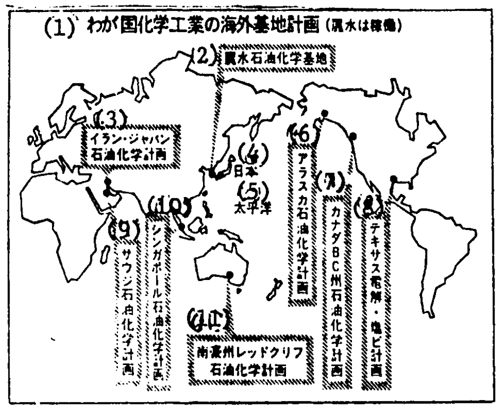
Difficulties in Singapore

Difficulties have arisen in the Singapore Project, another large-scale petrochemical project in addition to those in Iran and Saudi Arabia. Negotiations on the price of ethylene are facing rough going between Sumitomo Chemical Co, Ltd, which is in charge of the Ethylene Center, and the Singapore Government, on the one hand, and, on the other, the four companies in charge of production of derivatives, i.e., ethylene glycol (EG); these are the Mitsubishi Petrochemical Co, Ltd, Nippon Shokubai Kagaku Kogyo Co, Ltd, Mitsui Petrochemical Industries, Inc and Nisso Petrochemical Industry. The four EG companies insist: "Since cheap Canadian EG is flowing into the Southeast Asian market, we cannot make a profit unless the supply price of ethylene is reduced."

The Singapore Project, which, like Japan, uses naphtha (crude gasoline) as the initial raw material, appears greatly disturbed by the Canadian products based on cheaper natural gas. Mitsubishi Petrochemical, especially since it now has a Canadian project based on natural gas, must feel tempted to transfer its EG production from Singapore to Canada. Accompanied by crude oil price hikes, the Singapore Project has begun to reveal its character "as lying somewhere between a project based in a resource-based country and one based in a consumer-based country." (Executive of a major chemical company)

"We would like to come to an agreement on the EG problem through compromise. The Singapore [Project] is a strategy which takes into consideration the future of the Shinkyohama (Ehime Plant). If in the future we are to get involved in the petrochemical [projects] abroad, it would not be in a developing country but in an advanced country." (Takeshi Hijikata, president, Sumitomo Chemical Industries, Inc)

The reason for the concentration of recent new chemical projects in advanced countries surrounding the Pacific Ocean is not just limited to the problem of country risks. Geographical advantages also play a large part in bringing basic chemicals back to Japan as intermediate raw materials, and there are the advantages of cheaper natural gas and electricity. It appears that the world's major chemical [companies] are scrambling for natural gas reserves. For instance, in the case of natural gas found in the North Sea oilfield, which will be drilled after 1985, the "local" British ICI (Imperial Chemical Industries) and the U.S. Dow Chemical Company have already started a fierce competition.



Key:

(1) Japanese Chemical Industry's Overseas Base Projects (Yosu has begun operation)
(2) Yosu Petrochemical Base
(3) Iran-Japan Petrochemical Project
(4) Japan
(5) Pacific Ocean
(6) Alaska Petrochemical Project
(7) Canada, B.C. Province Petrochemical Project
(8) Texas Electrolytic-Vinyl Chloride Project
(9) Saudi Petrochemical Project
(10) Singapore Petrochemical Project
(11) Southern Australia, Redcliff Petrochemical Project

Secure Natural Gas Reserves

A sense of urgency is growing strong within the Japanese petrochemical industry: "Now is the time to get our hold on natural gas along the Pacific basin." Nobuyuki Tanaka, the director of the overseas department of Mitsubishi Chemical Industries, Ltd, is in charge of the Canadian Project in the Province of British Columbia; he explains this sense of urgency: "If foreign manufacturers secure the gas reserves before us, they will naturally try to sell their products to Japan, which is geographically close [to the potential reserves along the basin]. This is because Japan is using raw materials and energies that are higher than the international [price] levels and its competitive power in terms of cost is declining." In order to restore Japanese competitive power in the cost of basic chemical products, it must secure natural gas ahead [of foreign manufacturers].

"In the future, when Japanese petrochemicals want to establish bases abroad in search for cheaper raw materials, they will focus on Canada and Australia." (Yasuji Torii, chairman, Mitsui Petrochemical Industries, Ltd)

"Since we will lose our competitiveness if we stick to domestic production, we are conducting a [worldwide] survey. In the final analysis, however, we are eying the American continent, Australia, and New Zealand, where natural gas is available." [Koji Kishida, director, Quality Control Department, Showa Denka K.K.)

"Both Canada and Alaska would be crucial to Japan as bases for procuring intermediate products. There are no country risks there, and they are close to Japan. Further, sufficient trade and transportation routes already exist." (C.B. Branch, former chairman, Dow Chemical, United States)

[8 Jan 81, p 9]

[Text] Large-Scale Japan-U.S. Consortium

Toward the end of November 1980, executives of Dow Chemical Company who arrived in Japan for a board meeting of Asahi-Dow had a talk with executives of Mitsui Toatsu Chemicals, Inc. One topic of discussion was the Redcliff Project in southern Australia. A survey on the feasibility of the project, which will produce ethylene, polyethylene, sodium chloride, chlorine, and ethylene dichloride (EDC, the intermediate raw material for vinyl chloride resin) by utilizing natural gas and abundant rock salt in southern Australia, was first conducted by Dow; separate surveys were to be conducted by Mitsui Toatsu and the Asahi Chemical Industry Co, Ltd.

But Mitsui Toatsu had for some time been considering a partnership in Dow's EDC project, and the purpose of the talk with Dow was to confirm whether the latter was still "interested" in the joint Redcliff Project.

"From a long-term perspective we are considering Redcliff as a base for supplying EDC to Japan, and we would be asking Japanese EDC clients (vinyl chloride resin manufacturers) to invest their capital in the complex." (R.W. (Randeen), senior vice president, Dow Chemical Company, United States)

However, Seiichi Matsubaya, president of Mitsui Toatsu, is of the opinion: "In order to join hands with Dow's Redcliff Project for EDC, we, together with other Japanese manufacturers of vinyl chloride, would like to secure management rights." It is expected that the partners who will cooperate with Dow will not be limited to Mitsui Group. On the other hand, the Asahi Chemical Industry Co, Ltd, which began its own industrialization survey along with Mitsui Toatsu, has recently encouraged Japan's second largest vinyl chloride manufacturer, the Japanese Geon Co, Ltd, to participate in the Redcliff EDC project. The response was that Geon "will approach the project with a positive attitude." (Saburo Onishi, president, Japanese Geon Co, Ltd)

Asahi Chemical itself has said: "If we were to collide head-on with Dow's project at Redcliff, we would make adjustments through deliberations with Dow." (Seita Tochiku, vice president) In any event, it is certain that the Redcliff Project would become a large-scale Japan-U.S. consortium.

New Diagram in Overseas Development

A new diagram of the Japanese chemical industry's overseas development would set the stage in advanced countries around the Pacific basin and would be implemented by a league of both Japanese and foreign enterprises. The Alaskan Petrochemical Project is like a "united nations," as it is represented by such U.S. and European enterprises as Dow, Shell Chemical and DuPont, and by the Japanese firms of Mitsubishi Corporation and Mitsubishi Chemical Industries Ltd. The Canadian Petrochemical Project in the Province of British Columbia is a real Japan-U.S.-Canada league, involving the two Canadian resources companies of Dome Petroleum and West Coast Transmission, America's Occidental Petroleum which owns Hooker Chemical, a major U.S. chemical company and a Canadian corporation, and the Japanese firms of Mitsubishi Chemical, Mitsubishi Petrochemical, Asahi Glass, and Mitsubishi Corporation.

In Toyo Soda Manufacturing Company's Texas Electrolysis Vinyl Chloride Project, Texas Gulf will supply the raw material and Toyo Soda the technology. It is highly probable, however, that when the survey is completed in March of this year, other Japanese vinyl chloride resin manufacturers will be invited to participate in the project.

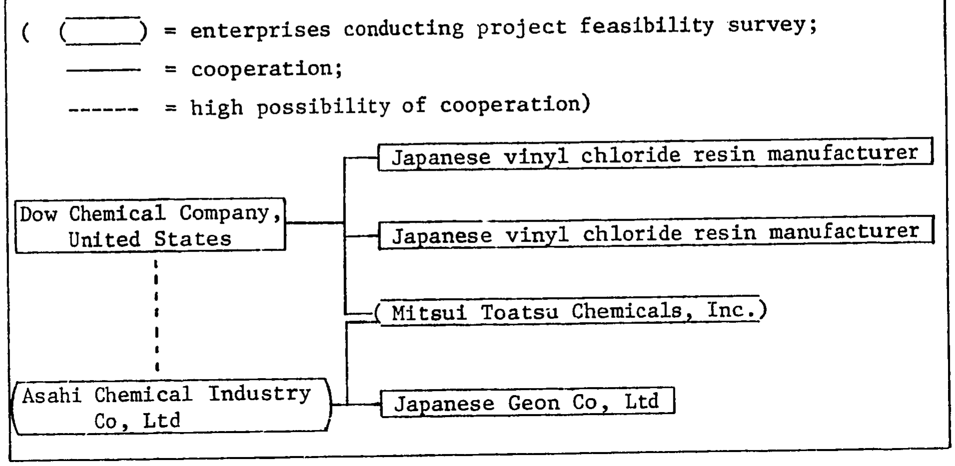
"In overseas developments, Japanese petrochemical companies should recognize their limits in terms of capital, technology, and risks, and join hands with leading manufacturers abroad." (Keisaburo Yamada, co-chairman, Mitsubishi Corporation)

"We are now entering an era of international division of labor and leagues, based on enterprises with competitive power and adaptability." (Jiro Furumoto), executive director, Asahi Glass Company, Ltd)

One reason for the arrival of this "era of leagues" is that production of basic chemicals overseas requires large investments; the league helps to reduce the amount of investment that each participant must share and, therefore, the risks it must face. The investment in the Canadian Project in British Columbia, for example, is expected to total 150 billion yen for a complex capable of producing 250,000 tons of ethylene annually. "In contrast, [the amount of investment] we can recover through the sale of products is about 50 billion yen annually, so that a revolving rate for capital invested is only one-third." (Hiroshi Watanabe, managing director, Mitsubishi Chemical Industries, Ltd) Since domestic equipment investment in Japan minimally expects more than a 1.0 revolving rate of investment, [overseas] investment efficiency is extremely poor.

As for the other projects, the Redcliff Project in southern Australia would cost about 600 million dollars for equipment for chemical products alone, Toyo Soda's Texas Project 600-700 million dollars, and the Alaska Project would cost "100 billion yen for industrialization survey alone." (Watanabe, managing director, Mitsubishi Chemical) When it comes to enterprises of this magnitude, it is necessary for both Japanese and foreign enterprises to join hands, if only from the point of view of financing.

Enterprises' Relationship on the Redcliff Project in Southern Australia, Which Is Expected To be a Large-Scale Japan-U.S. Consortium



On the other hand, from the standpoint of overseas enterprises, to join hands with Japanese enterprises would mean that they could expect to supply their products to Japan, "the giant market of the Pacific." When constructing a petrochemical complex in the coastal region of the Pacific, it is difficult to build one of appropriate scale unless a set volume of products can be consigned to Japan. However, although the market in Japan is attractive for overseas enterprises, [Japanese] manufacturers are solidly united behind MITI and the distribution system is complex; therefore, it is not easy to enter [the Japanese market] alone. The shortest route to the market, accordingly, is to join hands with Japanese enterprises.

"We ought to be able to cooperate with Japanese enterprises in Alberta, Canada, and in Australia. We had planned the project in Canada with the intention of supplying our products to Japan, and as a matter of fact it is turning out that way. If one wants to expand operations in Canada, I would be surprised if he does not join hands with Japanese vinyl chloride resin manufacturers." (C.B. Branch, former chairman, Dow Chemical, United States)

"The reason why foreign manufacturers wish to join hands with Japan is because the Japanese enterprises have both the market and the technology." (Hachiro Iyama, managing director, C. Itoh & Co, Ltd)

Diversified Bases for Overseas Production

The future issue for the Japanese chemical industry, in addition to the formation of "leagues," is "diversification." Even if [Japan] were to produce abroad and bring into Japan the basic chemical products whose competitive powers have declined, "It is not a good idea to 'commit' ourselves too deeply in one area, from the standpoint of security and stability of supplying Japan." (Kazuo Kume, director for both the First Chemicals Department and the Chlor-Alkali Department, Mitsubishi Corporation) This is because it is better to diversify the overseas production bases.

EDC, the intermediate raw material for vinyl chloride, is considered the most serious of all petrochemical products from the standpoint of the slant toward imports. The largest chloride resin manufacturer, the Shin-etsu Chemical Industry Co, Ltd, is "considering multiple supply sources, whether it be in overseas productions or long-term import contracts." (Teruhiko Aihara, board director) This approach is shared by the Kanegafuchi Chemical Industry Co, Ltd, and Mitsui Toatsu Chemicals, Ind. The Trend toward diversification [of sources] has just started, but it is expected that many such projects will surface in the future.

[9 Jan 81, p 11]

[Text] Ventures in the United States, Canada; Europe Is Apprehensive

It is said that whenever those engaged in the Japanese petrochemical [industry] visit European chemical companies, they are always asked the following question: "Although Europe exported petrochemical technology to the East European bloc, we are now suffering from the counterflow of East European 'politically underpriced products' to the European market. We see that Japan is also vigorously cooperating in the construction of petrochemical bases in the Middle East and China. Don't you have to worry about such phenomena as 'sales back' (receiving products as collateral for technologies provided) and a 'boomerang' effect (products flowing back into [the country]?"

Despite the European concern, Japanese petrochemical companies are successively setting forth "new" overseas ventures, aiming at basic chemicals and intermediate raw materials which can be secured stably at low cost and brought back to Japan. This is strategy which will take Japan into the United States, which has an overwhelmingly superior position in terms of price competitiveness, and into Canada, which follows the United States in the same aspect. European petrochemical companies are investing their capital in the United States, and as a rule they sell their products in the U.S. market.

From the start, however, Japan's intention in establishing [chemical bases] in the Pacific area has been to supply the Japanese market.

"The development of the Japanese chemical industry is [now entering a period of] great qualitative changes. From an age of technology imports, it went through an age aimed at production and sales in overseas markets through joint ventures, and now it is entering an age in which intermediate raw materials are produced in overseas bases and then imported." (Nobuyuki Tanaka, director, Overseas Department, Mitsubishi Chemical Industries Ltd)

"As seen in U.S. Dow Chemical's offensive in Japan, basic chemical products, supported by the gap in costs between the United States and Japan, are increasingly pouring into the Japanese market. However, if we become totally dependent on imports simply because of low prices, the price-determining rights will go to the exporters. It is necessary to air Japan's stand and secure the leadership. The time has come for the industry to cooperate and consider how it can supply cheaper raw materials." (Seiichi Matsubaya, president, Mitsui Toatsu Chemicals, Inc)

The blueprint for Japan is as follows: "(1) to secure cheaper raw material sources; (2) to produce abroad as far down the process line as the intermediate raw materials; (3) to bring these intermediate raw materials back to Japan; and (4) to enhance the competitive power of the final products." The "boomerang" of intermediate products is indeed what Japan should be looking for. "If we can obtain, at international market prices, products that can become raw materials, we can compete with any country on an equal footing. We are competitive technologically. The closer we get to the final product, the more severe the needs of the Japanese market become; therefore, we can maintain sufficient competitive power." Every manufacturer "upstream," "middlestream," and "downstream" agrees with the above assertion.

In the fall of 1979 a Canadian resource company, Dome Petroleum, proposed to a Japanese petrochemical company that it "would like to supply low-cost ethylene from natural gas." The Japanese were excited, but it turned out that Canadian policy made it impossible to export ethylene, and so the proposal went down the drain.

"It is best to import in the form of ethylene; however, countries with resources would probably set a policy of exporting it only after some processing. If production is done locally up to the intermediate raw material level, it will also lead to nurturing the host countries' industries. Bases that produce intermediate raw materials would be welcomed." Therefore, the Japanese are discreetly confident about their new overseas establishments.

Those items which are considered targets for overseas production are such raw materials for vinyl chloride as ethylene dichloride and vinyl chloride monomer, and such materials for synthetic textiles as ethylene glycol, all-purpose polyethylene, styrene monomer, and methanol. These are all "upstream" products, they are directly affected by the price gap between natural gas and naphtha, and they suffer a decline in international competitive power.

Mixing With Overseas Raw Materials

The derivative manufacturers' strategy is to maintain their competitive strength in downstream products by using a mixture of expensive Japanese raw materials and cheaper overseas raw materials. "The 'raw' material manufacturers must think about a product supply system that would allow end-users' product prices to maintain an internationally competitive power. One condition is that the prices be at the international market level. If we take part in overseas production, we can import [raw materials] at least at the lower limits of international market prices." (Teruhiko Aihara, board director, Shin-etsu Chemical Industry Co, Ltd)

When we look at the actual cases of the Japanese chemical industry's overseas ventures, we see that in most cases they were putting out final products. Surveys show that the motives for overseas investments are 71 percent for "securing and developing markets," 14.4 percent for "securing raw materials and resources," and the remainder for "diversification of management and inclination toward internationalization." In addition, the destination of the products and the sales routes were mostly dependent on overseas markets and partners. This was an "overseas market priority type," and it contrasts significantly from the recent [trends] of "overseas raw materials plus Japanese market priority type."

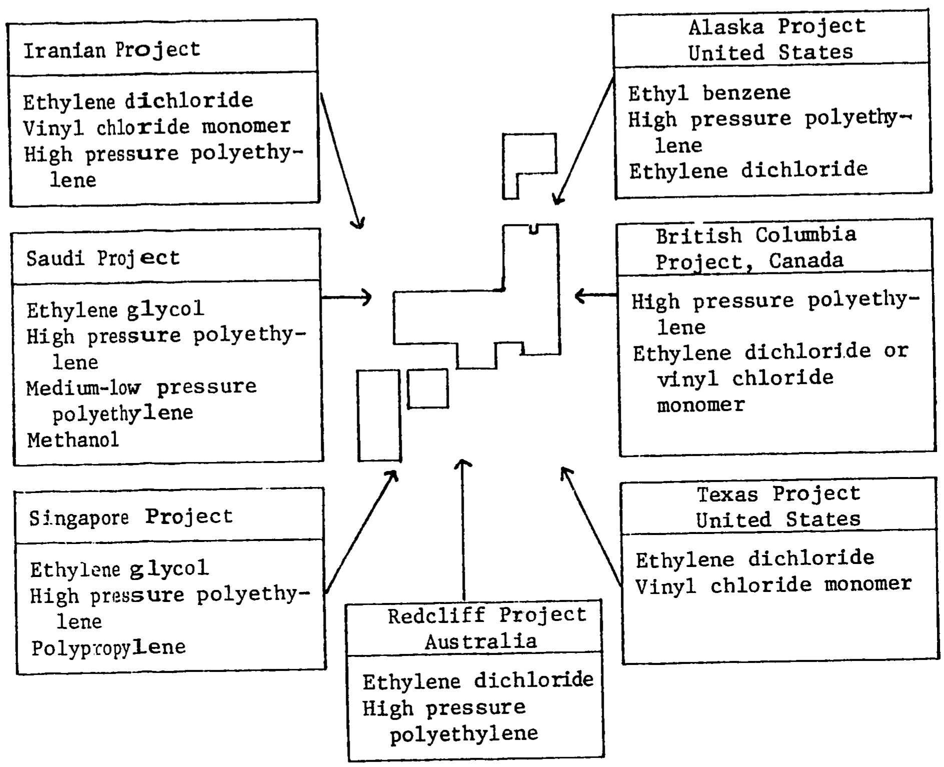
There are three representative Japanese overseas petrochemical projects; they are found in Iran (IJPC), Saudi Arabia, and Singapore. Presently, although there are differences in degree, these three projects expect to bring the products back to the Japanese market. However, it was not planned that way, for the projects were started on "the basis of securing petroleum and economic cooperation at the national level." (MITI) That is why we can say that [the countries involved] are promoting the projects as national projects where the government and the private sector are united. Here, there was little room for the Japanese petrochemical [industry] to express, from the very start of the projects, any thinking based on its own economic consideration and strategy.

What amounts to "cost-free" natural gas of oil-producing countries is extremely attractive for petrochemical companies. However, country risks and market problems have been the bottlenecks. Where can we sell the products? "In the cases of Iran and Saudi Arabia, Japan has no choice but to take the responsibility of distributing the products"; therefore, the products will be brought back to the Japanese market. Since the raw materials are inexpensive, if things go smoothly there is a possibility that [these projects] will turn out cheaper intermediate raw materials to be exported to Japan.

The Singapore Project was planned to take the place of Japanese exports to Southeast Asia; however, since, like Japan, raw material used in naphtha, the competition with U.S. and Canadian products is the focal point. Here also, the boomerang phenomenon seems inevitable: "Although the rewards in terms of raw materials are few, we consider Singapore as an extension of our domestic plants." (Executive of Sumitomo Chemical Industry Co, Ltd, in charge of promoting the project)

"Except in an advanced country, it is difficult for a chemical industry to develop in a balanced way. I believe that because the regions around the Pacific, which have been receiving much attention, have raw material resources and excellent markets, more petrochemical bases will be established there, and demand will grow. Then, horizontal transactions and exchanges will improve and the areas of activities of trading firms will expand. In connection with overseas ventures, the Japanese industry too will be affected greatly. The trading companies will utilize their organizing functions, information-[gathering] ability, and distribution and sales functions in line with trends in the industry." (Hachiro Iyama, managing director, C. Itoh & Co, Ltd)

Overseas Petrochemical Projects Expected To Supply Japan With Products and Intermediate Raw Materials



Comprehensive Trading Firms Ready To Make Their Appearance

The Japanese petrochemical industry is in its "First Year of Internationalization." Due to international competitive power problems, many movements have emerged in search for a "new order." In the midst of the large undulating current, the comprehensive trading firms are waiting to make their appearance: "Trading firms would also like to contribute in developing the Japanese petrochemical industry." (Toshio Iijima, managing director, Mitsui & Co, Ltd) [This would include] the gathering of information overseas, the creation of international leagues aimed at lower risks, and the establishment of distribution bases accompanying overseas production....

Mitsui & Co, taking pride in its annual 1.5 trillion yen business in chemical products, stumbled over the Iranian Project. Mitsubishi Corporation, which is pursuing Mitsui [in sales], thereupon gave a big pep talk: "Here is our chance

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to reduce the 500-billion-yen difference between us. Let's not miss it." The rivalry between C. Itoh & Co, Ltd, Marubeni Corporation, and Sumitomo Shoji Kaisha, Ltd is also quite fierce. Overseas bases, which are the axis of the petrochemical industry, are emerging at a rapid rate, and the industry is swaying to and fro, involving the trading firms in the process.

[10 Jan 81, p 9]

[Text] Mitsubishi Group To Form a Solid Block

On the night of 19 November last year, executives of Mitsubishi Chemical Industries, Asahi Glass, and Mitsubishi Corporation met in the Mitsubishi Club, located in the Mitsubishi Building, in Marunouchi District, Tokyo. Opinions were exchanged until late into the night regarding participation in the petrochemical project in British Columbia, Canada. The conferees were Hidetoshi Kinoshita, vice president, and Hiroshi Watanabe, managing director, both of Mitsubishi Chemical Industries; Jiro Furomoto, executive managing director of Asahi Glass; and Keisaburo Yamada, cochairman, and Kenjiro Oka, managing director, both of Mitsubishi Corporation. The meeting ended with the agreement that the conferees "will actively exchange information and resolve [differences of] opinion in matters related not only to the Canadian project but also to the entire petrochemical industry."

"Today, powerful majors are rapidly moving into downstream petrochemical production. We can no longer say that Mitsubishi Chemical will do this or that Mitsubishi Petrochemical will do that. From now on, whenever there is a possibility of teamwork, whether it may be here or abroad, we must work together...." (Executive, Mitsubishi Group)

Executives from Mitsubishi Petrochemical were absent from the meeting, but naturally that firm too is participating in the British Columbia Project. Both Mitsubishi Chemical and Mitsubishi Petrochemical belong to the Mitsubishi Group, but they are at odds with each other in domestic matters, both stressing that it is the "leader" of the group. The Canadian project is their second joint overseas project; the first was in Saudi Arabia. Their joint efforts have attracted attention as a sign that they have begun to work together seriously in the area of overseas ventures.

There are indications that strengthening of cooperation is not confined to the group but extends beyond it and its financing subsidiaries. For the Redcliff Petrochemical Project in southern Australia, a consortium consisting of America's Dow Chemical and Japan's Asahi Chemical Industry, Mitsui Toatsu Chemicals, and Japanese Geon, in a secondary role, is expected to be formed. It is the consensus of the petrochemical industry that these overseas joint ventures "will inevitably trigger a restructuring of the industry in Japan."

"The Kashima [petrochemical] complex (in Ibaragi Prefecture) is built on a large tract of land. We want to restructure it so that it can operate in accordance with overseas bases in Saudi Arabia and Canada." (Tsutomu Shuto, managing director, Mitsubishi Petrochemical)

"If cheap basic chemical products continue to pour in, the Japanese petrochemical complex will eventually undergo restructuring." (Daisuke Komiyama, executive managing director, Sumitomo Chemical Co, Ltd)

Overseas Ventures Will Have a Double Impact

Overseas ventures will have a double impact domestically. First, there is the question of how to handle the loss in domestic facilities created by the switchover to overseas bases. In point of fact, "if EDC (the vinyl chloride intermediate raw material) is manufactured overseas by adding ethylene to chlorine produced through electrolysis, a certain percentage of electrolysis (= sodium hydroxide) manufacturers will have to quit." (Teruhiko Aihara, board director and director, Vinyl Chloride Division, Shin-etsu Chemical Industry Co, Ltd)

For example, the Kashima complex, which is Japan's representative petrochemical complex, supplies vinyl chloride resin for about 40 percent of Mitsubishi Petrochemical's ethylene production, and about 70 percent of the chlorine for Kashima Electrolysis. With the acceleration of overseas ventures and increased "imports" of EDC, this complex has no choice but to restructure.

The second impact comes in the form of increased imports. As overseas projects progress and cheap basic chemical products enter Japan, the market that is handling similar products will naturally decline. To tackle this problem, facilities must be rejuvenated or intensified.

This double impact will lead to a restructuring of the industry.

As the mood for overseas advances heightens, the following view has surfaced rapidly within the petrochemical industry: "In order to avoid confusion within the industry, we cannot let products produced overseas enter Japan without some sense of order. It would be better if the industry could reach a consensus on the extent to which Japan should rely on overseas production." (Jiro Furumoto, executive managing director, Asahi Glass Co, Ltd)

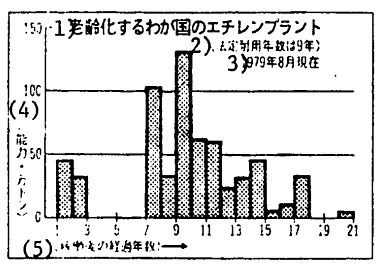
"We should rely to some extent on domestic production, and the portion resulting from increased facilities should be developed overseas." (Keisaburo Yamada, cochairman, Mitsubishi Corporation) It is possible that overseas procurement of products like EDC and ammonia, whose costs domestically far exceed those abroad, will not be limited to those portions resulting from increased production." (Shiro Kunugihara, executive managing director, Mitsubishi Chemical Industries, Ltd) "We would like to rely for 40-50 percent of our cheap vinyl chloride intermediate raw materials on imports, and thus bring down the cost of final products." (Mitsunaga Onishi, president, Japanese Geon Co, Ltd) So the views differ. The problem [of degree of reliability on imports] is expected to be debated, with officials from MITI participating; but no matter what the conclusion is, it does not change the fact that Japan's petrochemical complexes must be restructured.

"Japan's petrochemical industry rose suddenly in the mid-1950's. The older complexes have been operating for 20 years. Even the 300,000-ton ethylene complex, the construction of which was begun in 1968, is 12 or 13 years old, and it needs to be reconstructed. How to transform it into a new facility will be a significant issue, in additon to [the general question of renewing] the industrial structure." (Masashi Yamamoto, director, Basic Chemicals Division, MITI)

Reconstruction To Include Old Facilities

Even without the impacts created by overseas ventures, the petrochemical industry was already in need of reconstruction. On account of aging facilities, "the Japanese petrochemical industry looks like an old man with weak knees." (President of a petrochemical company) If this continues, there is no way Japan can compete with American [companies] that have new facilities and are full of life. Unless we quickly move into reconstruction of these facilities, we will be left behind, just like America with her steel. But with increased expenses, it is becoming more and more difficult to invest in large projects singlehandedly. Accordingly, for the coming period of reconstruction of facilities, many believe that a number of joint investments, tie-ups, or intensification [programs] will surface.

It is inevitable that internationalization, principally in the form of overseas ventures, will accelerate the move toward reconstruction projects. Already in the field of vinyl chloride intermediate raw materials, the Mitsubishi Group has begun to intensify its facilities. A total of 17 domestic vinyl chloride resin manufacturers are also moving toward intensification. It is very possible that the 1980's will become the age of internationalization and industry reconstruction.



Key:
(1) Aging Japanese Ethylene Plants
(2) (legal durability: 9 years)
(3) As of August 1979
(4) (Capacity: 10,000 tons)
(5) Years of operation

[12 Jan 81, p 8]

[Text] We have been examining the future of "Petrochemical Japan," which, due to raw material restrictions, is now at a turning point. We have followed some new overseas projects that are surfacing one after another; these aim at procuring cheap natural gas through overseas bases and bringing into Japan the basic chemical products. We asked the following three specialists to discuss, under the theme of "Future Overseas Strategy of Japan's Petrochemical [Industry]," the outlook on competitive strength of basic chemical products, the direction of overseas advances, and the problem of adjusting overseas and domestic production: Toshio Iijima, managing director, Mitsui & Co, Ltd, Tsutomu Shuto, managing director, Mitsubishi Petrochemical Company Ltd, and Masashi Yamamoto, director, Basic Chemicals Division, Basic Industries Bureau, Ministry of International Trade and Industry. (Moderator: Akira Kurata, vice director, Third Industries Division)

Moderator: Let me begin by asking your views on the present circumstances of Japan's petrochemical industry that [uses] naphtha as raw material.

Yamamoto: Japan's petrochemical industry was beset by increases in the cost of the raw material by two oil shocks, so that today the raw material cost constitutes 80 percent of total costs. As an industry, the petrochemical industry has changed qualitatively from one dealing in equipment to that dealing exclusively in raw material processing. For this reason, when we think of the future of the chemical or the petrochemical industry, we cannot think about it without considering the question of raw materials. Conversely, how well we handle the question of raw materials will determine the [future] development of Japan's petrochemical industry. At the moment, this is the consensus of the specialists.

At present, questions relevant to the future direction of the industry are: Is there ultimately an existential basis for Japan's chemical and petrochemical industries? If these industries were to grow in step with the GNP, can we continue to operate them within Japan, as we have been doing, or shall we establish overseas bases in search for cheap raw materials? The next 2 or 3 years will be an important turning point in determining the future of Japan's petrochemical industry vis-a-vis the central question of raw materials.

Shuto: We are approaching a very crucial period. The raw materials for petrochemicals are divided into two large categories: naphtha, used mainly by Japan and Europe; and natural gas, used by the United States. After two oil shocks, natural gas has proven to be superior than naphtha in terms of cost. But the cost differential will be reduced as the United States "decontrols" oil and natural gas.

The volume that we can get out of natural gas is limited. If a "well-thought-out" policy can be implemented, it is perhaps possible for Japan's petrochemical industry to grow further. What is crucial is the kind of policy that will be pursued.

Iijima: With the completion of the 300,000-ton capacity ethylene center in 1968, new plants have sprung up one after another. Japan's petrochemical industry has changed a great deal in terms of scale and quality. At that time, naphtha cost about 4,000 or 6,000 yen per kiloliter; it was then the world's cheapest raw material. But since the oil shock, the situation has changed fundamentally. Petrochemicals in Japan and Europe are based on naphtha; those in the United States are still based largely on natural gas. There is the problem, then, of whether, after decontrol, U.S. oil prices will approach the international price level and, if so, how long will this take. If this were to happen, decontrol of natural gas would occur slightly later than that of oil. In the meantime, the superior position of natural gas would be established.

For some time to come, then, we have to recognize the multiple characteristic of raw materials in the United States and, especially, the superior position of natural gas. In contrast, Japan and Europe, which lack the freedom of choice available to the United States, would be in a tight squeeze. With things as they are, a "naphtha base" is going to be difficult without bringing in some [new] ideas. In fact, let's look at some recent developments. For instance, many U.S. chemical companies are moving out of Europe, and in our own backyard, in Southeast Asia, Japanese exports are being replaced by those from the United States. We've got to look at these facts and decide how we should proceed in the future.

Moderator: Can we discuss more specifically the prospect of Japan's competitive power?

Shuto: Even within one chemical industry, differences in product fractions emerge, depending on the raw material used. Natural gas yields methane and ethane. From ethane, we get methanol and fertilizer; from ethane, mainly ethylene. Thus, not all products derived from oil can be covered. On the other hand, if we begin with naphtha, we get propylene, aromatics, butadien, in addition to all of the above [from natural gas]. Naphtha, therefore, is more versatile.

It is a fact that natural gas [products] are [more] competitive, but this is limited to the derivatives mentioned above. If the United States decontrols oil this October and natural gas in 1985, their prices will approach the international level after 1985; we can then predict that price differences will eventually disappear. If Canada follows the example of the United States, [our competitiveness] will approach theirs, but in the meantime North America will remain superior.

Iijima: On this issue of competitiveness, I feel that the United States, relatively speaking, is superior to Japan and Europe. In the United States, where it is easy to make forecasts regarding new materials, a number of new plants have emerged in the past 4 or 5 years. In Japan we cannot make such forecasts, and therefore new projects are only talked about. Furthermore, unlike Japanese enterprises, those in the United States have higher depreciation rates, so that there are considerable differences between the two in terms of potential and actual strength. The U.S. market is huge, and the superiority of the United States will continue.

As for petrochemistry, its products are divided into olefin (ethylene, propylene, etc) and aromatics. Even if there is decontrol of oil and natural gas, the superiority of the United States in olefin will continue. But it would not have a competitive edge in aromatics, since the price would rise with its increased use in replacing lead to raise the octane value of gasoline.

Shuto: Even in Europe, the view is that the U.S. superiority in aromatics is not that great, but that it is in olefin and, needless to say, in ethylene groups. I previously mentioned that the use of natural gas is limited. Looking ahead, the worldwide demand for ethylene 10 years from now would be about 66 million tons. Ethylene from natural gas would constitute about 20 to 25 percent of total demand--from about 15 to 27 million tons. No more than this is possible. Natural gas is beginning to dry up in the United States. There are the Middle East and Canada to consider, but in terms of securing volume and in terms of supply of petrochemical products, a considerable portion must be supplied on the basis of naphtha.

Yamamoto: Competitiveness is divided three ways. The strength to move into the market of the competitor, whether it be in the United States or in Europe; the strength to move into the markets of the Third World, like Southeast Asia, and win; and the strength to resist the competitors moving into the domestic market. On the first, Japan has never had that kind of strength. On the second, at least up to now, Japan has been very competitive, but it has been declining the past few years. As for the third, here too we used to be competitive, but now things are not so rosy. This applies to "commodities" (mass-produced, all-purpose, basic chemical products), especially liquid products. I believe we can somehow hold onto this third type of competitive power, but it would depend on our future efforts. The competitive power in the Third World markets will be tough unless we think it out thoroughly.

[13 Jan 81, p 10]

[Text] Moderator: Our talk thus far ultimately has boiled down to the question of a choice between naphtha and natural gas and that between domestic and overseas [production]. How does MITI feel about an expansion of production overseas? The recent trend in overseas projects is toward advanced countries such as the United States, Canada, and Australia. In what direction will these advances take in the future?

Yamamoto: Because the foundation of industrial activity is its creativity and enterprising spirit, enterprises are fundamentally free to do as they please, and [MITI] would like to see them become more and more active. However, we know clearly that overseas advances have reached a turning point. Projects in Iran, Singapore, and Saudi Arabia represent three typical overseas petrochemical operations. In terms of resources, Singapore offers naphtha, Saudi Arabia natural gas, and Iran "fluctuates" between the two. Each of these areas is unique in terms of motive for Japan's presence there and in terms of the market at which we aim.

On the other hand, when we review what we experienced during the oil crisis, and considering the domestic situations in the countries that Japan has moved into, I feel that the shape of future overseas advances emerges very clearly. First, the question of country risk looms heavily over us. Secondly, the issue is one of raw materials. It is clear that we want natural gas from abroad. Overseas ventures thus far have not proceeded on the basis of [Japan's] chemical industry's decision alone. They have had to consider various factors, such as the relationship between the countries and the securing of oil. But hereafter, these ventures will probably take the form of overseas investments based solely on the [judgment of the] chemical industry.

Iijima: From our experiences over the past few years in overseas ventures, and from listening to the opinions of overseas manufacturers, we must, even more than in the past, be wary of country risks. On top of that, we must consider the question of infrastructure (industrial basis). If so, we see that it is easier to fulfill these conditions in advanced countries. In fact, the Americans are pulling out of Europe, and a number of European countries, except Great Britain, are foregoing investments in Europe and are trying to enter the U.S. [market]. Both in theory and practice, these tendencies are emerging.

Shuto: A petrochemical [industry] in countries [rich in] natural resources begins with the [unavoidable] fact that the cost of raw material is cheap.

In the Middle East, they were burning away gas. In other words, it begins from where the use of gas is at "cost zero." On the other hand, as a result of worldwide increases in oil prices stemming from the first and the second oil shocks, it became possible for advanced countries with resources to use gas; even though that costs a little, it began to pay off. It is with this in background that new movements began to appear in Canada, Alaska, Australia, and New Zealand.

Yamamoto: It is not necessarily true that [Japanese] petrochemical industries established themselves in Saudi Arabia and Iran in the true sense of the world of obtaining raw materials for themselves and shipping their products to Japan. I feel that the motive was more the securing of oil, and that petrochemicals, which use oil as raw material, werein in terms of cooperation in the economic development of these countries, what these industries wanted the most and what became most convenient [for Japan in securing that oil]. So, [the Japanese industries did not go there] because of the economic nature of petrochemicals nor because of [Japan's domestic market situation regarding petrochemicals.

Moderator: Are you saying that it was a logical move for the industry as a group?

Yamamoto: No, I rather feel that it was the logic of Japan's need for oil. [Our ventures in] Singapore are not based on the need for oil; it was through and through our goal to establish our bases in Singapore, rather than Japan, so that we can enter the Southeast Asia market. Coincidentally, the Singapore Government strongly encouraged us to establish ourselves there as part of their "national project." So, it was not motivated by our desire to supply Japan. But, projects under consideration now do indeed have this as one of its goals. They will probably become the first projects that are based on [desire for] commercial success. From the viewpoint of industrial policy, we can say that the next few years will determine the fate of overseas ventures.

Moderator: In Saudi Arabia also, there are new movements to cooperate with Dow Chemical, United States. When we look at the projects of advanced countries, we note that there are more cases of tie-ups with powerful overseas enterprises. Is this also the result of past experiences?

Shuto: In Saudi Arabia's case, it was [the Saudis] who proposed a partnership with Dow; it wasn't something that came as a result of talks between Dow and Japan. In Alaska, Canada, and Australia, it looks like a consortium will be formed, but a country possessing raw materials has its own way of thinking. In other words, it does not want to lean to one specific country. For another thing, there are aspects which we cannot carry out without forming a consortium. There are also market considerations. If [an enterprise] were to start a complex on its own, it would not be able to handle all of its products within its own country, even if this enterprise happened to be a major U.S. enterprise. I believe it is due to these various reasons that enterprises have come to join their hands.

Yamamoto: The chemical industry is an outstanding international venture. Products can be distributed throughout the world's markets. The petrochemical industry in Japan began by importing technology from abroad and producing [products] domestically. Twenty years have elapsed, and finally the industry has matured. Now at a time when the industry is contemplating large international projects, there will be an increasing [need], whether one likes it or not, for international consortiums under which enterprises can share their respective strengths, reduce risks, and share markets. I believe this is only natural.

Iijima: In principle, it is [desirable], from the point of view of Japan's security, to cover Japan's demands with production within Japan. But, while demand continues to rise, there are limits to raw materials and energy. What is needed may be acquired from overseas bases, or we can import intermediate products--a majority of these would probably be cheap liquid products--and attach added values to them so that they can compete internationally. This kind of "pattern" would probably emerge.

Moderator: If we limit overseas advances to one place, a strike or something like that could suddenly cut off our supply. It is conceivable, then, that domestic production cannot make up the loss. So, to secure the supply [of raw materials] to Japan, isn't there a need to spread ourselves out overseas?

Iijima: Logically yes. But the decision to do so is ultimately the prerogative of the industry. It is only natural for an enterprise to concentrate on one spot and then, if it has any extra strength, to move into another area.

Shuto: It is ultimately desirable for the industry to spread out. In any case, the ideal thing is to produce a considerable amount domestically, and the rest can be produced overseas and brought back to Japan. In this way we can supply consumers regularly; this is the form the Japanese petrochemical industry would take in the future. In particular, since in Japan the more one approaches consumers at the extremities of the industry the more "severe" their demand for quality becomes, we must produce at home, particularly those products that have high added values. To that extent, the proportion of raw material costs would decrease and we could become internationally competitive.

[14 Jan 81, p 9]

[Text] Moderator: Even if we were to rely on overseas [production] for a certain volume of basic chemical products, in terms of degree of processing, to what extent should these products be completed [before they can be brought to Japan]?

Yamamoto: I don't think this is something that we can determine beforehand. But it is also [true] that what we can bring in is [more or less] predetermined. For example, it would have to be in liquid form so that it can be transported easily and, of this, it would mainly have to be of unquestionable quality. Plastics would be limited necessarily to those which have wide applications. The products will be selected, not on the basis of policy or strategy, but more naturally on the basis of domestic production costs, market conditions, and overseas situations.

There is the problem of industrial security, but this is not something we should be overly concerned with. This is because I don't expect the Japanese petrochemical industry to deteriorate that much, nor should it be made to deteriorate. Naturally, [the products] will come in as long as they do not disrupt the harmony of domestic industries and are beneficial to the economy of the public in general. These will be the limits.

Moderator: You mentioned liquid products. Specifically, what kind of liquids will be imported on a regular basis?

Iijima: From the trading firm's standpoint, the liquids would include EDC (ethylene dichloride, the intermediate raw material for vinyl chloride), styrene monomer, paraxylene, acrylonitrile, and ethylene glycol. One thing we must consider is that while Japan's electronics industry is a 16-trillion yen business, the chemical industry as a whole handles less than 15 trillion yen. Our users have become larger and larger. One new tendency is that some of these users are importing what they consume for their own use without the service of our industry. At the moment, one large vinyl chloride tube manufacturer is importing [its own raw materials]. Since, in fact, there are considerable price differences, more examples of this nature may emerge [, for example,] in the auto industry.

Shuto: Ultimately, that is a question of the extent to which such a move will be followed [by others]. As we know from our experiences in the oil shock, it is obviusly more reliable to procure raw materials domestically than it is to rely on overseas [suppliers]. Most probably, a part will be imported, but then a considerable amount will be procured through us. In this regard, there is another matter: at first, the raw materials may come in cheaply, but later, when the share changes greatly and prices are raised, it will turn out that in the final analysis they have been purchasing something expensive. From the point of view of the bargaining power needed to make purchases at low prices, the industries must be united, and on top of that we must enlarge the sections where added values are high.

Moderator: What would be the overseas production ratio of ethylene 5 and 10 years from now?

Yamamoto: What I have to say may sound irresponsible. Ethylene production in 1979 was excellent. Of the total production of 4.8 million tons, about 700,000 tons were exported. Roughly speaking, therefore, in the future we will import the amount corresponding to our exports--i.e., 600,000-700,000 tons. This would balance out imports and exports. This is our prospect at the moment. So the percentage would be about 10 to 20 percent, but nothing greater than that.

Moderator: If EDC is brought to Japan, consumption of ethylene and chlorine will decrease. It will also have an effect on the production of sodium hydroxide. This, then, would create an imbalance in volume in all the complexes, making it difficult to make adjustments. To prevent the confusions that accompany internationalization, isn't it necessary for the industry to determine the appropriate levels of reliance on overseas [production]?

Yamamoto: Two years ago, imports of EDC exceeded 400,000 tons. Last year they decreased by half, so it fluctuates. It would be extremely difficult if [the volume of imports] were to remain fixed at one specific level. But it would be improper for the government to intervene and give directions. Things ought to be carried out according to economic principles. But where, in actual business situations, things cannot be resolved individually, we need a process by which a consensus can be reached. Should such a situation arise, the government would like to participate in resolving it.

Shuto: Speaking as a producer, the 300,000-ton ethylene complex has been in operation for the past 10 years; the time has come to change it qualitatively or restructure it. Take the example of EDC. It is possible that EDC imports will vary from year to year. If so, a [petrochemical] complex must be flexible enough to maintain some sort of balance. That means that a complex ought to be changed so that no matter what portion of the process is cut--from the resources to the finished products--it can respond to the cuts.

Our principal resource is naphtha. We have already begun to change ethylene plants so that they can respond to various situations, such as by using LPG and slightly heavier oil. Something similar to this must be done by all of the complexes. This is the direction we must take.

Iijima: Japan is quite capable of storing crude oil, but there are not many terminals to handle imported chemical commodities. Along with rationalization in production, we ought to have functional storage capabilities, although this is difficult for environmental considerations.

Moderator: Incidentally, with a move toward internationalization in the form of production imports, it would appear that [finished] and intermediate products will enter Japan at costs near the lower limits of international market prices. Do you think this would lead to a lowering of market conditions of domestic goods?

Yamamoto: What I'm about to say may be too self-righteous, but our industry ought to be one that is capable of resisting introduction of such products, and I believe that our industry is not such that it will cry over it, protesting that the prices be lowered. It was previously mentioned that the next 2 or 3 years will test the viability of Japan's chemical industry. This is not confined to [the] relationship with overseas [production]: [domestically as well], a huge undercurrent may develop. In any case, since manufacturers of chemical products are few in number and their profit is small, is it all right for a basic industry to continue operating in its present form? I believe the industry is nearing a turning point.

Shuto: From my experience, if we move toward raw materials, we will be in a position where we have to compete with the United States. America is also acting with a similar awareness of the problem. American enterprises have vitality and considerable experience based on their multinational status. From a worldwide perspective, I am painfully aware that it is not easy to compete with America.

Yamamoto: From what has just been said, it seems that while the United States is screaming about its steel and automobile industries, Japan is in a similar position with petrochemicals. We have to roll back if we do not want this to remain a reality. Japan's petrochemical industry still has a considerable amount of vitality; the problem is how to direct this vitality in the right direction.

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SCIENCE AND TECHNOLOGY

SENSOR DEVELOPMENT HAS WIDE RANGE OF APPLICATIONS

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 5 Jan 81 p 5

[Text] The creation of pseudohuman systems by giving eyes, ears, skin, noses and tongues to computers is leaving the realm of dreams. The popularity of the personal computer, especially, has enabled the widespread use of electric controls in industry, the home and all other fields. It is sensors which have been the decisive factor. These are devices which sense--detectors which emit electric signals. Products with artificial intelligence are spreading to include air conditioners, electronic ranges and automobiles, and are found in all fields of human endeavor, such as remote sensing for geophysical efforts, nuclear fusion and ocean development. The range of detection goes beyond the five human senses, and includes temperature, pressure, humidity, gases, light and chemical detection. Many new and old materials, from thermocouples to Josephson elements, are expected to be applied or developed for specific purposes. So 1981 can be called the year of sensor development.

Remote sensing is a matter of loading artificial satellites with measuring devices and investigating various conditions on earth by remote operation. The Landsat project of the United States is an example; its three satellites are equipped with mass measuring devices such as spectral scanners (MSS) and return beam vidicon cameras (RBV).

For the Maritime Observation Satellite 1 (MOS-1), which Japan's Space Activities Commission has decided to launch in 1984, there are plans to develop measuring devices including a visible and near-infrared radiometer (MESSR), a visible, thermal and infrared radiometer (VTIR) and a microwave radiometer (MSR).

The MESSR shows the surface of the earth in hundred-meter widths, using two optical detectors and a charge-coupled device (CCD). The Electrotechnical Laboratory, which is charged with CCD development, is developing a sensor using indium and antimony, with a target of 1983. The laboratory is making use of materials with longer wavelength and greater sensitivity than silicon, and has confirmed the special operating characteristics of MOS [metal oxide semiconductor] diodes and transistors. It is now entering the next stage, which is to create processes and design devices for integration of the CCD structure.

The VTIR has one channel in the visible spectrum using a silicon PIN diode, and three infrared channels with mixed crystals of mercury, cadmium and tellurium cooled to minus 173 degrees Celsius. Japan has taken the lead in detectors in which the peak sensitivity can be freely adjusted from 1 to 20 microns by changing the proportions of the mixed crystals. The MSR is a way of detecting microwaves.

According to Space Development Director Hiroaki Takagi of the Science and Technology Agency's Research Coordination Bureau, the Earth Resources Satellite 1 (ERS-1), which is scheduled to be launched in 1986, is to be "equipped with a synthetic aperature radar (SAR), which is an all-weather sensor." And for the future, he says "altimeters, scatter gauges, microwave sensors using SAR activity, precision visible and infrared radiometers, laser sensors, and magnetism and gravity sensors will be developed."

Attempts to measure temperature go back some 2,000 years. They have been based on a wide range of principles such as heat expansion (as in the case of a fever thermometer), changes in the resistance of metals, generation of electricity in response to heat, electromagnetic properties, electrostatic capacity, forward voltage of semiconductors, elasticity, color, deformation, radiant heat and so on.

The range of temperatures to be measured is extraordinarily broad, from the ultrahigh temperature of 100 million degrees Celsius found in thermonuclear fusion reactions to the minus 270 degrees Celsius needed for operation of Josephson elements. If one considers that the surface temperature of the sun is 5,800 degrees Celsius and that the temperature range of the healthy human body is less than 1 percent, one can see it is quite difficult to measure temperature accurately for every purpose.

It is widely known that many household electric appliances depend on the bimetal thermostat seen in electric rice cookers. Now new detector elements are emerging in order to bring lower prices, precision, durability and energy conservation to air conditioners, electronic ranges, refrigerators, and various types of heating equipment. Among the semiconductors called thermistors, Matsushita Electric Co has used silicon carbide in responsive resistors with a precision of plus or minus 3 degrees Celsius over a range of 30 to 300 degrees Celsius; this is called a high-temperature, silicon carbide film thermistor for use in fixed equipment.

Nippon Electric Co has developed a high-sensitivity, high-precision sensor with a precision of 1 degree Celsius over a range of 55-150 degrees Celsius. Among thyristors, which also function as switches, Mitsubishi Electric Corp is selling low-hysteresis products for automatic chokes in automobiles and also to prevent overheating in floor mat heaters and power transistors in audio equipment. In the future, martensite transformation of metallic sinters will be applied to thermal switches.

Automobiles have provided the largest market for sensors. Pressure and oxygen sensors are needed to control fuel combustion, and many other sensors are needed for such things as preventing collisions. In 2 or 3 years the number of sensors in use may increase from the present 20 or 30 to as many as 40. There are efforts to use semiconductors for pressure detection in place of the present aneroid method which measures electrostatic capacity. Making use of the piezo effect in which the resistance in a crystal changes greatly in accordance with the pressure on it, Mitsubishi Electric Corp is developing semiconductors for a drive on the automotive field, and Hitachi Ltd is taking a similar approach.

On the other hand, it is the Toyota Central Laboratories where a method of controlling fuel-to-air ratio with an oxygen sensor has been developed. These are made by forming solid electrolytes of oxides of zirconium and yttrium and controlling the fuel mixture by means of the voltage changes which arise from changes in the concentration of oxygen ions.

A sensor is needed to inflate airbags when a collision is imminent. Mitsubishi Electric Corp is using gallium and arsenic field effect transistors, and automobile manufacturers are developing frequency-modulated radar and magnetic sensors, but there is concern over how to deal with a chance malfunction. Hitachi Ltd has developed a Doppler radar with an oscillator on a titanium oxide substrate; the radar's sensitivity is 100 decibels.

Since the gas leak and explosion in Shizuoka, much attention has been focused on city gas and propane gas detectors. The conductivity of N-type semiconductors of stannic oxide changes as gas is absorbed; using this principle, Figaro Technology (in Toyonaka Osaka) quickly put a gas sensor on the market. Matsushita Electric Co recently developed a sensor using γ-ferric oxide, and new materials like titanium oxide, zinc oxide and gallium oxide are being developed one after another. The current task is gas sensors which respond to specific gases and have high precision, low-power consumption and high reliability, but in terms of quality of materials, there are those who say, like Fagaro Technology Director Akira Chiba: "I am confident this is the best material to show up for a dozen years."

Warning of fires is difficult because the science of fires has not been elucidated. Smoke is an effective indicator of fire in new flame-resistant construction materials; Matsushita Electric Co is developing a photoelectric sensor which works with smoke particles. Of course, the plan is to integrate sensors and test the detector with various types of particles, and to include sensitivity to temperature as well as gas; the detector is expected to be commercially available in the second half of 1981.

It is Matsushita Electric Co which resolved the difficulty of using electronic ranges. A P-type diode ceramic humidity and gas sensor is able to determine the state of cooking by the water vapor from the food. But detection of humidity is difficult. Exposure to organic gases and surface condensation changes the basic characteristics of ceramic semiconductors, so Shinyei Kaisha has switched to organic polymers, and is confident the HPR type can last 42 months and be used in moist-air heaters. With a response time somewhat over 10 seconds at a relative humidity of 63 percent, it has the advantage of ease of use, and it is also better suited to mass production than ceramics, which require time for aging. Hitachi Metals Ltd has developed an amorphous metal frost sensor for freezers and air conditioners which uses the changes in electrical line losses as frost accumulates on the surface of amorphous magnetic ribbon.

Changes in situations have caused expansion of the security industry, including burglary alarms. Mitsubishi Electric Corp, which has expertise in gallium and arsenic, makes microwave sensors using field effect transistors (FET). These are superior in terms of utility, reliability, degree of integration and energy efficiency, and are driving the rival gas diodes off the market. Speed and direction of movement can be determined using the Doppler effect (the reflected sound grows higher in pitch as an object approaches and lower as it recedes).

The Electrotechnical Laboratory has been developing gallium-arsenic Hall elements. Elements made with the ion implantation method have a high output even though the thickness is 0.2-0.3 microns, and compare in resolution with those 10 times as thick.

The method of placing atomic nuclei in the field of superconductive magnets and using precessional movement to detect by means of nuclear magnetic resonance plays an important role in analyzing the structure of protein substances like interferon.

The importance of reliability cannot be overestimated in the market for medical electronics (ME), and the excitement over technical development is quite obvious. There are many applications regarding the circulatory system. The Toyota Group has attached silicon crystal pressure sensors to catheters to use in measuring blood pressure and blood flow within the heart and has, with curare on the tip of the catheter, used IS (ion sensitive) field effect transistors to measure blood pH and the concentration of carbonic acid gas within the blood vessels.

The advent of highly sensitive sensors--enabling CT (computed tomography) and ultrasonic diagnosis--has brought a medical revolution and (in the words of Osaka University President Yuichi Yamamura) "has eliminated the need for individual medical disciplines." Revolutionary technology, including electronic sensors, will be steadily emerging.

Biosensors make use of the mysterious capabilities--such as precision and energy-efficiency--of living organisms. These are used with food and in clinical blood tests. Enzymes, which are particularly prominent, are increasingly tied in with electronic technology. Fuji Electric Co has commercialized the method of counting blood sugar by measuring the effect on glycose (grape sugar) oxidase. Tasks for the future include the medical use of uric acid (with the enzyme uricase) and cholesterol (with cholesterol oxidase), and measuring the maturity of fruits and leavened foods with dehydrogenation enzymes and developing sensors to check the freshness of meats.

Matsushita Electric Co is doing practical research on the fixing of enzymes for sensors.

Optical technology is expected to grow--because of its advantages in terms of multiple transmissions, insulation, resistance to electromagnetic noise and nonexplosiveness--from the present 1-billion-yen market to a market of 50-80 billion yen in 10 years. Fuji Electric Co is using the absorption of ultraviolet radiation by organic substances to measure organic pollution in sewage, and is also applying optics to measuring the thickness of polymer films which absorb infrared radiation at a wavelength of about 2 microns and to analyzing the composition of gases using oxidation products of nitrogen which absorb wavelengths of about 5 microns. And 1981 will see efforts to adapt optics to the oil distribution system and high-tension electrical transmission at 500,000-1 million volts.

Hitachi Ltd, which has commercialized electromagnetic flowmeters and ultrasonic flowmeters for process-control use in chemical plants, has been developing metal oxide semiconductor message sensors, semiconductor optical sensors, sensors using optical fibers, optical fiber fluxmeters and so on. This development of optical technology is aimed at future application in plants: "Adoption in such things as analysis and surface detection is conceivable."

Various companies are competing fiercely in regard to television cameras with integration of circuits in the super-LSI range. Matsushita Electric Co has moved forward in this technology and is working energetically on image handling. Progress is being made in the broad but deep field of optical technology, and Mr Hayakawa senses the dawn of optelectronics: "Optics by electronics (O/E) technology will be needed from now on."

The annual value of sensor production (including pickup tubes) in 1977 was 49.5 billion yen and it is expected to be 100.6 billion yen 6 years later in 1982. As seen in the name, "the little giant," a sensor may have an important function but may not be adopted in an automobile or home appliance if it costs more than a few hundred yen. In addition to development of new materials and applications, finding production technology to "make it cheaper" is an urgent task.

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SCIENCE AND TECHNOLOGY

ELECTROMECHANICAL DEVICES APPLIED IN MACHINE INDUSTRY

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 21 Jan 81 p 1

[Article by Staff Reporter Sagara:] "Mechatronics Operations'."

[Text] The new age of "mechatronics operation" [A Japanese term meaning application of electronics technology to machinery] has arrived to the world of machine industry. To enliven electronics technology and to build its operational system has become a new management strategy of the machine manufacturers to succeed in the 1980's. The movement toward mechatronics is shaking up the basis of business in many areas such as product development, personnel training, factory rationalization, parts purchasing and marketing strategy. To cultivate the "power to endure shocks" is a task more urgent than anything else for machine industry. [(see page 3 "industrial coin-words for the definition of mechatronics. A serial on mechatronics operation will appear in this paper on Machine Section every Thursday, beginning on 22nd.)]

Since about 3 years ago, the industrial Technology Center in Tokyo has been holding lectures on microcomputers for small and medium size businesses. Although they are called small and medium businesses the majority of the lecture attendants come from smaller companies employing fewer than 100 persons. Enrollment is limited to 30 companies, but more than 100 companies applied every year. Their aim is to firmly grasp the microcomputer fundamentals and apply them to their company's product development and plant rationalization. "Unless they master the microcomputer technology points out Isamu Shimazaki an instructor at the center, "small and medium size business will not survive."

Say what one will, the basic strategy of mechatronics operation is to build up the basis of electronics technology. What is needed is to master electronics technology centering on the microcomputer, so that a company can be equipped with the technical capability to functionally change conventional machine products. To do so, it is absolutely necessary to train and reinforce electronic technicians. Electronic technicians are now in great demand, regardless of whether they are high school or college graduates. Small and medium size machine manufacturers are feeling the shortage of qualified workers, and the reeducation of employees has become an urgent task.

Those who receive the lectures on microcomputers at the Industrial Technology Center are not limited to mechanical engineers. Mixed among them are clerical workers. Yasumi Muto, an employee of Kete Manufacturing (headquarters, Tokyo; President, Toshiko Kozuki; capital, 14.4 million yen), a bottling machine manufacturer, has been receiving the training at the center, and is busily engaged in computerizing the bottling machines. All by himself, he is struggling hard.

Takuwa is a small manufacturing concern making measuring devices related to civil engineering (headquarters, Tokyo; President, Masahito Okuda; capital, 60 million yen). Two years ago the company incorporated the microcomputer electronic controls in a formerly mechanically controlled measuring device that measures the degree of the water gate opening of a dam. This electronic control system is maintenance-free. The inspection of gate opening has become exact, and resulted in the conservation of water resources. Since the microcomputerization of the measuring device, the company's business share has expanded rapidly, now commanding 40 percent of the water gate guage business, climbing to the top in the industry.

Takuwa is one industry example that has succeeded early by breathing the innovations of electronics into the field of products heretofore ruled by mechanical technology. The application of electronics to the conventional mechanical products has stirred up the latent demand, promising a chance for new business growth to machine manufacturers.

Conversely, however, to delay to apply electronics technology is to bring about inevitable decline and fall. Already in industrial scale business, some firms are suffering the sorrows of declining sales by delaying the introduction of microcomputers.

"Triggered by the application of quartz in watches (a crystal oscillator), various automobile panel indicators are rapidly becoming electronically controlled. By utilizing the regular signals emitted by the crystal, the means to control the wiper, the direction indicator the speedometer and the tachometer (a device to measure the engine rpm) is being contemplated. The automobile dashboard is about to change into one comprehensive electronic module." (Kazuo Takamine, chief researcher at Nihon Efficiency Association).

Electronics has unified many mechanical parts into one, and the trend shows that purchase orders issued to several companies will be collectively issued to one company that possesses microcomputer control technology.

Electronic devices such as quartz crystal, electronic camera, and NC (number control) machine tools greatly reduce the number of parts needed in various mechanical devices. In case of the single-eye reflection camera, about 1,100 parts were traditionally required. The number of the parts needed now by going "electronic" are about 700, a reduction to two-thirds of the former level. Such a reduction in the number of parts needed is having a great impact upon the world of machine industry. Small and medium size subcontractors, who supply parts to the manufacturers of completed systems, are being exposed to a "life or death" crisis.

"Mechatronics is forcing fundamental changes in the operational modes of the industry" says Hideya Matsumura, president of Matsumura Manufacturing, a manufacturer of mechanical parts in Tendo City, Yamagata-ken (capital: 75 million yen).

The remark was made while he was describing the abrupt changes brought about in the operational modes of his company in a period of few years because of the "electronic" strategy adopted by his parent company.

The company mentioned above was originally a manufacturer of mechanical parts for domestic sewing machines. But sewing machines were going "electronic," and the orders for mechanical parts have fallen drastically. The company aggressively launched a business venture in the field of electronic machine parts. The nucleus of the business shifted to the fabrication of parts for various I C fabrication machines and the assembly of integrated circuits.for Hitachi, Ltd. Now the sales of processed electronic parts along with atuomotive components is rising, reaching 30 percent of total sales volume of the company while the sales of sewing machine mechanical parts has fallen to 10 percent of the business.

This company could ride out the stormy waves of the drastic product changes because it had established a channel of close communication between the company and its parent company to absorb electronics technology. The company has adopted the educational system of dispatching its technicians to Hitachi, Ltd. every year, and have them thoroughly acquire electronics technology over a period of 2 to 3 years.

Says President Matsumura: "Machine parts makers that do not own electronics technology will be abandoned by their parent companies." It can be said that only those subcontractors aiming at "mechatronics operation" can win success together with their parent companies.

Another example: Star Precision, a machine tool manufacturer in Sizuoka City (president, Eiichi Yamada; capital, 500 million yen). The company has achieved the 24-hour, no-operator production line. Its new machining center operates day and night wwithout any operators.) Electronic automatic control technologies make it possible to incorporate various components such as machine tools, clocks and printers together, and have them operate as the "mixed flow processing line" which orderly manufactureres products.

The company president Yamada openly says: "Mechatronics operation will be the greatest pillars of our company in the '80's." Mechatronics does not mean that machine and electronics will become one body in a product; it means that electronic technology changes the characteristics of a plant where machines are playing the major roles.

The application of electronics technology to production processes plays an important role in the strategy of mechatronics management. With the surging crude oil price in the background, it may be said that what will absorb the "costup" will be electronics technology.

In addition, in order to establish mechatronics operation it is necessary to be fully equipped with a comprehensive system in many areas such as the innovation of flow routes, internal production of electronic parts and purchasing strategy. The advent of mechatronics operation demands fundamental changes in the characteristics of machine manufacturers.

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SCIENCE AND TECHNOLOGY

CHARACTERISTICS OF DEEP SEA SUBMERSIBLE DESCRIBED

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 19 Jan 81 p 3

[Text] Japan's first full scale manned submersible survey ship "Shinkai 2000" that probes "secrets" of the ocean by submerging to depths of 2,000 meters, has been completed at Kobe Shipyard of the Mitsubishi Heavy Industries, and the launching ceremony will be held on the 21st. This 2,000 meter deep sea submersible survey ship system has been the target for development challenged by the Science and Technology Agency and Marine Science and Technology Center (chief director, Shogo Kurachi) at a total invested working expense of 7.5 billion yen, in order to deploy it as a new resourceful tool for Japan's future oceanographic development in the eighties when it is used together with "Natsushima" (gross tonage 1,500 tons), a mother ship that supports "Shinkai 2000," which was first launched in August last year.

Oceans that occupy 2/3 of the earth encompass unlimited possibilities such as, to begin with, biological resources, mineral resources on the ocean floor, ocean energy and ocean space for use. The primary requirement for the exploitation of these possibilities is the accurate assessment of the underwater and the bottom of the sea. Nevertheless, in reality, the natural environment of the sea is extremely harsh, and hardly any work has been done at present in spite of the development earnestly called for. "Oceanographic development is the last frontier left for the human race" (chief Toshitaka Takagi, Oceanographic Development Section, Science and Technology Agency) sympolizes the difficulty of the task. The 2,000-meter deep sea sumbersible survey system is a type of challenge by Japan to this "unknown deep sea."

There are three currently existing measures for surveying the deep sea: a system which uses marine observation ships, a system which uses unmanned observation equipment, and a system which uses manned submersible survey ships like "Shinkai 2000." Among them, the manned submersible survey ship system has far greater merit than the others since it actually allows scientists and engineers to come aboard the ship and to observe the objects to be examined directly by human eyes.

On the other hand, risks associated with having men directly aboard is indeed unavoidable, and the technological development to cope with it is a more important factor.

This deep sea submersible survey ship system consists of the "Shinkai 2000," self-navigating manned submersible survey ship which submerges to depths of 2,000 meters, and "Natsushima" (built by Kawasaki Heavy Industries), a support mother ship that carries the survey ship to the sea area chosen for survey. It is arranged to be operated as a total system by working in harmony with a land base of the Marine Science and Technology Center.

Of the system, "Shinkai 2000" which plays a central role, must be so structured that it can endure a water pressure of 200 atm [sic] at a deep sea depth of 2,000 meters, and it can be said the ship proper commands sophisticated and the most advanced technology.

First, a pressure resistant shell. This is a vessel that serves to protect the full complement of three (two pilots and one observer) from the high water pressure of the deep sea, and is shaped in a spherical form which has a proven advantage for strength. In order to reduce the weight as much as possible, a high ductility steel (NS 90) with a high specific strength and excellent weldability and workability, was adopted. The pressure resistant shell of 2200mm in inner diameter and 30 mm in thickness is structured to endure a water depth of 3,300 meters in consideration of safety. Also, minimum required equipment such as environment control, oxygen cylinders, carbon dioxide adsorbents and emergency batteries are posted inside the pressure resistant shell. Other machinery and equipment are housed in a subsidiary pressure resistant vessel made of titanium alloy. The oil-jacketed uniformal pressure bearing structure maintains a balance with the outer water pressure.

In case of "Shinkai 2000," it can freely ascend, descend or remain steady in the water, which requires the weight of the ship to always be equivalent to the buoyancy. For this purpose, the buoyant material adopted shows a salt water specific gravity of below 1.025 and a very high pressure resistance. The initial submersible ships used gasoline for fuel, which attributed to the large body and safety hazards. For "Shinkai 2000," a new buoyant material (specific gravity 0.55) was developed by hardening an air filled glass ball of around 100 microns with an epoxy resin.

All power sources are batteries. For this service, silver-zinc batteries (72 cells, 2 groups) with a larger generation of current per unit weight is effective than the generally used lead batteries.

It is designed to move straight forward and turn at a maximum underwater speed of 3 knots with its main propeller of 1150mm in diameter installed at the stern and a pair of 340mm supplementary propellers installed on both broadsides. To adjust the weight for upward and downward movements, the ship is equipped with a main ballast used for surfacing, a supplementary ballast used for upward and downward movements at the bottom of the sea by the action of a hydraulic pump which pumps salt water in and out, and shot ballast used for ascending and descending of submersible ships. The major particulars of "Shinkai 2000" including all of these are roughly 9.3 meters in length, 3.0 meters in width, 2.9 meters in depth and approximately 15 tons in the air.

Due to the system design characteristics to have the deep sea submersible ship "Shinkai 2000" carried aboard the mother ship when embarking on an actual oceanographic survey, it is necessary to resort to the support mother ship "Natshshima." "Natsushima" with the following specifications has already been launched and is currently being fitted out: total length 67 m, width 13 m, depth 6.3 m, gross tonage 1530, maximum speed 12.5 k, full complement 55. Servicing and supplying the submersible survey ship "Shinkai 2000" can all be taken care of aboard "Natsushima."

When executing the oceanographic survey, "Shinkai 2000" is carried to the objective survey sea area, and put in the water at the arrival point. The launched "Shinkai 2000" descends at an approximate speed of 1 knot by activating the shot ballast, and arrives at the bottom of the sea 2,000 meters below in approximately 90 minutes. At this point, a weight (a steel ball of 2.4mm in diameter) of approximately 300kg can be discarded to balance the ship weight and buoyance. When ascending, it is designed to float upward by discarding another 300 kg weight. The designated submersion time is 8 hours, but the ship is structured to function 10 times longer for 8 hours or precautions against emergency.

The information from "Shinkai 2000" is signaled by a transponder or a pinger which is set up in advance on the bottom of the sea, and communicated to "Natsushima" by ultrasonic underwater telephone. The submersible survey ship is equipped with a peep window, an underwater TV camera, a stereo underwater camera and a manipulator (robot), and is designed to facilitate sampling of materials and data as necessary and required.

European nations and the U.S. started to develop deep sea submersible survey ships such as this years ago, and it is reported that already more than 20 submersible survey ships capable of diving over 1,000 meters are being operated. Among them, "Trieste No 1" built in 1960 by the U.S. and "Archimedes" of France in 1961 recorded a diving depth of 10960m and 11000m respectively. However, these ships were all made for military research, and the emphasis was only on diving deep into the sea.

Recently, with the progress of the oceanographic development, full scale deep sea submersible survey ship systems with more survey functions, are being zealously developed more than ever dominantly by the nations advanced in oceanography. America completed "Albin" [phonetic] (diving capacity 3650m) and France also created "Seanad" [phonetic] (diving capacity 3000m). Both countries are building new ships aimed to conquer the diving mark of 6,000 meters.

In contrast to these activities, Japan built "Shinkai" (completed in 1970, diving capacity 600m), possession of the Maritime Safety Agency, but the ship had already retired. Now, there is only one ship left that can go deep under the water to depths of about 300m. Consequently, great hopes are put on "Shinkai 2000."

The tentative operational schedule dictates that both "Shinkai 2000" and its supportive mother ship "Natsushima" will be fitted and mechanically equipped and serviced in February or March, will be tested for diving to depths of 2,000m at Kii Channel in May-July, and be delivered to the Marine Science and Technology Center who ordered it.

Yet, the practicalization of the 2,000 m deep sea submersible survey ship system does not imply that this system can cover any sea areas. What it can cover is 30 percent of the 200 nautical mile commercial waters and less than 16 percent of the world's sea areas. In the light of this, the Science and Technology Agency also intends to start building a 6,000m submersible survey ship which can cover 98 percent of the entire sea areas subsequent to the operation of "Shinkai 2000." At any rate, the completion of "Shinkai 2000" marked a great step forward in Japan's oceanographic development.

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SCIENCE AND TECHNOLOGY

TECHNOLOGY OF DEEP-SEA SURVEY SUBMERSIBLES DEVELOPMENT, SHINKAI 2000, ANALYZED

Tokyo NIKKEI BUSINESS in Japanese 23 Feb 81 pp 143-146

[Interview with Akira Koriki, director, the Marine Science and Technology Center, by Koichi Shiraishi, assistant editor of the magazine]

[Text] Profile of Akira Koriki

Born in Nagasaki Prefecture in 1925, 55 years old. In 1948, graduated from Ship Engineering School of University of Tokyo and immediately found employment at Ministry of Transportation. Served as a ship inspector, a director for the Acropolice Operation Headquarters of Okinawa Marine Fair and an assistant director of the Institute for Technical Research of Ships before transferred to the Marine Science and Technology Center in 1977.

Manned With Crew of Three, Construction Cost 3.8 Billion Yen

Submersible to Depths of 2,000m With the Support of a Mother Ship

Shiraishi: First, would you please tell me the outline and the capacity of the unprecedented home-made submersible survey ship "Shinkai 2000" that can dive to depths of 2,000 meters and is scheduled for a test run very shortly?

Koriki: "Shinkai 2000" is shaped like a child of a whale. It measures 9.3m long, 3m wide at maximum and weighs 24t. The full complement is three, and the crew will ride in a spherical pressure resistant shell of 2.2m in inner diameter located inside the front of the ship. Diving and surfacing are manipulated by buoyance. It can dive to depths of 2,000m, and also can freely move forward and backward, turn, ascent or descend in the sea by use of propellers. The underwater speed is 3 knots. Additionally, investigations at the bottom of the sea can be conducted by the crew inside the ship using a TV camera, mechanical arms, a sonar for detecting obstacles ahead, etc. The maximum submersion time is 80 hours per one dive. Furthermore, the net construction cost was 3.8 billion yen, and the Kobe Shipyard of the Mitsubishi Heavy Industries built it.

Shiraishi: I hear that "Shinkai 2000" does not act alone, but is a part of a submersible survey ship system combined with a land base and a mother ship.

Koriki: That is exactly so. "A 2000m Submersible Survey Ship System" contracted from the Science and Technology Agency in fiscal 1977 is specified to combine three harmonious and closely interrelated functions, a submersible survey ship, a supportive mother ship and a land base. This specification was formulated from the concern over past shortcomings. The mother ship is essential for carrying the submersible survey ship to any sea area of the workd, but the mother ship of the submersible survey ship "Shinkai" which had operated until 4 years ago, was a remodeled passenger ship and had been towing the submersible survey ship. In that case, inefficiently, it took time for boarding and servicing the survey ship. In comparison, this time, the supportive mother ship "Natsushima" is completely equipped with winches to recover the ship from the surface and to alight it on the water, and the service and supply system is also improved. Furthermore, it is also equipped with sonar and loran, and serves as eyes, ears and mouth necessary for the survey and observation by means of underwater telephones.

The land base handles services and repairs that cannot be provided even on the mother ship. For the time being, the site designated is to be in the grounds of the Marine Science and Technology Center in Yokosuka, but the construction is set aside pending the fiscal budget.

Pressure Resistant Shell Made of High Ductility Steel NS 90

Elaborate Precautional Measures Such as Emergency Escape System

Shiraishi: Is there any unique technology that is employed for "Shinkai 2000?"

Koriki: First of all, I can name the material for the pressure resistant shell. A high ductile steel termed NS 90 is used for the shell. In the sea at 2,000 meters deep, the shell must bear the pressure of 200atm, and titanium is used for this purpose in foreign countries. However, we can use steel owing to the excellent iron and steel technology available in Japan. Well, another reason is the high cost of titanium. In addition, the adoption of alternating current for the propulsion motors is also unique. Alternating current was chosen because of the merits of easier maintenance and control. The direct current system is predominant overseas, because, I guess, direct current electricity is generated from a silver-zinc battery power source.

Other characteristics are: a total of three units of main and supplementary propellers, good mobility and an emergency surfacing system which includes drop-weights, to start with, and an explosive bolt that separates a total load of 800kg from the ship.

Shiraishi: What was the most difficult point when developing the technology?

Koriki: I still say, coping with the extremely high water pressure was the most difficult task. Besides the development of the high ductility material which I have just mentioned, it was also very frustrating to establish a technology for working it into a real spherical shape. If any slight errors were made, the pressure resistant shell would be crushed by the load of 200atm. Also, naturally, ultrasonic waves were the only thing usable for underwater communications between the submersible ship and the mother ship. Japan is advanced in electronics technology which uses radio waves, but not exactly in the field of ultrasonic waves....

Experienced Overseas Makers' Technologies Imported

Ultrasonic Underwater Telephones and Buoyant Materials

Shiraishi: Do you mean that the system was not completed entirely by domestic technology?

Koriki: Yes, we bought from overseas only that which cannot be properly made by domestic technology. After all, the ship costs as much as 3.8 billion yen, and we must consider safety first. For example, underwater telephones which utilize ultrasonic waves are also produced in Japan, but the performance of the telephones was not necessarily guaranteed since they must be operated under a high water pressure. The same can be said about other sound equipment. Not only the performance but the price is also more reasonable in the case of overseas makers who have already actually developed the machinery and equipment for deep sea submersible ships, compared to Japanese producers who must account for new development expenses.

Besides, we cannot overlook the fact that the special technology is the speciality of smaller business among the overseas related makers. For instance, a buoyant material which we used is called "balloon," made of a small glass ball hardened with a resin. We purchased this from a small American maker, Emerson. In the old days, gasoline was used as a buoyant material, but this is vulnerable to fire, and buoyance was not attainable unless a large quantity of it was loaded on the ship due to its specific gravity being at the 0.9 level. Disadvantageously, the size of the ship had to be increased. In contrast, this balloon is very light, as proven by its specific gravity of 0.52, and safe. This Emerson, a specialized maker as it is, offers unbelievably low cost balloons, although I do not doubt that technologically Japanese makers can produce the same article.

Shiraishi: Can we expect any technological influence in association with the development of "Shinkai 2000?"

Koriki: I believe that the effects of the development of a material which can withstand high pressure and the achievement of working technology for this material are far-reaching. NS 90, an unprecedented high ductility steel, is extremely strong and can maintain sufficient strength even if it is made thin compared to conventional materials. The significance of this material is unmeasurable in the light of the fact that manufacturers are presently working hard to develop raw materials.

United States, France and USSR Advanced in Submersible Ships

Adventurism and Military Purposes Push Development Forward

Shiraishi: By the way, how deep could yesterday's deep sea submersible ships of Japan dive?

Koriki: As I have mentioned before briefly, "Shinkai," which was built about 10 years ago, run for 6-7 years and retired 4 years ago, had a diving capacity of 600 meters. That means, "Shinkai 2000" can dive 3 times deeper.

Shiraishi: What about the capacities of the submersible ships that belong to overseas nations? Also, are there any differences in attitudes toward working for oceanographic development?

Koriki: There are 15 submersible ships in the world that are capable of diving more than 3,000-4,000 meters at present. The majority of them are in the possession of the United States, France and USSR. Building technology is also very underdeveloped in the countries other than these three. Japan now possesses a 2000m class ship as a result of the completion of "Shinkai 2000." The fact of the matter is that we are trying to catch up with them, though the gap to be filled is still considerably large.

Also, each nation's approach to the development of the submersible ships is distinctively different. First of all, France has a ship that dives to depths of 12,000 meters. As can be guessed from this fact, in short, their objective is, I feel, in diving deep for itself. In other words, they, led by adventurism, are trying to challenge the technically possible limit.

On the other side, the United States appears to be more interested in developing this as a war potential requested by the Navy. President Kennedy once proclaimed that the post Apollo project was oceanographic development, which I guess was the statement made while being well aware of the military purposes. In addition to this, we cannot disregard the point of view as a measure to cope with the oil problem. American major oil companies endeavor to dig oil from the bottom of the sea, and indeed, they also spend a lot of money for the development of submersible ships for that purpose.

Meanwhile, in Japan, the need for deep sea diving has been rare, and research in such a field has not been particularly pursued. However, with the progress of the development in other countries, we are starting to feel more motivated to catch up with them, and our interest in resources on the seabed is growing. At last, Japan has awakened and is ready to take some action.

First Survey of Seabed Mineral Resources and Biological Resources

Geological Survey May Be Useful for Prediction of Earthquakes

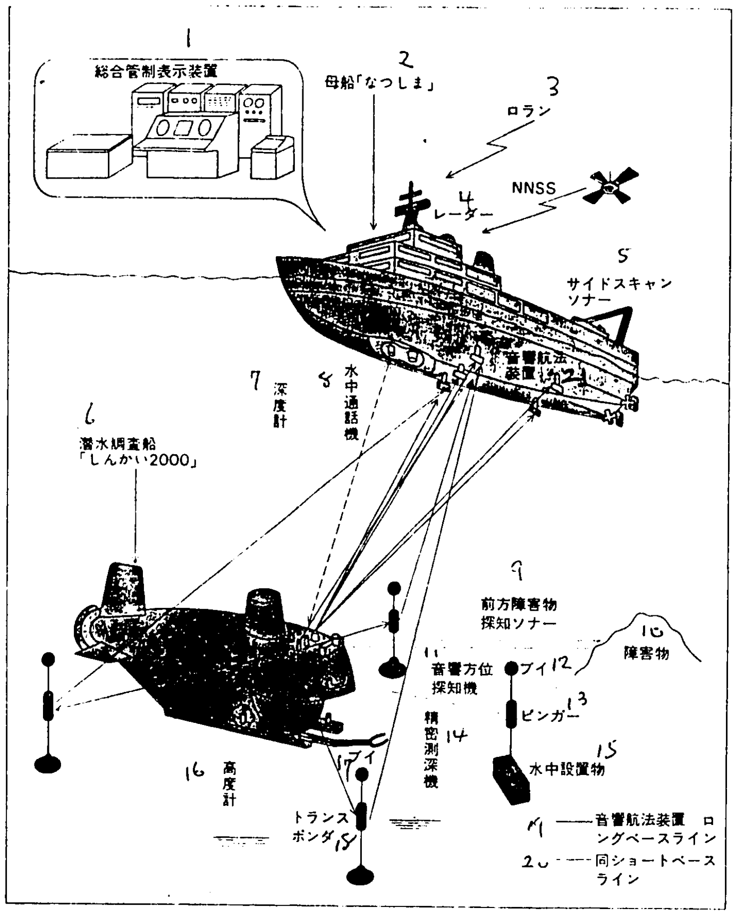
Shiraishi: What kind of surveys can be conducted from now on by "Shinkai 2000?"

Koriki: The definite survey themes will be determined by a future committee to be set up while continuing to train the crew and test the machinery and equipment. For now, we are thinking of using the ship for probing seabed mineral resources headed by manganese, oil and natural gas, surveying unused deep sea biological resources such as deep sea codfish. Furthermore, it can be used to investigate the condition of installations in the ocean such as the condition of underwater cables. Besides these, it may be mobilized for the purpose of surveying, for instance, geological features of Suruga Bay to predict earthquakes, as is popularly discussed.

Shiraishi: I hear you are examining the possibility of building a survey ship that can dive to depths of 6,000 meters in the future. What kind of plan do you have?

Koriki: Well, if a ship can dive 6,000 meters, it can virtually cover 97-98 percent of the world's seas. We are hoping to build a 6,000-meter class submersible ship as early as possible, but unfortunately our record achieved in the past is only 600 m, and we cannot reach our goal all at once without causing many problems. Therefore, first "Shinkai 2000" was built to master the operation of the ship. Starting from April, the docking test with the mother ship "Natsushima" will be conducted. Subsequently, from the middle of May, a challenge to the depths of 2,000 meters will be commenced in the open sea off Shiono Point.

Likewise, the most essential task is the development of a material for the pressure resistant shell that can bear the pressure of 600atm. For the time being we are thinking of using steel material containing 10 percent nickel and 8 percent cobalt, and this idea has been proven feasible. However, we had never actually used it. Our important issue of the tomorrow can be said to be the development of this material. Simultaneously, it is also of primary consideration to confirm the technology for fabrication such as cutting and welding.



Key:

1. Integral control indication system
2. Mother ship "Natsushima"
3. Loran
4. Radar
5. Side scan sonar
6. Submersible survey ship "Shinkai 2000"
7. Depth sounder
8. Underwater telephones
9. Sonar for detecting obstacles ahead
10. Obstacles ahead
11. Sound course detector
12. Bouy
13. Pinger
14. Precision echo sounder
15. Underwater block
16. Altimeter
17. Buoy
18. Transponder
19. Sound navigation system long base line
20. Short base line of the same
21. Sound navigation system

8940
CSO: 4105

END