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Japan Report

(FOUO 68/81)

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POLITICAL AND SOCIOLOGICAL

RULING LIBERAL DEMOCRATIC PARTY'S ACTIVITIES UPDATED

Internal Party Maneuvering

Tokyo NIHON KEIZAI SHIMBUN in Japanese 3 Oct 81 p 2

[Text] Possible New LDP Leaders Discussed

While control of the Liberal Democratic Party (LDP) by the three elder statesmen--Prime Minister Suzuki and former Prime Ministers Tanaka and Fukuda--continues amidst relative harmony, various budding "signs" and changes are detected among the second echelon of party leaders which could influence the future political trend.

In the Tanaka faction, Noboru Takeshita and Shin Kanemaru, who have hitherto been generally regarded to be "on their good behavior," recently resumed their activity on center stage. Rokusuke Tanaka (MITI minister) and Michio Watanabe (finance minister) are intensifying their respective policy study group activities, while Shintaro Abe (LDP Policy Research Council chairman) is increasing his voice within the party and stepping up stumping activities throughout the nation. Also, the Shukyo Seiji Kenkyukai (Religious and Political Study Society; Kazuo Tamachi, chairman), the base for the debate on a change of generations which had been dormant for some time, is again actively holding weekly general meetings.

The alignment between the three elder statesmen, which was consolidated with the joint Upper and Lower House elections in June 1980 as a backdrop, does not presently show any signs of disintegrating. However, the new movements mentioned are seen as likely to gradually alter the party power structure in the future.

During the joint elections last year, a movement arose within the party to "destroy the Tanaka-Fukuda power alignment after the elections and to set up a new leadership, in which Takeshita and Kanemaru would participate.

Consequently, the general view within the party was that relations between the two men and former Prime Minister Tanaka had cooled. Meanwhile, Susumu Nikaido (LDP General Affairs Council chairman), who is considered to be former Prime Minister Tanaka's "alter ego," rose to control the real power within the party, and Ganri Yamashita (Lower House Steering Committee chairman) has also loomed as one of the likely heirs. Takeshita seldom attends the meetings held by the new leaders, and there have been rumors that "Mr Takeshita was shouted down into complete humility by the master of Mejiro (former Prime Minister Tanaka)."

But a more recent view is that "he appears to have been reinstated in Mr Tanak's favor." This opinion is based on Mr Takeshita's appointment as chairman of the Tanaka faction delegation to South Korea in late August, his participation in the Nikaido-led delegation to China (PRC) in early September by direct order of former Prime Minister Tanaka, and his closing address at the seminar for young members of the faction in early September.

Sources close to former Prime Minister Tanaka have publicly acknowledged that "judging from the makeup of members at the seminar, rumors of cooled relations concerning Mr. Takeshita are unfounded. One could easily surmise Mr Tanaka's feelings on the basis of the attendance." They thus imply that Mr. Tanaka's ire has subsided.

Also, on the basis of former Prime Minister Tanaka's decision, Mr. Kanemaru was appointed to the post of chairman of the Lower House Political and Financial Committee, which actually controls the fate of the Suzuki cabinet.

There are speculations within the LDP such as: "It probably means Mr Kanemaru has become so powerful that Mr Tanaka could not destroy him, even if he wanted to" (a cadre Diet member of the Tanaka faction), or "Mr Tanaka set up the Nikaido connection and the Takeshita-Kanemaru connection as trump cards to be used in the worst possible case situation arising from the Lockheed scandals trial" (an LDP cadre).

The Shinsetai Kenkyukai (New Generation Study Society) led by Rokusuke Tanaka had hitherto been characterized as a "policy group,) but it was admonished by former LDP Secretary General Kunikichi Saito, leading cadre of the Kochikai (Suzuki faction), that "it is all right to hold study meetings, but one should refrain from holding so-called politically oriented general meetings." On 17 September, 34 of the groups' 58 members gathered in the city of Fukuoka, Rokusuke Tanaka's home base, for a party to commemorate a publication by the group. There was reportedly one Diet member among them who was visiting Seoul as a member of the Japan-South Korea Parliamentary League delegation, but he hurriedly flew to Fukuoka in the middle of his Seoul tour.

Although Rokusuke Tanaka himself denied that he "made contacts or ordered members to attend, or that he anticipated such a large turnout," sources close to him pointed out: "Whenever a study meeting is held in the Tokyo office, members are tempted to casually 'buy a ticket to the race' and attend on the strength of appeals by Miyazawa (chief cabinet secretary) and Rokusuke Tanaka. On the other hand, when the study meeting was held in Fukuoka, they took the plane with a certain determination." It was thus openly implied that attendance at the commemorative party constituted a kind of "test of loyalty."

It is reported that six Diet members have subsequently applied for membership in the study group, attracting attention within the party in the sense that "the race for a successor to head the Kochikai has become quite interesting." (A non-affiliated Diet member)

According to Rokusuke Tanaka, the following dialogue took place between the late Prime Minister Ohira and himself: "Rokusuke, I intend to supply Michio Watanabe with men and funds. Is that agreeable to you?" "Fine, I have no objections."

During the 40-day struggle late in the year before last, Watanabe entice Kabun Muto and Sempachi Oishi of the Nakasone faction, which was confronting the Ohira-Tanaka camp, to support Ohira. He was expelled from the Nakasone faction and is presently non-affiliated. Once a month, he gathers together young Diet members from the various factions and conducts study meetings under the aegis of the Onchikai.

The study group has 34 or 35 members. There are many who came from the Kochikai with the blessings of the Nakasone faction and the late Prime Minister Ohira. Beginning in October, they will be holding breakfast meetings every week. This is seen by party members as "a steppingstone to the formation of a Watanabe faction."

Watanabe himself believes: "It is more relaxing to be by myself. I am so busy with administrative reform and financial reconstruction that I don't have time to think about forming a faction." He therefore postponed hanging up an Onchikai nameplate on his office door, although he had planned it for 2 days. He explained to his colleagues: "One cannot predict the future, but the important thing is to strengthen lateral relations within the party."

Nonetheless, the Nakasone faction and the Kochikai are warily eyeing Watanabe's moves. They are "debating whether they should warn the young members against participating" (a Kochikai cadre).

Cabinet Reshuffle Prospects

Tokyo NIHON KEIZAI SHIMBUN in Japanese 13 Oct 81 p 2

[Text] Talk of Cabinet Reshuffle Stirs Up LDP Factions

The theory of a "drastic reshuffle" has come to the fore, pointing out that "without a drastic reshuffle, passing up the July opportunity would prove to be meaningless" (a source close to the prime minister). The prime minister is said to have "already prepared a list of 70-80 candidates for the cabinet." (a party cadre). However, the target date is next fall and a balance between the factions would be the highest priority. There is also an opinion within the party that "there is no room for the appointment of Diet members from the intermediate factions and non-factions to the cabinet" (a party cadre). Let us therefore take a look at the conditions within the five main factions and LDP members of the Upper House.

Lineup of Top Three Officials for Reelection Is Focal Issue

[Suzuki Faction] The focal issue is how to line up Kunikichi Saito, Kiichi Miyazawa and Rokusuke Tanaka--the top three faction leaders--as chairman of party affairs, chairman of "zaibatsu" (business groups) affairs and principal cabinet member. There is a growing opinion within the faction that, with an eye toward a Suzuki reelection, a solid foothold must be secured among the three party posts.

As far as the three party posts are concerned, the faction is not particular, except that Chairman Nikaido of the General Affairs Council should either remain in that post or assume the post of secretary general. It is rumored that if he should remain in his present post, either Kunikichi Saito or Heiji Ogawa would be fielded as candidate for secretary general.

On the premise that Nikaido would become secretary general, the faction elders are urging the prime minister to field Miyazawa for chairman of the Policy Research Council. However, sources close to the prime minister are strongly urging retention of Miyazawa in his present post, saying: "There is no one else who is qualified as chief cabinet secretary, and Miyazawa has proved to be a capable chief cabinet secretary."

The elders of the Suzki faction are increasingly for "support Miyazawa," while the younger members are leaning toward support for Rokusuke Tanaka. Consequently, the candidacy of Miyazawa and Tanaka with respect to the cabinet reshuffle is tied to the question of a successor to the Kochikai leadership.

A Host of Candidates Seeking Cabinet Posts

[Tanaka Faction] The basic strategy is to support Chief of General Affairs Nikaido for the post of secretary general, and to increase the allocation of cabinet posts by one. As for the question of Nikaido as secretary general, "There aren't many candidates for secretary general in either the Suzuki or Fukuda factions" (a Tanaka faction cadre). This situation is thus regarded as providing "an excellent opportunity." As a backdrop in the quest for an increase in cabinet posts, there is the expansion factor of the faction into " a host" of 104 members, many of whom are seeking cabinet nomination. The aim is therefore to seek nominations for newcomers. The plan is to obtain appointments for those with six or five terms in the Diet, including Noboru Minowa, Yukiyasu Matsuno, Ryohei Tamura, et al. It is also hoped that a post can be garnered for one of the members who joined during the past year.

Among former cabinet members, the "man in the spotlight," Chairman Kanemaru of the Lower House Special Political and Financial Committee, is regarded as the front runner.

Abe's Move and His Successor Are Keys

[Fukuda Faction] The focal points are Shintaro Abe's move to a major cabinet post and a successor in one of the three party posts. There are calls among the middle cadres and younger members of the faction of Abe's appointment to foreign minister or finance minister, or in the case of the three party posts his appointment as secretary general.

In the event of Abe's appointment to the cabinet, names looming as candidates for the three party posts include: Kichizo Hosoda, Tatsuo Tanaka and Keijiro Shoji. At present, their respective support groups are reportedly holding meetings and directly or indirectly approaching former Prime Minister Fukuda, who has the "power to make recommendations" to Prime Minister Suzuki.

In case a problem is faced by the faction regarding a successor to the three party posts, the speculation is that "former Prime Minister Fukuda may recommend Ichiro Nakagawa, who has been acting as a detached force of the Fukuda faction."

Additionally, the faction is prepared to field newcomer Ihei Shiseki, as well as Mutsuki Kato, who seeks a complete comeback from his tribulations in connection with the Lockheed scandal, for cabinet posts.

Accommodation of Top Cadres Is Difficult

[Nakasone Faction] Administrative Management Agency Director Nakasone is prepared to remain in his present position if asked. "Unless I am asked to quit by the prime minister, I will concentrate on administrative reform." In that case, the sorest point is what to do with Secretary General Sakurauchi. He himself appears to be expecting a cabinet post as a matter of course for his "great contribution to the landslide victory in the joint elections." If it turns out that way, only the top cadres would secure

the posts they aspire to. There are some faction members who feel that "things would be better all around if Mr Sakurauchi would resign from his post. The other top cadre, Sadanori Yamanaka, is well qualified in view of his accomplishents as director of the party Tax Affairs Committee. Equal treatment for him will prove to be difficult.

Newcomer Motoharu Morishita is at the top of the list of recommended candidates with a record of six terms in the Diet. If Morishita is again passed by, the younger members of the faction will not be pacified. Hikosaburo Okonogi, with five terms, is in the "eye of the typhoon." He may not only pass his seniors, but he also has close relations with Tanaka faction members, which causes Nakasone aides to worry that "if he should be recommended by the Tanaka faction, it could result in a decline in prestige for Nakasone as faction leader."

Rumors Rampant of Boss's Resignation

[Komoto Faction] Amidst his "independent statements" on administrative reform and tax reduction, there are frequent rumors within the party concerning Komoto's resignation as chief of the Economic Planning Agency. Komoto himself laughs the matter off as having "merely expressed his personal thoughts," while the prevailing view in his faction is that "Mr Komoto's departure from the cabinet would mean a decline in his prestige and a minus for him in the race for the post-Suzuki party presidency " (a cadre). However, middle-level cadres and younger members admit their inner feeling that "in view of the limited number of cabinet posts (two, including Komoto), if only the boss would resign from his post...." Komoto's moves will thus continue to draw attention inside and outside his faction.

In the event Komoto remains in his present post, Soichiro Ito (party public relations director), who has served seven terms in the Diet, would be the strongest contender for the reamining post. However, Hyosuke Niwa, who served as National Land Agency director during the "28-day cabinet" of the Tanaka regime, is said to be eager for a "return match," causing a dilemma among faction leaders.

Can The Three-Post Quota Be Retained?

[Upper House] The Upper House is allocated three cabinet posts. For a while, it was allowed two posts, but this was increased to three with the advent of the Suzuki government, thanks to the persuasive efforts of Secretary General Fujita of the Upper House. Although LDP members of the Upper House are confident of retaining the three posts despite the cabinet reshuffle, one worrisome element is the direction of the Tanaka faction. The Tanaka faction is demanding more posts for Lower House members on the basis of the expansion of the faction, and if the issue cannot be settled within the framework of the Lower House, the Upper House would be affected. There is thus concern that the three posts may be cut to two.

Although the three posts may possibly be retained, if the Tanaka faction is denied an increase in posts for Lower House members, it is possible that the faction may demand that "a Tanaka faction candidate be promised one of the posts allocated to Upper House members."

Two Ways To Promote Stability

Tokyo NIHON KEIZAI SHIMBUN in Japanese 19 Oct 81 p 3

[Text] Suzuki Government and Cabinet Reshuffle

Encouraged by the smooth sailing deliberation in the Diet on the administrative reform fill, LDP Diet members are focusing their attention on the direction of the cabinet reshuffle and on nominations for the three party executive posts. Visits to the prime minister's residence by politicians who have become eligible for cabinet posts are incessant. Active "encouragement meetings: by politicians are increasing, and many are viewed as seeking demonstrative effect with an eye toward the coming cabinet reshuffle. Meanwhile, the so-called "pilgrimage to former Prime Minister Tanaka," who has powerful clout with regard to the political situation, continues without letup.

As far as the general public is concerned, they may entertain spectators' interest, but it doesn't matter to them who occupies the three LDP posts, or who sits in the principal cabinet posts. This is because the public considers that "the cabinet really does not change, and the situation will be the same regardless of who is appointed." Therefore, the hubbub in Nagatacho (the prime minister's residence) even appears abnormal. Nonetheless, from the standpoint of predicting the direction of the domestic political scene, there is an aspect of the November reshuffle which cannot be overlooked.

The noteworthy point in the upcoming cabinet reshuffle is how the stability of the Suzuki government will change. As far as the prime minister, who is handling the reshuffle, is concerned, he will do his utmost to enhance the stability of the government and to build a readiness to cope with domestic and foreign situations. This is in line with his strategy for reelection next fall. The question is the proper personnel alignment for that purpose. Therein lies the main concern of the prime minister's personnel moves.

There are two ways to increase government stability. First, to join hands with the forces which constitue an overwhelming majority within the party, and to control the political situation as its leader. The second is to maintain a balance of power between the various forces within the party, which is the key to maintaining the stability of the government. In building language, the former is a "hard" structure, while the latter is a "soft" structure.

The Suzuki cabinet has the earmarks of a "soft-structure government," in view of its inauguration after the demise of his predecessor, and the character and political methods of the prime minister himself. Its governmental base is founded on a mainstream factional system centering on the Suzuki, Tanaka and Fukuda factions, and its stability depends on a balance between the Tanaka and Fukuda forces. However, during the year and a half existence of the Suzuki cabinet, the conditions within the party have changed drastically. The Tanaka faction has expanded to the point where it is said: "Whoever doesn't belong to the Tanaka faction is a nobody."

Within the Tanaka faction, there are already strong demands for a larger allocation of cabinet posts, with an eye toward the cabinet reshuffle (an increase from the present four to five posts), and to "field Nikaido, or a Diet member friendly to the Tanaka faction, for the post of party secretary general."

Regarding recommendations for the cabinet reshuffle, the Tanaka faction "does not intend to make any requests which would perplex the prime minister, but the prime minister is well aware of the Tanaka faction's position" (a Tanaka faction cadre).

The Fukuda faction is showing signs of rejecting the wishes of the Tanaka faction. "increasing the allocation from four to five posts would violently upset the peace within the party" (a Fukuda faction cadre). There is deep-rooted caution against a Tanaka faction takeover of the three party executive posts, especially the post of secretary general.

Although Prime Minister Suzuki is reportedly seeking stability for his government based on a "Tanaka-Fukuda equilibrium," to what extent is it possible? A dilemma exists in that if relations with the Tanaka faction should sour, a split would occur in the government itself. On the other hand, an extreme compromise would result in deteriorating relations with the Fukuda faction.

In that sense, the focal issue regarding the cabinet reshuffle would again concern appointments to the three party executive posts. The transfer of Secretary General Sakurauchi is said to be a foregone conclusion, and the issue is: who will succeed him to the post of secretary general? As for Prime Minister Suzuki himself, he would like to appoint someone from his own faction to one of the executive posts in order to solidify his strategy for reelection, and the most probable solution is a combination of candidates from the Tanaka, Fukuda, and the mainstream Suzuki factions.

In such an event, the party control would shift to a Tanaka-Suzuki government. How will the prime minister, who is solicitous of relations with the Fukuda faction, deal with this? Inasmuch as it relates to the foundation and stability of his government, it may turn out to be a "troublesome cabinet reshuffle for the prime minister" (a party elder).

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POLITICAL AND SOCIOLOGICAL

MAGAZINE UPDATES JAPAN SOCIALIST PARTY'S FACTIONAL DISPUTE

Tokyo SHUKAN SHINCHO in Japanese 15 Oct 81 p 24

[Text] No One Is Troubled by the Split in Tokyo Headquarters of Japan Socialist Party

At the regular general meeting, supposedly convened to reconstruct the party, by the Tokyo headquarters (Diet Councillor Shongo Oki, committee chairman) of the Japan Socialist Party [JSP], which suffered severe defeat in the July metropolitan elections and fell to second place among the opposition parties, the Socialist Association and the Anti-Socialist Association confronted each other and a split resulted.

Immediate Cause of the Split Is the Question of Reduction in Party Dues

One of the Diet members of the Socialist Association pointed out that a party member of the Japan Telecommunications Workers' Union, the supporting organization from which committee chairman Oki emerged, was paying only 1,000 yen of the monthly party dues of about 1,200 yen, and a supplementary resolution "that he reinstate payments retroactive to February of this year" was put to a vote. Upon this development, chairman Oki and the executive committee (16 members) of the Anti-Socialist Association resigned, claiming that it was "in fact, a vote of no confidence." They boycotted the general meeting and held a "Diet members' conference to rebuild the Tokyo party headquarters."

At this conference, a metropolitan assemblyman of the Anti-Socialist Association was selected as secretary-general to replace the secretary-general belonging to the Socialist Association; he organized an executive committee with the incumbent chairman and vice chairman remaining. The Anti-Socialist Association withdrew from the JSP party headquarters in Hongo and established an office in the House of Councillors' building.

For the executive committee to split over the question of only 200 yen discount in party dues is typical of JSP actions but actually this is only an outward excuse. It is reported that the strategy to oust chairman Oki, with the party dues question as an excuse, began to be formulated a month prior to the general meeting. A veteran party member of the Socialist Association reported this.

Two-thirds (252) of the Diet members of the general meeting are members of the party faction "March Association," which is sympathetic with both the Socialist and Anti-Socialist Associations, and the leader is Tamio Miyabe, chairman of the Federation of Municipal Labor Unions. Miyabe intends to run as a candidate from Tokyo's four

districts in the next Lower House elections. The retirement of Diet member Mitsu Kaneko, who presently represents the four districts, is certain. However, Miyabe cannot get the nomination being only the chairman of the Federation of Municipal Labor Unions. Therefore, he sought the position of chairman of the JSP Tokyo headquarters and connived to crush Oki by forcing the supplementary resolution to a vote.

Chairman Miyabe is not the only one aiming to replace Diet member Kaneko. So is Mitsuo Tomizuka, secretary general of the General Council of Trade Unions of Japan, who advocates coalition between the JSP and the Komeito [Celan Government Party]. It is also said that chairman Oki is also thinking of switching from the Upper House to the Lower House.

On the other hand, a member of the Anti-Socialist Association who is also a veteran Diet member interprets the recent split in this manner:

"I had anticipated that the Socialist Association would try to discredit chairman Oki with the dues question. In short, the difference between the Socialist and the Anti-Socialist Associations is the difference between the 'JSP-JCP' or 'JSP-Komeito' course of joint struggle. The Socialist Association criticizes us for cooperation with the Komeito, but the victory of 107 Diet seats (House of Representatives) was the result of the 'JSP-Komeito' joint struggle. Labor unions and the Japan Telecommunications Workers' Union are saying that unless a candidate belongs to the 'JSP-Komeito' faction, he will not be recommended.

Therefore, at this time, even if the organization has to be broken up, I want to disassociate myself from the Socialist Association which supports the 'JSP-JCP' line. The vote on the supplementary resolution was an opportune measure, but will the JSP use that as an excuse to split? The aforementioned Socialist Association party member states vaguely that: 'We will make our position clear and stage a demonstration aimed at the next general meeting. We will make chairman Oki admit that he is responsible for the split and isolate him locally, limiting his support to only the Japan Telecommunications Workers' Union. Up to that point, the strategy has been planned, but there are no plans to split the party. Coordination with the supporting labor unions remains to be carried out....'"

The Anti-Socialist Association states: "There might be a difference in the policy but the party is dependent on labor unions for building a party of a million members, for providing election funds and for delivering the votes. We cannot cursorily break up the party." For the moment, we must be concerned with the election of the Tokyo governor. He added nonchalantly that "we will probably be in trouble unless we are unified by then."

Kaoru Ota, former chairman of the General Council of Trade Unions of Japan, made the following comment:

"Following last year's 'double' elections, if the party loses the metropolitan assemblymen's elections, the positions of veteran labor union leaders might decrease and no future job prospects exist. Becoming helpless, they will lean toward the side with money and votes in order to obtain positions. It would be a split without any relation to party ideology or principle. If developments have become this bad, the situation might be cleared up if the party did split...."

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SCIENCE AND TECHNOLOGY

NEW PRODUCT LINES OF VARIOUS ROBOT MANUFACTURERS INTRODUCED

Carrier Robots

Tokyo NIHON KOGYO SHIMBUN in Japanese 19 Jun 81 p 6

[Text] Nihon Robot Industry (president, Noriaki Motoda; 1-25-1, Nishi-Shinjuku, Shinjuku, Tokyo, Japan; telephone: 03-348-8585), a manufacturer specializing in carrier robots established by the tie-up of Toyo Terminal and Motoda Electronics Industry, has built a 110 unit/month-scale mass production system at the Kagoshima plant, and has started full-scale sale of the product through 25 agencies. First-year sales of 2.5 billion yen are projected. Also, the company has received inquiries concerning production tie-ups, sales tie-ups and plant exports from 25 countries. For the time being, it plans to set up bases in two areas, the United States and Europe, and has begun to select the tie-up partners. In conjunction with the starting of this series of business activities, the capital was increased from 50 million yen to 110 million yen, which invited a new capital participation by Motoda Electronics Industry and Heim International, which is the parent company of Toyo Terminal.

Nihon Robot Industry is a manufacturer specializing in carrier robots and was established in September 1979 by Motoda Electronics Industry which offered the robot technology and Toyo Terminal which offered the capital. The company has industrialized its robots, headed by "Piler" robots with 125 patents including utility model patents, and "Ampman" and "Y-man" robots. The company has already achieved appreciable sales results with domestic automobile makers and with overseas major industries such as Volvo of Sweden. Nihon Robot Industry is characterized by the fact that it accommodates the needs of users by offering various machine models and an ample selection of robots costing from 1.5 million to 20 million yen.

The company has been building a new plant adjacent to the Kagoshima plant of Motoda Electronics Industry (Kedoin-Machi, Satsuma-Gun, Kagoshima-Ken) since its establishment, and it has recently completed and begun to operate fully a total production line which is capable of manufacturing 10 "Piler" robots a month, and 100 "Ampman" and "Y-man" robots a month. According to the company, orders have been received from all types of industries: from the automobile industry, to begin with, and from the food industry, the cement industry, the cement secondary product industry, the metal mold industry, the storage industry and the port industry. It is evident that the production line will not be enough to meet all the needs unless "automation of the robot plant" is promoted. The company is now rushing construction work aimed at increasing the total production to 250 units by the end of this year--50 "Piler" robots and 200 "Ampman" and Y-man" robots.

The capital was increased to prepare for an increase in funds in association with the starting of this full-scale operation, and new capital was raised to 110 million yen. Toyo Terminal has been the 100 percent investor (50 million yen) of this company until recently, but Heim International and Motoda Electronics Industry have made new investments of 50 million yen and 10 million yen respectively.

On the other hand, the steady flow of inquiries from overseas is very encouraging--for instance, inquiries concerning the purchase of plants from the USSR and North Korea. Meanwhile, inquiries from advanced nations such as the United States and European nations have been dominated by sales partnership offers. In line with the overseas strategic policy of the company to send only essential parts and to finish the goods at the local sites, it is willing to show positive interest in tie-up proposals. The company will expedite the selection of business partners focusing on production technology and sales capability. As a first step, it intends to conclude tie-up negotiations with one American company and one European company.

Casting Burr Removing Robots

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 31 Jul 81 p 21

[Text] Casting burr removing robots may be created as early as the next fiscal year. This means that the technological development pursued by the Small Business Promotion Corporation [SBPC], which had contracted the work for the automation of the cast finishing (removal of burrs), the final process in the manufacture of castings, to Japan Industrial Robot Manufacturers' Association, Sogo Imono Center, Kawasaki Heavy Industries and Kobe Steel, is on the threshold of a breakthrough. The SBPC has decided to make a trial model within the next fiscal year and to present it and spread its use. Casting burr removers specifically for mass-production use were developed previously. However, the machine which is about to be developed at this time is likely to become popular among smaller business enterprises because the robots will be equipped with a teaching machine, a sensor and a high degree of freedom, suitable for various small quantity productions.

Casting burr removal is a process that follows the mold-making, melting, pouring and mold-separating processes, and is the final process generically called cast finishing. This process has become the largest bottleneck standing in the way of rationalization of the entire process, as the burr removal involves removal of burrs using a grinder, which requires hard work, generates noise and dust, and produces a hazardous work environment. It is difficult to secure workers for this task, and the mechanization of the process is also problematic. In addition, lately it has been extremely difficult to hire young laborers, and the aging of employees is a serious concern. The automation of this process by the use of robots has become the issue of industry. However, in reality, 99 percent of the 2,800 companies throughout Japan that constitute the casting industry are classified as small businesses and lack the ability to develop their own technology.

With this background, the SBPC decided to wrestle with the technology development under a 6-year plan, from FY-78 to FY-83, and pushed forward research and development of both software and hardware by contracting out the project to the Japan Industrial

Robot Manufacturers' Association, Sogo Imono Center, Kawasaki Heavy Industries and Kobe Steel. This casting burr removing robot is composed of a teaching machine which instructs the machine which burrs are to be cut off, a sensor which verifies the location and size of the burrs, an oil pressure mechanism which drives a burr removing tool along burrs and a control system which controls the total system, so it is designed to remove burrs from various castings produced in small numbers. Robots are expected to remove burrs of several to some tens of casted products, such as gear boxes, pump casings, valves and motor casings, weighing 10 kg to some hundreds of kg. Robots for smaller castings and robots for larger castings are being developed by Kawasaki Heavy Industries and Kobe Steel, respectively, under contract. On the other hand, software development was carried out at the Sogo Imono Center—for example, the improvement of the manufacturing process to standardize the site and shape of the burrs. At present, the development of robots both from the software and hardware aspects will become a reality in the near future.

Up to now, robots for painting have shown remarkable progress in popularization. As this is the first time that a robot for casting work will be made, those involved in the manufacture of this robot are full of hope. The problem, however, is the price. The majority opinion is summed up: "It is difficult for the robot to become popular among small business enterprises unless the price is below 20 million yen." (Japan Casting Industry Association) It appears that the future spread of these robots will depend on how much lower the prices can be set.

Assembly Robots

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 31 Jul 81 p 10

[Text] Toyota Machine Works is advancing into the automobile assembly robot field. The company intends to utilize the technology accumulated through development of an automobile assembler by the company as part of the development of a compound production system with laser application, one of the large projects of the Agency for Industrial Science and Technology. The plan will be embodied after 1983, when the project to develop the system will be completed. The company intends to practicalize robots both for assembly of various articles produced in small numbers and for assembly of specialized mass-produced articles. Both types of robots will be developed as part of the rationalization of facilities in machine-work plants. As a start, a small-scale assembly robot will be manufactured, following closely the trend of demand. This is the first time that a Japanese tool machine maker has advanced into this type of robot field, and Toyota's future activities in connection with this business will be very interesting to watch.

Toyota intends to advance into the assembly robot field on the basis of the conviction that the company can surely grab a large share of the robot market if it can make its technological ability work and develop a unique product, since the automation of machine parts assembly lines is imperative but still totally unexploited. On the other hand, one of the reasons it does not intend to go into the material handling robot field is concern that there are too many other makers already in the field for Toyota to be able to squeeze successfully into the market.

The company began to get involved in the development of robots much earlier, about 10 years ago. It actually manufactured modular type spot-welding robots and sold some 50 sets to automobile related makers. The company also made a product out of material handling devices such as specialized machines and assemblers by giving them the function of a robot.

The assembly robot which Toyota is presently trying to merchandise is considered an extension of the specialized machines and machine work systems such as flexible manufacturing systems. A project team was organized to develop an assembler for the compound work system with laser application, and some 1 billion yen was invested, including a development fund from the national government, which resulted in the completion of a prototype robot that assembles gearboxes and spindle units absolutely without human labor. Toyota is now designing a utility model which is scheduled for delivery in 1983. Buoyed by this achievement, the company is showing growing confidence in the automatic assembly of various fine parts: "We have established a technology beyond the reach of other companies."

Although the manufacture of products will encounter some problems relating to the raising of the assembly speed, size and weight reduction of the robot, miniaturization of the control system, etc, "it is possible to receive orders and produce robots which can meet broad needs" even at the present stage of progress, the comapny says. Nevertheless, the spread of the assembly robot entails plenty of problems to be solved, in addition to problems related to the development of the robot proper and the software--for instance, changing the position of the workers. Toyota envisages a hopeful surge in demand once these problems are solved. Assessing the right time as 4 to 5 years from now, Toyota intends to merchandise the robot in tune with the arrival of the real demand.

16-Bit Microcomputer Control

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 15 Aug 81 p 6

[Text] Industrial robots, the ace of energy saving machines, are now basking in the dawn of the 16-bit microcomputer era. Kawasaki Heavy Industries, the largest robot maker, will adopt in full scale a 16-bit parallel processing microcomputer for an assembly robot to be merchandised next spring, following in the footsteps of a painting robot which has recently been offered for sale. Already, Yasukawa Electric Manufacturing and Shin-Meiwa Industry are using this computer for welding robots. Also, Hitachi, Kobe Steel, Fujitsu Fanuc and other prominent companies will soon introduce robot models with a 16-bit microcomputer to the market one after another. This series of actions reflects the rapidly increasing demand for sophisticated robots in industry. It is viewed as inevitable that in the next year the mainstream of microcomputers used for sophisticated robots will be the 16-bit model instead of the currently dominant 8-bit model.

Kawasaki Heavy Industries will use a 16-bit microcomputer for the sophisticated "Puma" model, an assembly robot to be sold next spring. Though an 8-bit microcomputer will be used for inexpensive models, it is forecast that a 16-bit model will be the mainstream of the robots. The company engaged in a serious sales promotion

for spot-welding robots with an 8-bit microcomputer starting at the beginning of this year, but now it seems to have determined to introduce a 16-bit model to cope with the steadily advancing technological innovation.

Kobe Steel, the largest manufacturer of the painting robot, will soon sell an arc-welding robot with a 16-bit microcomputer. The company has sold less than 20 arc-welding robots to date, and it is anxious to exploit this field with the pending opportunity of selling the 16-bit model for the first time.

Fujitsu Fanuc is now in the process of developing an intelligent assembly robot with the cooperation of Siemens of West Germany, and the 16-bit microcomputer will be used to all control parts of the robot. Already, currently manufactured models partially use the 16-bit microcomputer, and the company believes that "a 16-bit model will be a common sight in future robots." (President Seiuemon Inaba, Fujitsu Fanuc)

Likewise, Hitachi will switch all robot control systems over to a 16-bit model from the currently effective 8-bit models as early as this autumn. Mitsubishi Heavy Industries, Osaka Transformer, Tokiko and other robot manufacturers are all rushing to adopt the 16-bit model. All the main machine models of each company, all of the robots for welding, painting and assembling, may be converted to 16-bit models from this year to next year.

The industrial robot production was 19,800 units last year, a 36.7-percent increase over the previous year. Among them, 3,000 units are playback and numerical control model sophisticated robots which integrate a microcomputer in the brain--a remarkable four-fold increase over the previous year. A shortage of skilled workers in industry is becoming a serious problem, and this has spurred the steady rise in demand for sophisticated robots which can work almost as well as skilled workers. These microcomputers are currently of the 8-bit type, but future robots will be dominated by the 16-bit model, and it is predicted that the sophistication of robots will be furthered by the momentum.

Arc-Welding Robots

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 22 Aug 81 p 6

[Text] In September, Osaka Transformer will inaugurate a system which produces 50 arc-welding robots a month. With the completion of a new plant primarily for robot production scheduled at the end of this month in the Settsu factory (Settsu, Osaka Prefecture), the company deployed an aggressive formation--reinforcement of businessmen specializing in robots, organization of 30 sales agencies and placement of 100 full-time salesmen in each agency. With these positive strategies, the company wants to double the arc-welding robot sales of this term (April 1982 term) compared with the previous term.

Osaka Transformer has merchandised right-angle coordinate-type arc-welding robots since the end of 1979 to join the robot market. Additionally, in April of this year, it started to sell multijoint type arc-welding robots and furnished "both wheels" in terms of the makeup of the merchandise.

In consideration of the improving demand from automobile and machine manufacturers, the company decided to strengthen its production capacity. Once the new plant being constructed in the Settsu factory is completed, the major product of the plant will be robots, and a 50 robot/month system will be established.

In conjunction with this, the company has furnished a robot sales system. The core of the system is the "Robot Center" established previously in the main office for the management of sales and orders received, information retrieval and education of sales agencies. At this time, the number of businessmen specializing in robots has been increased to over 30 men. Also, in line with the policy of increasing robot sales agencies, 30 agencies were, as a first step, brought under one system, and 100 full-time robot salesmen have been positioned to facilitate the sales at each sales agency.

The robot sales of Osaka Transformer in the previous term (April 1981 term) were valued at approximately 1 billion yen, whereas in this term the company aims for the first time to reach 2 billion yen, double the previous term's sales as a start, in accordance with its vision to raise the robot sector to become the future backbone of the company by realizing an annual sales' increase of 1 billion yen from now on.

Cutting, Welding, Location-Determining Robots

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 22 Aug 81 p 6

[Text] As a link in the chain of robot model expansion, Shin-Meiwa Industry has seriously begun to pursue the development of "cutting robots" and the cultivation of the demand for them. The company has succeeded in merchandising the plasma-cutting robot, the first product of which has been just delivered to Toyota Motor, a gas-welding robot and an automatic shearing system with a location-determining robot as its core--two robot models and one system in the past year. It is planning to press positively for the standardization and generalization of these products.

Shin-Meiwa began to develop a robot which can effectively cut solid objects with a complex contour the year before last, and last year it succeeded in merchandising a gas-welding robot as the first of the many to come. One robot each was delivered to Hitachi and Fuji Electric, and currently another robot is being manufactured.

Also, this spring the company developed an "automatic shearing system" and sold it to Ishikawajima Kenki (main office: Tokyo; president: Yoichiro Doko; capital: 2.4 billion yen). This system is totally automatic and can shear steel plate out into any shape other than rectangles. Other components of the system besides the location-determining robot are a feeder (steel plate supplier), a turntable, a shearing device and various conveyers, and the total process is controlled by a minicomputer.

The plasma-cutting robot delivered to Toyota Motor is the first machine model produced in the robot industry which handles solid work with speed, and a standard model is scheduled to be merchandised very shortly.

Encouraged by the fact that the company could secure orders from types of businesses and corporations which had nothing to do with the manufacture of robots such as Toyota Motor as a new source of demand, Shin-Meiwa Industry hopes to exploit the field of demand from automobile manufacturers and home electric appliance manufacturers with a series of cutting robot .

Direct Numerical Control System

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 25 Aug 81 p 1

[Text] Nippon Electric Company has developed a DNC (direct numerical control) system for computer group management of NC (numerical control) machines using an optical fiber circuit. Since various data are exchanged between the computer and the group of machines by way of optical fiber circuits, large volumes of data can be transmitted without interruption from electric noise. The system has already been introduced in its own company plant in Kawasaki, Kanagawa. As this trial use confirms that the system has an extremely wide range of application as a FMS (flexible manufacturing system) which automatically and efficiently produces small quantities of various articles, the company finally decided to merchandise the system.

The DNC system developed by Nippon Electric is characterized by the use of an optical fiber circuit data transmission system. The optical fiber lines are the same thickness as wires used for home electric appliances and can transmit a large volume of data. The circuit can be easily installed in a machine factory. Furthermore, the transmission circuit can completely block noise induced by powerlines and sparks, reducing the concern for erroneous operation. Processes to produce various articles in small quantities require a control of gross data, and the use of electric wires has conventionally limited the spread of large-capacity circuits in the premises of a factory.

The company has already introduced a DNC system with an optical fiber circuit to the Tamagawa shop in Kawasaki, Kanagawa.

This system is utilized to process metal plates used for carriers to be installed in telephone exchange stations. A group of eight machines, including a turret punch press for making a hole and a shearing machine for cutting, are controlled by one microcomputer. The monthly metal plate production is approximately 150,000 pieces, but this is truly an example of a production line which manufactures various articles in small quantities, producing nearly 10,000 different plates. The average production lot number for manufactured plates is 15 pieces at a time, but this system can even produce one manufactured plate almost without human hands on the command of the microcomputer. With this benefit, the previous 40 workers in charge of the production line before the introduction of the system have now been reduced to only 5 inspectors.

At one time, plates were processed in this factory by the playing of an NC tape for the NC machines, but this has become obsolete with the introduction of the DNC. The photoelectric converter used for optical transmission has been put to practical use in the form of a general model. If this converter is adopted for the conventional NC machines, it is so designed that the DNC system of an optical fiber circuit can be used immediately.

In addition, at this production site, a CAD (computer aided design) system has been introduced which is connected directly to a large ACOS 900 computer at the computer center of the Tamagawa shop. In this system, not only graphic data of over 300,000 types, but also production technology data such as process designs and management data such as production plans, are centralized and processed. Presently, a microcomputer and a large computer for DNC are used under an offline operation. However, in the future, they will be operated under an online system so as to establish a comprehensive production system.

For the time being, the company will stick to the policy of limiting the acceptance of orders for the DNC system without getting into the comprehensive production system which integrates the CAD system. Sooner or later, the system presented at this time will be promoted to an FMS system which efficiently produces small quantities of various goods, and will be sold, according to the strategy, as a resourceful large system which incorporates an industrial robot besides the CAD.

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SCIENCE AND TECHNOLOGY

DEVELOPMENT OF ELECTROMECHANIC INDUSTRY ANALYZED

Tokyo SHUKAN DIAMONDO in Japanese 11 Jul 81 pp 12-23

[Text] Promote Exports

Would it be overstating the case to say that mechatronics rescued the Japanese economy from the oil crisis? According to the statistics released recently on the national income, the real economic growth during FY-80 was 5 percent (3.8 percent by the new standard), which is a rather high rate of growth in view of the second oil crisis. The United States showed a -0.1 percent growth, the United Kingdom -3 percent, and West Germany 1.8 percent, which places the Western countries in a position of low growth, and Japan's growth rate is causing some consternation in some of the countries. The economy did not suffer any more than a slight recession.

The growth has been sustained by exports and investment in facilities by industry. The breakdown of this 5 percent growth rate shows that 3.8 percent is attributable to increased exports and 1 percent to increased investment in facilities. The prime moving force behind this increase in exports and investment in facilities has been the machine, in other words mechanics, and the electronics area where IC and LSI are continuing their rapid advances, to comprise the area of mechatronics, which has become a spectacular field.

First of all, let us look at exports. The FY-80 exports topped the previous year's level by 29 percent (dollar base), and what is eye catching here is the 36 percent (same base) in machinery equipment, which contributed 75 percent of the increase in the nation's total exports. It was the mechatronics product group which led this export of machine equipment.

As shown in Table 1, new mechatronics products, headed by the automobile which is becoming more and more electronified, NC fabrication machinery, industrial use robots, reproduction equipment, typewriters, cash registers, automatic data processing equipment, quartz watches, medical equipment, and air compressors, are showing great expansion as export goods.

What is increasingly becoming the center of attention is office automation equipment, which is a systematized combination of personal communication, word processors, facsimile, and reproduction equipment, and this is expected to be the large growth export product of the future.

ECR (electronic cash register) is a good example of a product which when compared to the machanical cash register of the past possesses far more performance and capability (such as business management capability, sales information collection capability), is seeing advances in miniaturization, cost cutting, and reduced power consumption, and has been reborn into an entirely new product. Mechatronics not only is responsible for producing office automation equipment, medical equipment, and robot type new equipment but is also behind the promotion of tool machines, other machines, cash registers, and shipbuilding type industries, which had come to the brink of decadence because of the catchup efforts of the developing nations.

This 5 percent rate of growth is from a macroeconomic viewpoint, now is a time of unprecendented boom for electrical and machine industries, which are now entering into a new stage of growth.

Positive Development With Restoration of the Oil Crisis

"The term 'push out exports' has been applied to Japanese exports in the past, but the present situation is one of 'suck in exports' on the part of the importing countries," said Yuichi Moriya, head of the Domestic Survey Department, Plans Agency.

Automobile exports to the United States were forced into a self-imposed restriction, and this was because Japanese cars outsold American-made cars to the extent that the American car makers were in trouble. To be sure, this sharp increase in the export of mechatronic products will often encounter such roadblocks.

Particularly since the oil shock, Japan's industry has been trying to get back on its feet, starting off with conservation of energy, rationalization, and conservation of power and branching out to rekindling of domestic demand by the development of new products and the results of this all-out effort are now being seen.

NC fabrication machinery and industrial robots were born out of the need for improved power conservation and productivity, while car electronics and microcomputer-attached air-conditioners were developed to affect fuel economy in line with the needs of the energy conservation age. The electronification of machinery has recently advanced into the areas of continuous casting facilities in steel mills, heavy electrical machinery, and shipbuilding, which are the areas of giant machinery.

Investment in facilities on the part of industry was expected to remain stagnant for a while directly after the oil crisis, based on established theory. On the other hand, this emergency of mechatronics has had a large impact on the will to invest in facilities on the part of industry, and investment in plant facilities which had temporarily become dormant directly after the first oil crisis began to experience a real push starting about 1978. The investment in plant facilities by industry in FY-79 showed an increase of 21 percent over the previous year, followed by a 25-percent increase in FY-80, and a 13-percent increase is expected for FY-81.

The big gainers in this field are construction machinery, communications equipment parts, electronic parts, automobile-related electrical material, precision machinery, office equipment, and ceramic type members of the mechatronics-related industries. "NC construction equipment has made spectacular improvements in performance with the emergence of IC and LSI. Not only has efficiency been improved, but highly precise finishing is now possible without the need for very experienced workers. There has been sudden broad use starting along about 1978." This was stated by Kojun Shimizu, head of the Planning Department of Ikegai Steel Works.

The volume of the related industries participating in facilities investment is exerting a very large effect on demand which is spreading over the entire economy. This recovery in facilities investment will entually result in increased demand, which will support the Japanese economy.

These investments in facilities and export increases which have supported the emergence of mechatronics may be said to have rescued the Japanese economy from the depths it had plunged into following the oil crisis. On the other hand, this is still not all as far as the actual situation is concerned.

Take Up 18 Industries of the Top With Best Industrial Growth

"Mechatronics is not a technological innovation which has developed in a planned manner based on the interpretation of new scientific principles. It is a so-called applied technology which has upgraded and made more complex technology already on hand. This is an area in which the Japanese are most adept. Products such as industrial-use robots, electronic cash registers, electronics proliferation in automobiles, microcomputer-attached machines, quartz watches, and self-operating cameras all first became practical in the United States or Europe. But it was Japan which was able to mass produce and use them as growth products.

Although mechatronics is not a planned technological innovation, it is true that it has made for more complexity and brought new values. The market expansion of mechatronics has only just started, and it is only from this point that this industry will become numerically larger. Roughly speaking, the present situation is expected to continue into the latter half of the 1980's be it in demand or in exports. For example, the robot industry is as yet very small numerically speaking. Even so it has no competitor worldwide, and it is a product of which much can be expected in the future," said Yutaka Matsushita, director of the Nomura Combined Laboratory.

As shown in Figure 1, the expansion of the steel industry production index between 1975 and 1980 averaged 1.43 times overall, so a ranking was made of the expansion in almost 100 industries, and this ranking showed the top 20 places to be occupied almost exclusively by mechatronics-related industries. Placing applied electronic equipment, with a 21.64-fold expansion, at the top, the next is watches at 5.4 times, followed by office machines at 4.06 times, fifth-ranked photosensitive material and 14th-ranked medical products are the only outsiders to break into this near monopoly.

The Japanese economy is presently entering a new growth stage due to mechatronics, through the so-called merging of mechanics and electronics, which has resulted in a growth and high level of the economy through the "mechatronics" revolution that is proving to be a powerful propellant for growth.

Prof Tsuneo Iida of Nagoya University in his book "Composition of an Active Japanese Society" states: "What will probably spearhead Japan's economy through the 1980's will be the combination of the machine industry and the IC industry in the form of emerging 'mechatronics'. The development of such a combination-type technological innovation is made to order for an area where the high level of education and experienced onside training are superior, as in Japan. The possibility that Japan will lead the world is concealed in this present situation" (abstract).

The development of mechatronics has not only promoted increased exports and private investment in facilities, it has enhanced the efficiency of the Japanese economy through improvements in productivity in industry, energy conservation measures, and the higher level structuring of industry and has speeded up Japan's release from the oil crisis.

One example is the contribution to price stabilization. The rate of increase in wholesale prices averaged 32 percent in the 5 years between 1975 and 1980, but during this period there was a decrease of 29 percent in the price of desk calculators, 26 percent in cash registers, 17 percent in electric ranges, and 13 percent in cameras, and mechatronics-related goods all showed a similar reduction in price (see Figure 2). If the price of permanent consumer goods and capital costs had gone up, the effect of the oil shock on prices would have been amplified, and this probably would have been followed by a serious aftereffect.

The same applies to the international balance of trade. The rapid improvement in the international balance of trade picture is due to this increase in exports, but the fact that imports have not increased as much despite the high price of crude oil is also a large factor. In fact, the trend during the past few years has been for imports to run below the preceding year's total. What lies behind this situation is the establishment of an economic growth not tied in with the use of energy.

At the time of the first oil crisis in 1973, oil consumption per 100 million yen GNP was 346 kiloliters, this decreased to about two-thirds, to 224 kiloliters, in 1980. While the roles of energy conservation (there is a contribution of mechatronics here) and substitute energy policies have major roles here, this result basically is the change from steel, cement, and chemical type high oil-consuming industries to machine equipment production industry in which the concentration of technology and the introduction of higher levels in the production structure are promoted.

The fact that mechatronics is lowering costs and improving the international balance of trade is an aspect that should not be forgotten.

The 1980's Also Will Be Japan's Age

West Germany traditionally has been known as the ruling country in the field of machines, but at present, it lacks the power to compete on equal terms with Japan and is inviting collapse in its overall economy.

As shown in Figure 3, the portion of the export structure occupied by machine equipment in West Germany is only 40 percent, compared to Japan's 60 percent, and this figure has recently been slipping. This lack of growth is tied in with the high value of the mark, but what must not be overlooked here is that this country has fallen behind in the trend to mechatronics which is worldwide.

"There is the difference that Japan's machines are general use machines through mass production, while the German products are special use and massive machines produced by the accumulated and traditional mechanical technology. Their meister system is making difficult any introduction of electronics"--this statement is attributed to Yoshitomi Ishimaru of Tomen Sanyo. Hiroshi Takeuchi, head of the Research Department, Nagasaki Bank said: "Germany has relegated its dirty work to foreigners. Japan is considering the use of robots for such work, and that has brought forth the rapid development in mechatronics today."

The most important aspect is that Japan's government and industry have zeroed in on electronics, including computers and semiconductors, as the item for the future and are making all-out efforts to provide training and forward moving investments, and this has led to the position of mechatronics today. In West Germany, this goal is occupied by the nuclear power industry and aircraft industry. Its electronics industry has fallen behind in growth, and it is presently buying computers and IC from the United States and Japan.

In another direction, the United States is the home ground of electronics, and it is ahead in the areas of large computers and military industries. Its weapon is the model mechatronics, but the present picture is that the transfer of this technology to private use equipment and setting it on a commercial basis cannot be readily realized.

"Comparing the situation to mountain climbing, mechatronics is just at the stage that it has come up to the third seam. The products from here on will be large machines which will be used in all kinds of plants, and Japan's market will probably grow both internally and externally," according to Matsushita of Nomura Laboratory.

During the course of the next 5-6 years, mechatronics will bring Japan's industrial structure and export structure to even higher levels, the technological concentration and high add-on value to an unprecedented rapid tempo, and will lead to economic growth. Japan, which relies on foreign sources for crude oil and most other resources must rely on exports as its lifeline. Mechatronics produces products with various capabilities, and the past trade frictions arising from patterns centered on a single item will decrease. The 1980's will see the "mechatronics revolution," and it may be possible to say once more that it is Japan's day.

How Will Mechatronics Alter Industry? Power to Promote "Japanese Products as Number 1"

The central actor in this shift to mechatronics is electronics, and this is where serve (control) technology is a vital adjunct. Just how far has mechatronics advanced at the present time and what does the future hold?

The Shadowy Area of Mechatronics

There is not only light but some shadowy areas regarding mechatronics which will have to be overcome in the future. The following are some of the major problems.

First, functions which were previously performed by man are now being performed by electronics, and there is naturally a shouldering effect appearing. It is presently a broad process, and the problems are still few, but there is the possibility that a limit will be faced sooner or later. How will we face such a situation?

Secondly, there is the possibility that the self-reexpansion and development of technology will occur, and how do we handle this? As a result of replacing functions performed by man by functions performed by electronics, there will be no highly skilled men, and a high level of mechatronics introduction may become untenable. Once mechatronics takes over and skilled men are no longer around, there is the danger that the technique may stop right there.

Third, there is the question of the establishment of a reasonable production price. It is not the micon attached to machinery that is the main factor, but the software that is put in it that accounts for its true value. There is as yet no rule for reasonably evaluating the cost. Too high a price will result in sales resistance, and too low a price will muddle the economics. It is difficult to draw the deciding line.

Related to this is the situation that software is an intelligent judge of good or bad, and just as there are changes in models, newer models appear one after another to replace former models and cut down on the life cycles, giving rise to business instability, even though this may be hazardous to the business.

Fourth, there is the relationship of the machine maker to the electronics maker. As mechatronics develops more and more, there is a corresponding decline in mechanics, and the add-on value of machine makers who had been ordering their electronic parts elsewhere declines with the chance that they will become simply assembly houses.

Fifth there is a technological problem in that future development will leave behind many areas that have room for technological development encompassing peripheral technology such as sensors and new materials. At just what tempo can such developments advance?

To be sure, every maker has had his own resolve to meet these problems in his own way.

Intelligent Robots; Rising Figures in the Unmanned Plant Trend; Their Costs Can Be Recovered in a Year

The industrial robot is already attracting worldwide attention as the framework of Japan's mechatronics.

The number of Japanese makers, the production figures, and the number of units in operation are far greater than in the countries of the Western world.

Only the high-performance units with a capability beyond the playback type used for welding in Japan are called robots in the Western countries. In Japan the so-called fixed-sequence type low-performance robots account for 70-80 percent of the total number in operation, so that comparisons on the same level are not possible, but there is no question that Japan's robot industry has seen sudden growth as one of the tools of mechatronics.

At present, the production of high-performance robots is at a fever pitch and growing. It is estimated that these high-performance units will account for close to half the total production in 3-4 years.

Behind this sharp rise are the increased demands for conservation of power, conservation of energy, and lower cost from the industrial world.

For example, according to material furnished by the Japan Industrial Use Robot Industry Association, the value of the cost of a single robot divided by the labor cost of a single worker decreased from 10.5 times to 3.4 times between 1971 and 1979 as the result of rising labor costs.

If we use this calculation for a single robot-to-worker relationship and project its application to an all-night unmanned operation, then the cost of a robot will be retired after a year.

There is also the added effect that monotonous work and work in a messy environment can be performed in an automated manner, and product quality can be made consistent and even improved.

For example, the monotonous portion of material handling accounts for an average of 30-40 percent of the finishing cost, 80-95 percent of the worktime, and 85 percent of the industrial accidents, and the effect of robot use in such an area can be great.

A company such as the Nissan Automobile Company already has about 500 robots in operation and is already performing 100 percent of its welding operations by this means. It is now focusing attention on the use of robots for painting, and this is in keeping with what the other makers are doing.

The use of robots is also increasing among the electrical makers, and it is reaching high levels. Matsushita Electric Industry has introduced machines to insert parts on to a printed board to produce television sets at an 80-percent automated rate.

The various industries are eyeing the use of high-performance industrial robots for use in all-night unmanned plants.

The Fujitsu Fanac attempt is well known, but it is not only these top ranking companies but the medium ranking companies which should also see some expansion in the use of robots.

The influential tool steel maker Yamazaki Steel Company, with its main base in Aichi Prefecture, has put up close to 3 billion yen with production expected to start up this fall on a completely automated plant where everything--supply, working, and transport of products--will be automated. Where a plant required 250 workers in the past, the first shift will need 8 men, the second shift 5 men, and the midnight to 8 am shift will be entirely unmanned in this system.

Department head Michiharu Tanimoto of the Robot Business Department of Kawasaki Heavy Industries points out: "There are as yet only a few industries that are operating in the black using robots. A high-performance robot suitable for large variety small lot production requires the development of sensors to give it sight, feel and auditory power." Yet despite these problems, the demand has been increasing at the rate of 50 percent over the previous year during the past few years. It is expected that production will increase to 500 billion yen by 1985 (78.4 billion yen in 1980).

The subsidiary in Japan of the American Texas Instruments Company, which is the world's largest semiconductor maker, at the start of this year became a formal member of the Japan Industrial Use Robot Maker Industry Association. This is the first foreign company to enter this association, and it is said that its aim is to collect information from Japan's robot makers.

NC (numerical control) construction machines made their appearance in 1954, and Japan is still the "world's supply base" for these machines. "The Japan-American relationship in NC construction closely resembles that of the automobile. In 2 or 3 years the United States will come out with a "J car punching NC machine" is a prediction by a certain member of the industrial world.

Crossing Point From Starting to Post-NC Fabrication Machines

One of the reasons export of NC fabrication machines is expanding is that the leading country, the United States, has been completely engrossed in large machines, while Japan has specialized in junior machines. In other words, this should be regarded as a marketing victory.

If we liken the technological level of NC construction machines (ordinate) and its market (abscissa) to Mt Fuji, then "the United States accounts for the first three sections while Japan takes over between the third and seventh section" (Hitachi Seiki).

The reason Japan leads in the area of junior machines is largely due to the CNC (computer numerical control) device developed by Fujitsu Fanac. "The reason Japan has such a strong competitive strength is the Fujitsu Fanac CNC" is one view.

The story of CNC will be left to the interview with President Inaba of Fujitsu Fanac, but there is also the element of the demand of the times behind this NC construction equipment boom.

There is a shortage of mechanics. "Mechanics were once stars of blue-collar workers, but no one wants to be one any more." (related party).

In the midst of shouts for a reduction of business has been the need for conservation of power and energy, and this is also thought to have accelerated the boom.

While it may be partly grasping at straws, "the situation now is not that only Fujitsu Fanac has the high-level technology to produce CNC devices; it is the comparatively high cost," said a related party recently.

CNC devices are not the sole domain of Fujitsu Fanac: Yasukawa Electric and Mitsubishi Electric are entries in this field.

The ultimate target of NC construction machines is an unmanned plant. This is a common awareness shared by Fujitsu Fanac and the other construction machine makers.

In the meantime, it is necessary to clarify problems associated with automation assembly of a single product production and automation of automation production process.

Even at the Fujitsu plant of the leader Fujitsu Fanac, automation of assembly is still at the beginning stage.

"Looking at the present orders situation, we can confidently expect good export of NC construction machines for the next 2-3 years. From then on it may be a question of whether the construction machine maker will become a production process planner, which will decide the outcome (related party), and Japan's makers have started in the direction of post-NC construction machines" (same party).

Docking of Power Work and Brain; Komatsu Which Leads Caterpillar

There is the image of power work in the construction industry, and electronics may be considered a world completely apart, but there are also construction machines which carry micons.

Komatsu Limited displayed 12 models of its machines at "Conexpo '81" (held 25-30 January), among which its bulldozer, dump truck, and power shovels were equipped with micons.

"We are the first in the world to put micons in construction machinery" (Electronic Equipment Center of Komatsu).

It was about 15 years ago when Komatsu started to introduce electronics. When the first microprocessor 'Intel 8080' was marketed, this company immediately jumped into the picture. "At that time, a single chip cost 150,000 yen" (same source).

Simplicity of operation and energy conservation are the selling points of micon-equipped construction machinery. Where a bulldozer is concerned, the operator must move a lot of dirt rapidly. The "volume of earth moved" and "number of lever operations" are the yardsticks for determining operator qualifications.

A micon-equipped bulldozer can move 10 percent more earth than an ordinary operator, and the number of operations is reduced to one-tenth. Just this reduction in the number of operations is tied in with energy conservation.

The bulldozer can slip on earth. When it slips, the operator will increase the speed in order to increase the volume moved, but it cannot be done. A micon is used to catch the load on the blade (earth mover) and control the dozer at the optimum speed.

The wear-resistant specifications for IC used on construction equipment include temperature of -30 to -80°C, vibration impact level of 100 G, and humidity of 100 percent. The vibration impact value for IC used on automobiles is about 10 G.

Komatsu's rival, Caterpillar Tractor, began to strengthen its electronic capabilities about 2 years ago.

"Komatsu is leading Caterpillar where the change to mechatronics is concerned," is not very explanatory, but to say that "there is a vast difference between 15 years' and 2 years' experience" has more meaning.

Not only a large company such as Komatsu, with annual business of 504.9 billion yen, but even a small company such as Sanwa Kizai, with annual business of 6 billion yen, is developing mechatronics construction machinery.

Micon Horizonger is one such product. As the trade name implies, this is an excavating machine which cuts through earth in a horizontal direction, and this is an indispensible item for sewer construction.

The basic concept of this product development is that many sewer construction workers are of advanced age, and automation is necessary both from the standpoint of safety and conservation of energy, according to the general talk.

Where small-bore pipe is involved, the sewer line is placed in a horizontal position underground, and the water flows by natural slope by so-called blind reckoning such that previously it was possible only to dig no more than 50 meters at a given stretch.

This is why for every kilometer of line, it was necessary to dig vertical holes at 21 sites. It requires three or four times the labor to dig vertical holes that it does to dig horizontally.

When a Micon Horizonger is used, a combination of a laser beam, receiver, and micon are employed, and a horizontal excavation of 100 meters is possible, while the point of advance can be established from aboveground, thereby eliminating any right-left or up-down deviation.

Digging operations in the past required one operator, one observer, and 3 workers, but the introduction of the Micon Horizonger "eliminates 1.5-2 men" (Technology Development Department of the company).

It should be evident that Japan is leading the world in the matter of introduction of mechatronics to construction machinery.

To Computer Control of Engines

The wave of mechatronics is also beating against the shipbuilding industry. The Kinkazan Maru, which was built in 1961 for ferry service, is one such example.

Since that time the automation of ships has been expanded and the MO (Marshinari zero) makes possible elimination of night engine room watch: the Japan Magnolia (mineral oil and general use ship, 94,465-ton weight) was built in 1969, the Seiko Maru (tanker, 138,370-ton weight) was built in 1970, and the Samposan Maru (tanker, 227,756-ton weight) was built in 1971.

Automation was introduced in the engine room and the cargo oil loading, where computer controls were used.

As a result, a 10,000-ton cargo vessel which formerly needed a crew of some 60 men can use as few as 20 men.

The ability to cut a large fraction of the manpower costs, which account for a large slice of the roughly 300 million yen required to operate a ship per year, is a great plus for the introduction of automation.

At present, Nippon Yusen, Mitsubishi Heavy Industries, Osaka Shosen, Mitsui Senpaku, Mitsubishi Heavy Industries, and Mitsui Shipbuilding and Engineering are laying concrete plans for 18 men crew container vessels and container-liver [phonetic] ships.

Joint research by the Ministry of Transportation and the shipbuilding industry is targeting 11-12 men crew container bulk carriers and tankers as its technological goal.

There is also pursuit of superautomation in which the crew will be reduced to less than 10 and the international maritime satellite will be utilized to conduct unmanned navigation through remote control devices.

In 1981 a start was made on technological development of computer control of the engine to improve fuel consumption.

Mechatronics is a powerful weapon to guard Japan's position as ruling shipping country against the catchup efforts of late-developing countries such as Holland and Italy.

The introduction of mechatronics to automobiles started with the use of thermistors as temperature gauges to monitor cooling water for the internal combustion engine. This was followed by its introduction to the regulator (voltage adjuster) and igniter (ignition device) type parts around the engine.

A micon placed on a vehicle to serve as an electronic control fuel injection device made its appearance in 1979, in this a fuel injection valve replaces the carburetor and the flow of fuel is controlled by an electronic circuit to improve combustion efficiency and reduce the CO content in the exhaust gas.

Exhaust gas control and improvement of fuel consumption efficiency may seem to be opposing each other, but the introduction of electronics has made possible an 8-percent increase in fuel consumption compared to what was experienced in the past.

It is said that several years ago there were 25-70 IC units used on an automobile, but the advent of the micon-equipped car has resulted in the use of several hundred IC and transistors per automobile.

"The cost of the electronics in a high-class car is about 2-3 percent of the total value of the car. In the future the cost of the electronics on a passenger car will probably be 10 percent of the total cost. This is what is quoted, but I believe that this will be closer to 7-8 percent," said Vice President Hiroshi Takahashi of Nissan.

"The value of electrical equipment including semiconductors is presently about 5 percent, and this is sure to triple to about 15 percent in the future," said Director Masao Murayama of Nippon Denso.

Among the car electronics recently installed, digital displays and sound alarm device-type accessory units stand out, but it will become technologically possible along about 1980 [sic] to install microprocessors (CPU) as central information processing devices for an automobile, it was indicated.

Development of car electronics is being conducted in joint development by combinations such as Toyota Motor-Nippon Denso-Toshiba, Nissan Automobile-Hitachi-Nippon Electric, and Mitsubishi Automobile-Mitsubishi Electric-Nippon Electric.

Nippon Denso, which is a member of the Toyota group, has its own IC plant and has produced 3 million IC units per month for test research, Nissan is also reinforcing its self-development image.

"The automobile makers should have the semiconductor makers take over the introduction of electronics into automobiles and should also possess the software technology for the system" seems to be the joint outlook on the part of both parties.

LSI Pursues Mechatronics Parts Computer Incorporating Camera (?)

The electronification of cameras is generally seen in automatic exposure EE cameras, and a totally automated camera which has a CPU installed is a representative example of mechatronics.

The electronic circuit is placed in modular form within a single flexible base plate where computation and display of exposure, record of exposure, shutter speed, and even adjustment of lens opening are determined.

The use of an active element such as a transistor to control exposure was initiated in 1963 by the Polaroid automatic 100 camera which appeared on the market that year. This marked the appearance of the electronic shutter operated through an electronic circuit and magnet.

Since then the electronification of exposure control can be divided into three periods, according to improvements based on IC and LSI.

First of all, the period between 1963 and 1970 was the comparator age. This was used in the Yashica Electro 35; the comparator refers to a voltage comparator by which ON or OFF is determined according to the high and low input voltage.

The period from 1970 to 1974 was the time for the analog data treatment system using a monolithic IC. The Asahi Pentax ES (1971) and Nikomat EL (1972) are representative units.

The camera using a logic IC circuit to handle digital data made its appearance in the period after 1974. The Fujica ST 901 is such a camera.

The area of electronic adjustment of exposure has developed technology for application in photography sequence (order), electronic control, and automatic focusing.

Electronic control of a photography sequence is designed, for example, to control a series of operations from the time the shutter button is depressed until the end of the picture taking, or from the time the film is wound up until preparations for the next picture are completed. The Polaroid SX-70 (1972) and Canon AE-1 (1976) are representative of this technology.

The Konica 35A F (1977) was the first camera to appear on the market with an automatic focusing device using the Visitronics module made by the Honeywell Company of the United States. This was followed by the ultrasonic type Polaroid SX-70 Sonar Autofocus (1978) and the infrared type as represented by the Canon A F 35M (1979).

Electronic control of motor drives and strobe lights has also been introduced.

With all the different functions coming under electronic control, the camera has become an instrument which is much more simple to use.

New functions with electronic control have appeared one after the other, but the price has been held down despite all these developments. It also should not be overlooked that all these improvements have been incorporated without increasing the size and weight of the camera. Arbitrarily setting a value of 100 for 1975, the retail price index for 1965 was 65.5 and for 1980 was 96.2.

"When a camera is electronically controlled, there is a trend to miniaturize the electronics to assure space for the circuits and the power supply batteries. This fraction has made possible improvements in the mechanical parts, and miniaturization has been aided" (Nippon Kogaku).

Mechatronics technology stands behind Japan's position as the top in the world with respect to camera quality and quantity.

Number of Parts Down by 50 Percent or More

In contrast to the camera in which electronic control introduced new capabilities in an "add-on type electronification," an electronic watch is a case in which the mechanical parts of clocks have been completely replaced by electronic circuits in a so-called "substitution type electronification."

The crystal wristwatch generally called a quartz watch includes the digital type watch which has no gears or springs. The only parts are the battery, the crystal vibrating element, and the MOS·LSI.

The MOS·LSI contains a frequency divider circuit which converts the pulse signals of vibration current emitted by the crystal oscillator and divides the signal into seconds, minutes, hours, days, and months as well as a display command circuit.

Japan and Switzerland first displayed test-produced quartz watches at the 1967 Geneva Observatory Concours, and 2 years later Seiko came out with the world's first quartz watch on the market with an analog (needle type) display.

Crystal oscillators, LSI, and liquid crystals are all suitable for mass production, as a result of which the assembly processes of a labor-intensive nature previously characteristic of this precision instrument business no longer exist.

Where the number of parts is concerned, in an analog watch the number of parts decreases to 70 percent and in digital watches down to 40 percent, and the relative importance of the assembly process has also decreased.

At the Tamu plant of Citizens Watch, the conservation of power and automation have advanced to the stage that the day when a fully automated assembly line will be realized may not be very far off.

One of the problems facing the quartz watch is how to come up with a watch which can match the mechanical watch in size.

The single greatest item which limits size is the battery. Initially, a large current was required, which naturally required a large battery, but this size has now decreased to the stage that 1 cm diameter batteries are now being used.

As a result of the development of low power consumption C-MOS·IC and the development of high-efficiency pulse motors, quartz watches of 0.09 millimeter thickness are presently being marketed.

Mechatronics Will Determine Destiny of Household Electrical Equipment

The introduction of mechatronics is also taking place in the area of household electrical equipment. In the case of the washing machine, the mechanical timer used in the past was associated with many malfunctions, and the electronic-controlled or micon-controlled electronic washing machine has made its appearance.

Sequence (order of operating steps) control, automatic adjustment of imbalance at the time of the draining operation, and automatic control of waste water disposal are functions which are controlled in line with the volume and dirtiness of the wash load.

The electric range is an example in which the capabilities of the micon can be understood by anyone. Since micon remembers the 40 or so preparation patterns of menus which are used in daily fare, the cooking preparations can be initiated simply by pressing a button, as a result of which the micon stops the cooking by exercising temperature and humidity control and completely shuts off the heat when the cooking is completed.

An air conditioner is turned off when the entire room is adequately cooled, and the unit is restarted when the room temperature rises by 1 degree. This alone accounts for a roughly 10-percent saving in power cost. Meanwhile, a humidity count circuit operates to guard against a rise in temperature and cuts off the room fan when the thermostat is OFF and effects even more energy saving.

A micon jar beverage container "first applies a weak flame" followed by "popping" heat and then a temperature-maintaining effect by which a beverage is held at the proper drinking temperature.

"The pursuit of ease of use, miniaturization, and lower power consumption in household electrical appliances is similar to attempting to preserve their destiny. Mechatronics is a natural component in this direction" (Matsushita Industry and others) seems to be the consensus of the industry.

The merit of IC lies in the reduction in the power consumed and in the number of parts. Take the example of a color television set. According to Matsushita's explanation, the 20-inch color television T H 8800 D which was marketed in 1971 and which was provided with one or two units of special-use LSI consumed 150 watts/hour and consisted of 750 parts.

In contrast, the 20-inch T H 20-A2 (about five LSI units) color television set marketed in 1976 consumed 88 watts/hour and reduced the number of parts to about 500.

The 1981 color television set T H 20-B21 (five-seven LSI units) consumes 99 watts/hour and has increased the number of parts to 650, but this is because a new capability of sound and voice are incorporated.

It was the American Motorola Company which first announced to the world the use of IC in color television sets (1966), but Hitachi was the first to put the first model with IC on the market (1969). By the following year, all of Japan's household electric appliance makers had turned to the use of IC.

Whether it was the introduction of IC to color television or VTR, the basic development took place in other countries, but it was the Japanese makers which succeeded in commercializing the development.

The Fuji plant of Fujitsu Fanac has been called the plant where "robots make robots"; it is a place where a representative NC machine for tool machines used in Japan can be seen. It is already "Japan's NC tool machine showplace." In addition, there are many who sense the presence of feet in the movements of the transporting robot.

It is said that there are 300-400 visitors per week at this plant, which indicates the interest shown.

The foreign visitors who come by special bus all take a souvenir photograph of the plant, with the imposing outline of Mt Fuji looming in the background.

While there may also be a presentation by Fujitsu Fanac entitled "NC machine showplace" there is a feeling that this plant, which has collected the various aspects of mechatronics technology, displays the status of Japan's present economy.

Install Video on Robots; Top Strategy of Fujitsu Fanac for the 1980's--Interview with President Kiyozaemon Inaba of Fujitsu Fanac

> Fujitsu Fanac is the world's largest CNC device maker. This company played the role of igniting the mechatronics boom. It is presently directing its major effort to the development of an intelligent robot. This company, which is dubbed "little giant" by the rest of the industry, is headed by the man who founded the company, and he spoke enthusiastically of the past, present, and future.

Female Deity of Fate

More than 20 years ago, in 1956, a group of several technologists in electricity and machines began research and development on control systems in a small laboratory on the grounds of Fujitsu. The term control covers a broad field, and the situation then was that one could try anything. I had been delegated to be in charge of this development, and I tried to conceive a system based on a mechanical technology which exploited my specialty.

This operation was extremely successful, but 3 years previously the Massachusetts Institute of Technology (MIT) in the United States had developed a new control system for construction machines at the request of the air force, and this system was called a numerical control (NC) system by MIT.

The famous "MIT report" which covers this development is still interesting reading both from the classical standpoint as well as for the magnificent text.

About the same time, Prof Yasuto Takahashi of the University of Tokyo, who at that time was teaching at the University of California (Berkeley), introduced this report to a small control engineering meeting.

Upon hearing this report, we thought this would be the most suitable system for us, and we immediately took up research and development.

It may be said that this was the time when an element of Fujitsu entered the mechatronics area. The bonding of electronics and mechanics, including motors and fabrication machinery, and the struggle to bring this technology to fruition had begun.

The Ministry of International Trade and Industry was very interested in this research and development and granted this program financial aid a number of times over a 10-year span. There was a time when despite the very promising future of this technology, the market was not yet ready for it, and the subsidy funds from this ministry were extremely valuable to the industry. Such funds turned out to be the trigger which set off new product development.

During this period, it may be said that we had no reason for existing as an industry. But as the 1965 decade was approaching, there was a sudden expansion in the NC market. It seems as though the deity of fate had smiled on us. To this day, I believe that deity sympathized with our unbending philosophy in the midst of a world of negativeness.

We took this technology and jumped into the market. In 1972 we branched off and became known independently as Fujitsu Fanac. Since then we have been able to grab a good share of the CNC market. At present we account for about half of the world market and about 75 percent of the Japanese market.

From Automation to Unmanned Operation

During the 1965 decade, the Ministry of International Trade and Industry came forth with the Kidenho (machines and electricity law) ordinance and adopted a policy of encouragement toward machines and electronics. We set our sights on development of even higher degree control systems and laid plans by which an entire plant would be placed in the hands of a large computer, to which all the fabrication machinery would be bound and thereby enable automated operation of the entire plant. This was the entirely new group control system concept which we took up.

This system was completed in 3 years, and we believe that this system has been very instrumental in the automation of the Japanese machine industry at the present time.

As the 1975 decade was entered, the Ministry of International Trade and Industry came forth with a new ordinance entitled Kijoho (machine information law) which encouraged automation by the integration of machines and electronics on a much greater scale and also the development of completely unmanned systems. The large project based on this concept is presently centered at the Tsukuba Machine Technology Research Laboratory in which 16 companies are participating, and the target of these efforts is the unmanned operation of a plant called the Laser Application Multiple Production System. I believe that there is no other such system in operation elsewhere in the world.

Among the units which make up the unmanned system, the unit which is now coming under the greatest scrutiny is the robot.

In order to make practical this new concept, Fujitsu Fanac constructed a very modern machine plant among the rice paddies around Lake Yamanaka. There are only 100 workers including the plant manager. The machine fabrication plant is completely unmanned. It is thought that simple machine parts and assembly of machine units will be possible through the use of intelligent robots by the end of the 1980's.

Robots with Sensors

Previously, complete assembly performed by a robot was achieved before September of this year at this company's Servo Motor Plant in Hino. Unfortunately, this robot cannot be classed as an intelligent robot. Since it is not equipped with sensors, it is incapable of judgment discriminations despite the high capabilities the microprocessors have. It may be thought of as a blind robot with a good mind.

This is why the next robots must be provided with senses associated with the eye an hand. Should a robot equipped with such senses be developed, the automated assembly of complex machine units will be possible.

The development of sensors is treated as an industrial secret by each company. On the other hand, there is the accumulation of high technology in a variety of areas in Japan, and there is no need to start from zero. What we have set our sights on is something which has already been partially completed. The answer is found in the item which is enjoying the greatest expansion in the area of home electrical appliances and is the greatest menace to camera mechanization. In other words, it is video.

We will miniaturize video and then couple it with our microprocessor. This will serve as the eyes of the robot. This explanation alone should make it possible for one to realize what mechatronics of the future will be like.

The development of new technology is not conducted only at the one Fanac site. We have obtained the cooperation of a number of friendly companies. The development of sensors is being promoted jointly by the Fujitsu Laboratory and the Semiconductor Industry Department of Hitachi Limited. We want to use the highest technology that can be found in Japan and in the world.

What will be the future of NC? We incorporated into NC as quickly as possible the bubble memory that was developed for communications use in electronic exchanges, and we were able to greatly improve the reliability of the NC.

The next generation NC naturally will use bubble memory, but the use of optical fibers also comes to mind. Here again, the first ones used will probably be in the communications area.

When I inquired about optical fibers from Director Ishigaki of the Agency for Industrial Science and Technology, I learned that optical fibers can even transmit energy, and this was a tremendous shock to me. Till then I had thought that optical fibers could be used only in data communications. If energy can be transmitted as well, then the level of power required in NC fabrication machines should be transmittable. We are resolved to put every effort into the application and introduction of optical fibers.

Dividing Line Between Victory and Defeat

It is thought that some 10 years are required before a single product can be marketed seen from an idealized viewpoint. A product made ready in short order has shallow roots and will readily be subject to improvements by other companies. On the other hand, too much time in development will delay its appearance on the market. Here is where the problem lies: just how much absolute research time should be allowed? This is a major problem.

The ideas that man comes up with will always have something resembling some other idea. This is why success or failure is determined by just how fast the product can be marketed or whether this product has a basic nature which other companies cannot readily match.

To this end, the first step is to settle on a price which will be difficult for any of the world's other makers to meet. Next, the unit cost of production must be established. This is followed by a sales price which allows an absolute profit. Product development is assigned the condition of a 5-year minimum life.

Product development is conducted along the lines of a singular policy. The slogan for this basic policy is summarized in "Weiniger Teil" which is written in a strange German dialect. This can be summarized as meaning: "make a design involving the minimum of parts." This means the development of products with maximum performance using a minimum number of parts.

The production system at the plant is also another important aspect in the practical application of the developmental results. I believe that the most effective system is one which is a combination of NC fabrication machines, robots, and computers of a versatile nature--in other words the FMS (flexible manufacturing system).

We hope to come up with an ideal FMS by the end of the 1980's. This is why we need to push development of the intelligent robot which is the nucleus of this project.

There are about 200 robot makers in Japan alone, and they are probably in the fray gritting their teeth; and it is not yet the time to criticize any one company's share. I would like to know what Fujitsu Fanac's share will be 2-3 years in the future.

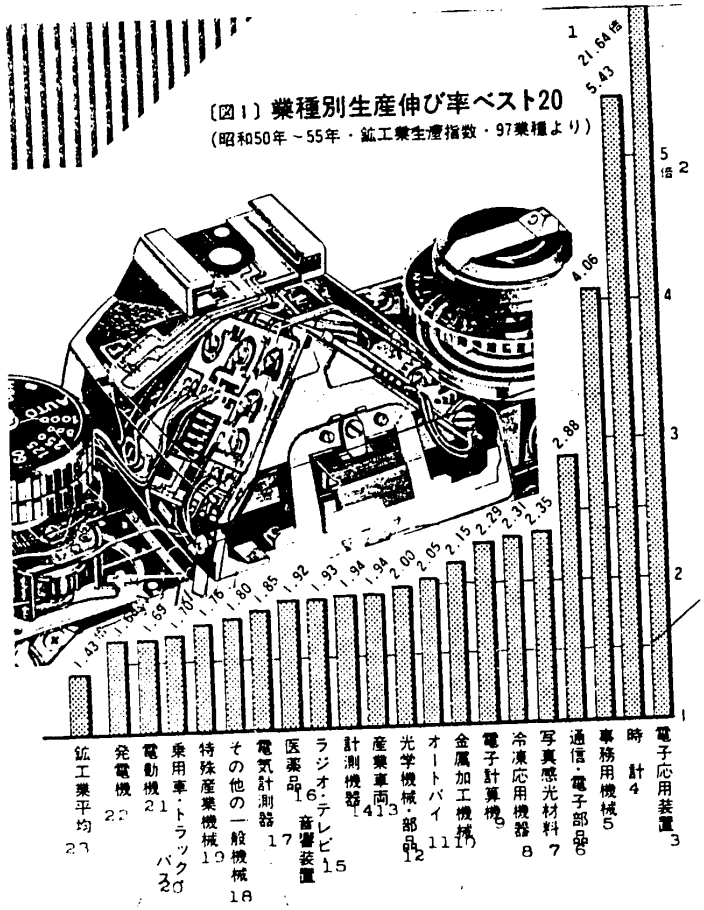
The variety and areas of application of robots are very wide. Every maker should succeed as long as it does not err in selection. One can fail if he embarks into an area requiring vast investment. I believe the key lies in putting all effort into a simple and specialized area. This selective capability is one which a robot maker president should have.

Table 1. Rankings of Principal Machine Exports (1980)

		輸出金額 1 億円	前年比 2伸び率 %
3	乗用車・トラック	58,780	62
4	通信機器	18,419	28
5	船舶	10,765	28
6	VTRなど	9,142	52
7	光学機器・カメラ	8,371	22
8	重電機器	7,086	29
9	原動機	5,736	26
10	事務用機械	4,355	35
11	金属加工機械	3,950	17
12	時計	3,905	40
13	家庭用電気機器	2,993	46
14	建設・鉱山機械	2,976	34
15	荷役機械	2,965	42
16	農業機械	2,080	9
17	繊維機械	1,653	24
18	鉄道車両	1,545	36
19	医療機器	1,125	36
20	計測機器	1,078	12
21	ミシン	1,055	18
22	印刷機械	418	68
23	包装機械	134	58
24	機械合計	162,189	35
25	(輸出総額)	293,825	30

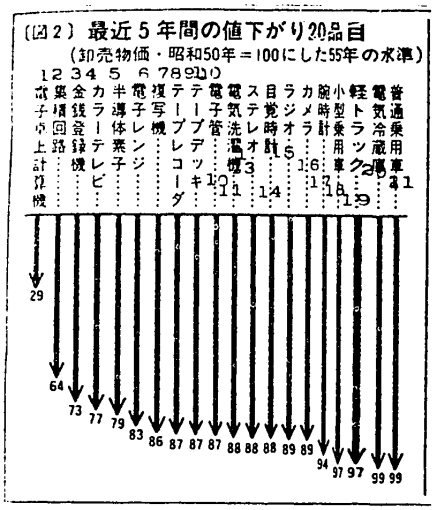
Key:
1. Export value, 100 million yen
2. Ratio vs previous year, %
3. Passenger cars, trucks
4. Communication equipment
5. Shipping
6. VTR, etc
7. Optical equipment, cameras
8. Heavy electric equipment
9. Prime movers
10. Business equipment
11. Metal forking machines
12. Watches
13. Household electric units
14. Construction, mining equipment
15. Loading equipment
16. Agricultural equipment
17. Fibermaking machines
18. Railroad vehicles
19. Medical equipment
20. Measuring equipment
21. Machines
22. Printing machines
23. Packaging machines
24. Total machines
25. (Total export value)

Figure 1. Best 20 Expansion Rates According to Different Industries (1975-1980, Mining and Manufacturing Production Index of 97 Industries)



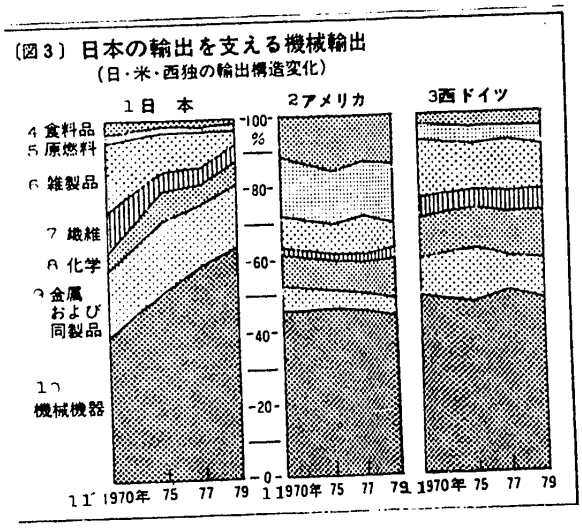
Key:
1. 21.64 times
2. Five-fold (or 500 %)
3. Applied electronic devices
4. Watches
5. Office equipment
6. Communication, electronic parts
7. Photosensitive material
8. Cryostatic equipment
9. Electronic computers
10. Metal fabrication machines
11. Motorcycles
12. Optical equipment, parts
13. Production vehicles
14. Measurement instruments
15. Radio, TV, audio equipment
16. Medical equipment
17. Electric measurement units
18. Other general use machines
19. Special production machines
20. Passenger cars, trucks, bus
21. Electric motors
22. Generators
23. Average mining and manufacturing

Figure 2. 20 Products Which Were Lower in Price in Last 5 years.
(Wholesale Price, 1975 Price = 100 of 1980 Level)



Key:
1. Electronic desk calculators
2. Integrated circuits
3. Money counters
4. Color TV sets
5. Semiconductor elements
6. Electronic ranges
7. Reproduction equipment
8. Tape recorders
9. Tape decks
10. Electron tubes
11. Electric washing machines
12. Stereos
14. Memory watches
15. Radios
16. Cameras
17. Wrist watches
18. Small passenger cars
19. Light trucks
20. Electric refrigerators
21. Ordinary passenger cars

Figure 3. Machine Exports Which Sustain Japan's Exports
(Changes in Export Structures of Japan, United States, West Germany)



Key to Figure 3

1. Japan
2. United States
3. West Germany
4. Food products
5. Primary fuel
6. Various manufactured products
7. Fibers
8. Chemistry
9. Metals and metal products
10. Machine equipment
11. 1970

Table 2.

Rankings of Semiconductor Manufacturing Device Markets.

Source: Fuji Keizai "Survey of Semiconductor Manufacturing Equipment"

1 商品名	56年2販売見込(億円)	対前年比3(%)	4主要参入企業
LSIテスト装置 5	392	42.5	タケダ理研工業、安藤電気、東京エレクトロン、ミナトエレクトロニクス 6
マスクアライナー 7	287	105.0	キヤノン、兼松セミコンダクター、東京エレクトロン、国際電気 8
超純水製造装置 9	145	31.8	栗田工業、オルガノ、野村マイクロサイエンス、日本錬水 10
縮小露光装置 11	115	94.6	住商電子システム、日立製作所、日本光学、伊藤忠商事 12
全自動ウェーハプローバー 13	90	38.5	東京エレクトロン、東京精密 14
イオン注入装置 15 (ドーピング装置)	75	19.0	東京エレクトロン、日本真空技術、国際電気、コロンビヤ貿易 16
エピタキシャル成長装置 17	70	50.4	国際電気、AMTジャパン、兼松セミコン、テンプレスジャパン、キヤノン 18
クリーンルーム 19	69	32.7	高砂熱学工業、日立プラント建設、三機工業、日本エアーテック 20
ドライエッチング装置 21	44	84.8	東京応化工業、日電アネルバ、日本真空技術、東京エレクトロン 22
金属膜厚および抵抗率測定装置 23	43	59.2	安部商事、東京エレクトロン、日本分光工業、ジャスコインターナショナル、兼松エレクトロニクス 24
スパッタリング装置 25	38	75.2	東京エレクトロン、日電アネルバ、徳田製作所、日本真空技術 26
減圧CVD装置 27	24	49.1	国際電気、東京エレクトロン、AMTジャパン、丸紅エレクトロニクス 28
微小寸法測定装置 29	18	36.8	日本光学、コーガク、シイベル機械、ユニオン光学 30
シリコン単結晶引上げ装置 31	17	104.9	国際電気、丸紅エレクトロニクス 32
自動マスク外観検査装置 33	17	90.9	日本自動制御、日本光学 34
拡散炉 35	16	7.2	東京エレクトロン、国際電気、テンプレスジャパン 36
走査型電子顕微鏡 37	15	27.4	日本電子、明石製作所、島津製作所、日立製作所 38
フラットネステスター 39	8	100.0	小西六写真工業、ニデック、丸紅エレクトロニクス、安部商事、兼松エレクトロニクス 40
フォトマスク露光修正装置 41	8	56.0	日本電気、ユニオン光学 42
プラズマCVD装置 43	8	36.1	AMTジャパン、兼松セミコン、丸紅エレクトロニクス 44
マスクコンパレータ 45	5	73.3	日本光学、シイベル機械 46 48
常圧低温連続酸化膜成長装置 47	5	42.9	AMTジャパン、兼松セミコン 50
レーザー走査欠陥検査装置 49	3	120.0	日立電子エンジニアリング、ユニオン光学
ウェーハ外観検査装置 51	3	73.3	日本光学工業、ニデック 52
マイクロズーム顕微鏡 53	1	75.0	ボシュロムジャパン、シイベル機械 54
レーザーダストモニター 55	1	54.1	近藤工業、新田ベルト、日立電子 56
フォトマスク欠陥確認装置 57	1	40.0	ユニオン光学 58
パターンジェネレーター (レチクルマスク製造装置) 59	—	—	住商電子システム 60 62
電子ビーム描画(露光)装置 61	—	—	日本電子、兼松セミコンダクター、東芝機械、東京エレクトロン、日立製作所

Key to Table 2.

1. Name of product
2. Estimated 1981 sales (100 million yen)
3. Ratio vs previous year, %
4. Principal participating industries
5. LSI test equipment
6. Takeda Riken Industry, Ando Electric, Tokyo Electron, Minato Electronics
7. Mask aligner
8. Canon, Kanematsu Semiconductor, Tokyo Electron, Kokusai Electric
9. Ultrapure water making equipment
10. Kurita Kogyo, Organo, Nomura Microscience, Nippon Junsui
11. Reduction exposure equipment
12. Sumisho Electron System, Hitachi Limited, Nippon Kogaku, Itochu Shoji
13. Automatic wafer prober
14. Tokyo Electron, Tokyo Seimitsu
15. Ion injection device (doping device)
16. Tokyo Electron, Nippon Shinku Gijutsu, Kokusai Denki, Columbia Boseki
17. Epitaxial growth equipment
18. Kokusai Denki, AMT Japan, Kanemitsu Semicon, Tenpress Japan, Canon
19. Clean room
20. Takasago Thermochemical Industry, Hitachi Plant Construction, Sanki Kogyo, Nippon Airtech
21. Dry etching equipment
22. Tokyo Oka Kogyo, Nichiden Anelba, Nippon Shinku Gijutsu, Tokyo Electron
23. Metal film thickness and resistance rate measurement device
24. Abe Shoji, Tokyo Electron, Nippon Bunko Kogyo, Jascointer National, Kanemitsu Electronics
25. Sputtering equipment
26. Tokyo Electron, Nichiden Anelba, Tokuda Seisakusho, Nippon Shinku Gijutsu
27. Reduced pressure CVD equipment
28. Kokusai Denki, Tokyo Electron, AMT Japan, Marubeni Electronics
29. Microdimension measurement device
30. Nippon Kogaku, Kogaku, Seibel Kikai, Union Kogaku
31. Silicon single crystal drawing device
32. Kokusai Denki, Marubeni Electronics
33. Automatic external mask examination device
34. Nippon Jido Seigyo, Nippon Kogaku
35. Diffusion furnace
36. Tokyo Electron, Kokusai Denki, Tenpress Japan
37. Scanning electron microscope
38. Nippon Denshi, Akashi Seisakusho, Shimazu Seisakusho, Hitachi Limited
39. Flatness tester
40. Konishiroku Shashin Kogyo, Nidec, Marubeni Electronics, Abe Shoji, Kanematsu Electronics
41. Photomask exposure correction device
42. Nippon Electric, Union Kogaku
43. Plasma CVD device
44. AMT Japan, Kanematsu Semicon, Marubeni Electronics
45. Mask comparator
46. Nippon Kogaku, Seibel Kikai

Key to Table 2 continued

47. Normal pressure low-temperature continuous oxide film forming device
48. AMT Japan, Kanematsu Semicon
49. Laser scan defect searching device
50. Hitachi Electron Engineering Union Kogaku
51. Wafer appearance testing device
52. Nippon Kogaku Kogyo, Nidec
53. Microzoom microscope
54. Bausch Lomb Japan, Siebel Kikai
55. Laser dust monitor
56. Kondo Kogyo, Nitta Belt, Hitachi Denshi
57. Photomask defect recognition device
58. Union Kogaku
59. Pattern generator (reticule mask manufacturing device)
60. Sumisho Denshi System
61. Electron beam engraver (exposure device)
62. Nippon Denshi, Kanematsu Semiconductor, Toshiba Kikai, Tokyo Electron, Hitachi Limited

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SCIENCE AND TECHNOLOGY

PRODUCT DEVELOPMENT OF MAJOR CHEMICAL INDUSTRIES SURVEYED

Tokyo SHUKAN ORU TOSHI in Japanese No 453, 30 Jul 81, pp 14-18

[Text] Toray Already Leads the Compound Fine Chemical Industry

Toray's emphasis on fine chemicals is based on the following fundamental position: "Because of hikes in fluctuating expenses and excessive competition, we can no longer make profits in mass production-based chemistry. From now on, business must be based on the price per gram, per set, or per square meter, instead of per ton and per kilogram" (President Masahisa Ito of Toray).

The main target of Toray is to provide information-related industries with materials which it will develop using as weapons its high-particle chemical and minute-processing technologies which it has accumulated over the years through its interest in synthetic fibers and plastics. The second target is life science which, as represented by genetic engineering, will change the very foundation not of only the chemical industry but also of the society.

First of all, all of Toray's new materials have one thing in common: they are all high-particle substances. For instance, although polyester film and PBT resin differ in shape and function, they have the same polymers. Also, the majority of engineering plastics and carbon fibers (made from long acrylic fibers) have the same polymers as the synthetic fibers. Therefore, Toray's new materials are basically the result of the application of high-particle chemistry and fine-processing technologies.

Polyster film has already become Toray's major product and its "present source of income" (Ito). Its VTR tapes are among the best in the world. It has captured the mass market for "information-related tapes." Its monthly production capacity is 2,200 tons, but this will increase to 3,100 tons in 1982. The sales of the film department, including those from polypropylene film, reached 53.7 billion yen (fiscal 1980). The sales target of this department 5 years from now is 100 billion yen, which will make it the most profitable department of Toray.

Technologically, the electronics materials are extensions of engineering plastics. This fact alone is sufficient to show the potential power of Toray, the top engineering plastic manufacturer.

The department of electronics raw materials and equipment recorded sales of only several billion yen in FY-80, most of which came from integrated circuit materials.

Its goal for FY-83, however, is 10 billion yen; and in 10 years, combining the sales from personal computers and character printers, its sales and ordinary profits are expected to reach 100 and 30 billion yen, respectively. These are ambitious goals. Toray's electronics resist for forming integrated ciruit patterns will be one of the principal money-making products.

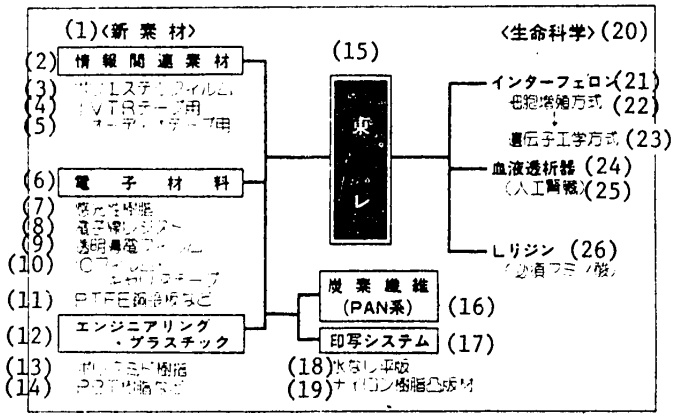
The sales of engineering plastics have already become steady, and in polyamide products Toray is the leader, appropriately, as the king of nylon. Sales reached 35.6 billion yen in FY-80, its target is 100 billion plus for FY-90.

Toray supplies carbon fibers to UCC of the United States, and its strength lies in the fact that it has dominated the U.S. aerospace industry. Carbon fibers are essential to compound raw materials, and Toray holds 50 percent of the world market; its dominance is unlikely to fall. The secret of its dominance is in the high quality of its polyacrylonitrile (PAN) and in its superior spinning and calcination processing technologies. By June 1982, production of carbon fibers will triple to 105 tons.

The present domestic demand for carbon fiber comes from sporting goods, and in America it comes from space and aircraft industries. Already it has been unofficially decided that Toray's carbon fiber will be used in the B-767. A ton of fiber is used for each aircraft.

In the area of life science, interferon has already been developed and is being clincally tested. In 5 years, Toray hopes to have its interferon in the list of drugs. Interferon has opened up Toray's interest in the overall development of pharmaceuticals. For example, it is fully committed to production of pharmaceuticals using genesplicing technology.

Toray is already the leader in the compound fine chemical industry, supported by its large-scale revolutionary new materials such as engineering plastics and carbon fibers. In 5 years, the sales from the fine chemical departments will increase to more than 40 percent of all sales, as Toray tries to transform itself from a mass-production-based synthetic textile manufacturer to a high-techology fine chemical enterprise.



[Key on following page]

Key:

1. New Raw Materials
2. Information-Related Raw Materials
3. Polyester films
4. For VTR tapes
5. For audio tapes
6. Electronics Materials
7. Photosensitive resin
8. Electronics wire resist
9. Transparent conducting file
10. IC film carrier tapes
11. PTFE copper plates, etc
12. Engineering Plastics
13. Polyamide resin
14. PBT resin, etc
15. Toray
16. Carbon fibers (PAN-related)
17. Photo-printing system
18. Waterless flat sheets
19. Nylon resin convex sheets
20. Life Science
21. Interferon
22. Cell-breeding method
23. Genetic Engineering Method
24. Blood dialyzer
25. Artificial kidney
26. L-lysine (essential amino acids)

Mitsubishi Chemical Industries Active in Life Science and Rare-Earth Materials

Mitsubishi Chemical has been stepping up its efforts in fine chemicals. Mitsubishi Chemical's business strategy is "to activate the existing operations by individualizing the products, including general products" (President Eiji Suzuki). This may include items that deviate from what may be called the concept of fine chemicals, but its position can be understood better as that of "specialization."

Mitsubishi's fine chemicals can be categorized roughly as: 1) information materials, including carbon products, resin (such as engineering plastics), are rare-earth substances; 2) life industry products, ranging from pharmaceuticals and reagents to equipment, foods and agricultural chemicals; and 3) dyes.

In the area of carbon products, the future development of the new pin-shaped cokes and that of carbon fibers now being developed look interesting. The carbon project has also produced technologies that have become the basis for the development of C1 chemicals and coal liquefaction.

For the petrochemical companies, what should be at the core of their "fine-ization" process is, first of all, engineering plastics. As for Mitsubishi Chemical, it possesses three principal items: nylon, polycarbonate, and PBT (polybutylene terephthalete). It was behind in PBT, but by commercializing its 1.4BG raw materials, it is gaining some of the lost ground. And by importing polyamide-imide and polyimide resins, it is consolidating its interest in engineering plastics. Mitsubishi's definition of life industry is broad: "An industry contributing to the improvement of human welfare and lifestyle." Its present operations include pharmaceuticals, agricultural chemicals, and reagents. But interest in Mitsubishi's life industry at present is due to its rapid development and commercialization of pharmaceuticals and other products resulting from genetic engineering.

Mitsubishi's interest in pharmaceuticals goes way back. Before the war, it established Takeda Chemical Industries and Yoshitomi Pharmaceutical Industries. The late president Shinojima served privately as a managing director of Tanabe Seiyaku Co Ltd. But in the postwar period, partially due to large investmetns in petrochemicals, Mitsubishi temporarily withdrew from pharmaceuticals and then reentered the field in 1969-70. However, since there was this blank period, its production

was limited to hemostatic drugs and steroid hormones (orignally used in birth control pills) and its development of pharmaceuticals (including intermediate raw materials) lacked vigour.

This situation, however, changed rapidly when it acquired Nikken Kagaku's stock through a third-party capital increase (Mitsubishi holds 5 percent of all shares) and became the fourth largest stockholder. This February, it acquired stock in Tokyo Tanabe Seiyaku by the same third-parth capital-increase method and became the third largest stockholder.

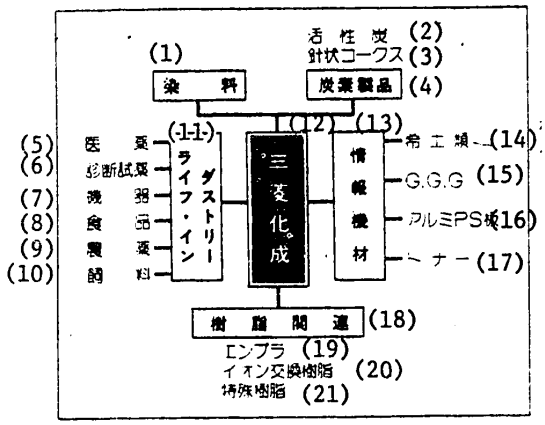
On the other hand, Mitsubishi Life Science Research Institute, which recently celebrated its 10th anniversary, is one of Japan's top institutes conducting basic research in life sciences. But thus far, there have not been many cases in which technologies developed by the institute have led directly to commercialization.

Last October, Akira Niwa, then vice president of Mitsubishi Chemical, was appointed director of the Life Science Research Institute. This was done to encourage commercialization of technologies developed by the institute.

For the time being, the institute's goal will be the application of genetic engineering for enzyme-related products. In addition, in terms of intermediate goals, it is anticipated that the developm ent of the catalyzer will contribute to the development of petrochemical processes at normal temperatures and pressures.

As in the life industry, Mitsubishi is actively promoting rare-earth projects. Following the purchase of America's USR Chemical Products Corp (manufacturer of fluorescent substances for TV) this July, Mitsubishi bought out the X-ray sensitized paper department of GAF Corp, and it is also planning to purchase a similar department of the Arc Light Corporation. With these purchases in the United States, combined with those already made in Malaysia and Norway and with that of Kasei Optonics (it bought out a plant of Dainippon Toryo Keikotai), Mitsubishi's strategy for an international division of production structure will be strengthened. Furthermore, it also has a plan to build a reare-earth plant at Kurosaki. Mitsubishi is already the world's third largest manufacturer of rare-earth substances, but it will continue to expand in a worldwide strategy.

Excluding cokes, Mitsubishi's ratio of fine chemicals to all other products is still below 10 percent. For the time being, the goal is to achieve a 30-percent ratio, which means that the rate of development of its life industry will be the key to its shift toward fine chemicals.



Key:

1. Dye
2. Active carbon
3. Pin-shaped cokes
4. Carbon Products
5. Pharmaceuticals
6. Diagnosis reagent
7. Equipment
8. Food
9. Agricultural chemicals
10. Feed
11. Life Industry
12. Mitsubishi Chemical Industries
13. Information Materials
14. Rare-earth
15. GGG
16. Aluminum PS sheets
17. Toner [?]
18. Resin-Related Products
19. Engineering plastics
20. Ion-exchange resin
21. Special resin

Asahi Chemical Industry Co Ltd: Pursues Toray in Compound Fine Chemicals

Asahi Chemical Industry has been mass-producing chemicals, mainly naphtha derivatives such as ethylene and propylene. It is, however, in the process of changing its policy, since this mass production of chemicals, which had been the company's strength, has shown to be ineffective structurally in raising profits. Thus, Vice President Reiichi Yumikura's statement that "Asahi will concentrate on nurturing fine chemicals."

As in the case of Toray, the basis of Asahi's success will be high-particle chemistry and minute-processing technology, which it has mastered through production of synthetic fibers and plastics; however, it is involved in food production and research in fermentation technology, neither of which Toray deals in. Moreover, in a life science field such as genetic engineering, it is slightly ahead of Toray. In addition, Toyo Jozo Co Ltd, its affiliate, has enzyme technology, so that in terms of drug development potential, it is the leader among the three synthetic textile companies.

On the other hand, among the synthetics, its polyester line is weak, so there is the disadvantage of not having polyester films. In any event, in the area of fine chemicals, its position is that of a pursuer of Toray and its potential is remarkable.

Among electronics raw materials, its emphasis is on sensitizing resin. The reputation of its dry film resist for print wiring sheets in integrated circuits has already been established. Another noteworthy item is the Hall elements.

In the area of engineering plastics, Asahi Chemical is superior to Toray in the production of Nylon 66, which the latter lacks. Nylon 66 is superior to Nylon 6 in terms of heat resistance and durability. In the acrylic MMA resin market, Asahi Chemical has the second largest share (20 percent), after Mitsubishi Rayon. But again, since its polyester division is weak, its plastics have not outgrown the stage of dependence on general use--principally, medium- and low-pressure polyethylene.

In the area of carbon fibers, although Asahi is the top acrylic manufacturer, its temporary halt in this area has made it fall behind Toray and Toho Rayon. In 1979 it resumed carbon fiber development, and in 1981 it cooperated with Nippon Carbon Co Ltd, a major pitch type manufacturer, to begin participation in PAN-related production. In 1982, it will immediately begin production at a rate of 20 tons a day. The question is how it will attach itself to the U.S. aerospace industry. For the time being, its demand will come principally from sporting goods. It is also inclined toward the development of products for automobiles as one means of reversing its position among its competitors.

In terms of new materials, it cannot be denied that Asahi is behind Toray, but its level of chemical technology based on the ion-exchange membrane is on par with that of world leaders.

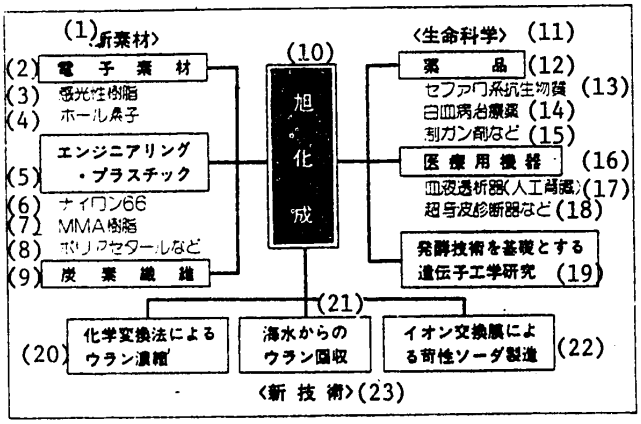
Its sodium hydroxide manufacturing plants using the ion-exchange membrane constitute 50 percent of all such plants in the world. Since conversion from mercury to the ion-exchange method is underway throughout the world, the market is growing rapidly.

In the area of life science, due to the accumulation of fermentation technology, Asahi's scale is two or three times that of Toray. Vice President Yumikura states with confidence: "Research and past performance of the enzyme are the key to success in genetic engineering."

In the area of drugs, Asahi Chemical moved from a bulk supply system to manufacturing. In 1976 it completed a pharmaceutical plant; it is now engaged in developing cures for leukemia, anticancer agents, and cephalo-type antibiotics. The hoped-for cure for leukemia is expected to be on the health insurance list by 1982, and it is expected to become a major merchandise item with monthly sales of over 1 billion yen. Asahi's market share of the midair thread-type blood dialyzer using Bemberg is number one. Furthermore, Asahi Medical, its subsidiary, has high profit rates. In the area of ME, it has a proven track record in CT scanners and an ultrasonic diagnosis system.

Asahi's genetic engineering research is done at the research institute in Fuji city. In addition to mass-production technology using the genetic characteristics of aminoacid, it is promoting mass production of pharmaceuticals and research into interferon.

Although the present sales ratio of Asahi's fine chemicals or special products is as low as 10 percent, it intends to raise it to 20 percent in 5 years, which will make them as profitable as its petrochemical products.



Key:

1. New Materials
2. Electronics Raw Materials
3. Sensitization resin
4. Hall elements
5. Engineering Plastics
6. Nylon 66
7. MMA resin
8. Polyacetal, etc
9. Carbon Fibers
10. Asahi Chemical
11. Life Science
12. Pharmaceuticals
13. Cephalo type antibiotics
14. Antileukemia drugs
15. Anticancer agents
16. Medical Equipment
17. Blood dialyzer (artificial kidney)
18. Supersonic diagnosis devices, etc
19. Genetic Engineering Research Based on Fermentation Technology
20. Uranium Concentrates by Chemical Conversion Method
21. Uranium Recovery from Seawater
22. Sodium Hydroxice Production by Ion Conversion Membrane
23. New Technologies

Sumitomo Chemical Co Ltd: Rapidly Moving Into Agricultural Chemicals, Pharmaceuticals, and New Materials

Sumitomo Chemical is strongly promoting its fine-chemical operations. This is based on its "present goal of achieving and maintaining a 30-percent share of fine chemicals as against all other products (the most recent period showed a 25-percent share)" (Takeshi Hijikata, president). The focus is on agricultural chemicals, pharmaceuticals, and new materials. The approach via bioengineering is also developing rapidly, supported by the introduction of technologies.

Among these, agricultural chemicals, in particular, have grown into major sources of profit. Their growth is phenomenal; 1981 sales are expected to reach nearly 50 billion yen, about 2.7 times those of 1976. Sumitomo is among the world's five top agricultural chemical manufacturers.

Agricultural chemicals are generally classified into three categories--insecticides, germicides, and herbicides. Sumitomo Chemical's strength lies in the first two. Especially the insecticides "Sumichion" and "Sumisaijin" and the germicide "Sumirex" are considered major international products.

In 1976, a joint venture plant with the United States began the manufacture of "Sumichion." The "Sumisaijin," which was first used for cotton, is being exported to more than 70 countries in Europe, North and South America. In the fall of 1982, the U.S. Shell Chemicals, to whom Sumitomo provides technological assistance, will begin full production of "Sumisaijin." The latter is also effective in animals, and for this reason it will probably be exported to South Africa, South America, and Australia.

"Sumirex," a germicide for vegetables and fruit trees, is mainly exported to European countries such as France and West Germany. Its Japanese registration permit was granted this spring so that domestic demand is also promising. To these three items, synthetic [? pyrethroid] (artificial Dalmatian pyrethrum) insecticide has been added. The export ratio of agricultural chemicals reaches nearly 60 percent.

The future focus will be on the development of new herbicides. Since the demand for herbicides accounts for 60 percent of all agricultural chemical markets in the world, it is an attractive field. For the time being, research will focus on herbicides for wheat and soybeans. The herbicide for soybeans, S3532, being developed in the United States, is a promising item, but its commercialization will come in 2 years at the earliest.

With respect to pharmaceuticals, Sumitomo has acquired bioengineering methods, and has been emphasizing the development of new drugs, such as those for the circulatory system, antibiotics, and anticancer agents. While it used to suffer from a lack of developmental efficiency and sales forces, these have been gradually improved. The sales volume of pharmaceuticals for 1981 is expected to increase to the 40-billion-yen level (33.5 billion yen, previous year).

The increase in 1981 is due to contributions made by [? "Inteban"] ointment, the price of which was officially listed at the end of last year, and by the anticholesterol agent [? "Epokurin"]. Other promising new drugs include the semisynthetic penicillin [? "Parushin"], the synthetic antibacterial agent [[? "Furudajin"] (jointly developed with Taisyo Pharmaceutical Co Ltd).

In addition, cephalo type, the third-generation antibiotic SM1652, the antiinflammatory painkiller SX1032, and the depressant ID1938 are among the drugs undergoing clinical testing. Each of these is a candidate for a new drug that is being jointly developed; if these become commercialized, the product line of Sumitomo will be strengthened in one sweep.

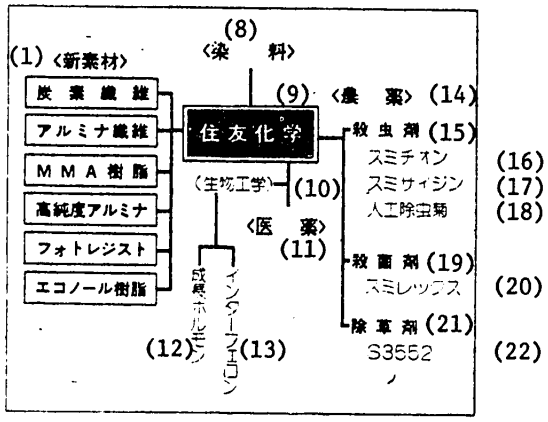
In the area of bioengineering, Sumitomo is prepared to make the developments in interferon and growth hormones a breakthrough in this field. As for interferon, Sumitomo has imported the lymph node method 2 type from Welcome Corporation of England, and is already conducting clinical testing. Depending on the progress of the testing, it may begin domestic production next year.

Growth hormones produced by the gene splicing method will undergo clinical testing in September. This method is imported from Kavi Corporation of Sweden. Although neither item is based on Sumitomo's own technology, they will advance pharmaceutical production technology that uses bioengineering and improve clinical testing methods.

Another growth area is new materials. Sumitomo's policy is to strengthen its position in three major materials: electronics, compound, and special function materials. In particular, it is interested in developing the application and expanding the demand for carbon fibers, MMA resin, highly pure alumina, sensitizing resin, and super-heat-resistant resin.

In particular, concerning carbon fibers, Sumitomo plans to increase facilities to produce 500,000 square meter sheets annually; this is supported by the export contract to America's Hercules Corp, with whom Sumitomo has had a long relationship. In this manner, Sumitomo is trying to catch up with Toray. With respect to MMA resin, whose applications in optical fibers and optical video disks are in progress, Sumitomo's goal is to surpass Mitsubishi Rayon.

Annual sales from these new materials are still under 10 billion yen, but Sumitomo's potential for growth is huge.



Key:

1. New Materials
2. Carbon Fibers
3. Alumina Fibers
4. MMA Resin
5. Highly Pure Alumina
6. Photoresist
7. [? Econol] Resin
8. Dye
9. Sumitomo Chemical
10. Bioengineering
11. Pharmaceuticals
12. Growth Hormones
13. Interferon
14. Agricultural Chemicals
15. Insecticide
16. Sumichion
17. Sumisaijin
18. Artificial Dalmatian pyrethrum
19. Germicide
20. Sumirex
21. Herbicide
22. S3552

Shin-Etsu Chemical Co Ltd: A Forerunner in Fine Chemical Strategy; Its Target Is To Achieve 50 Percent [Production Level of Fine Chemicals]

For Japanese chemical companies, whose raw materials foundation is weak, "fine chemicals" is the byword. But since the field of fine chemicals is wide, if too much time and money are spent on development, the very goal of achieving high added value becomes meaningless. For this reason, the target of development must be defined clearly and intense selection is required prior to commercialization.

In this sense, since Shin-Etsu Chemical's fine chemical sales constitute more than 40 percent of its total sales, its case can be seen as a model for the entire industry.

Shin-Etsu's fine chemical products can be classified into three categories: silicon resin, electronics materials consisting of semiconductor silicon and rare-earth substances, and [? Metorose] and synthetic perfumes. These fine chemicals were brought out strategically in order to get away from production of universal chemical products such as vinyl chloride, vinyl acetate, methanol, sodium hydroxide, and fertilizer.

The March 1981 period recorded a large loss; however, the loss in vinyl chlorides and vinyl acetates was covered by profits in fine chemicals. In other words, its fine chemicals are already supporting the company's profit.

The use of silicon resin is wide, ranging from electronics to sealing agents for super-high-rises, to medical products such as blood circulation tubes. Demand for it is expected to grow by more than 10 percent annually. At present, Shin-Etsu has a 50-percent market share in this item, surpassing those of Toray Silicon and Toshiba Silicon.

The sales volume of electronics materials reached 30 billion yen, a 30-percent increase (ending May 1981). Their combined sales ratio, too, has increased to more than 20 percent (16.5 percent in previous period) of all sales. The major product here is semiconductor silicon. Single crystal silicons are semiconductor materials for IC and LSI, and are shipped as wafers.

The production of semiconductor silicon is carried out by Shin-Etsu Semiconductor (100 percent capital investment), a subsidiary company. Shin-Etsu Semiconductor became an independent enterprise when it joined hands with the U.S. Dow-Corning Corporation (45 percent investment) in March 1967. In 1979, partially because Dow-Corning was concentrating on a multicrystal semiconductor silicon, the joint venture was dissolved and Shin-Etsu Semiconductor became the sole owner.

The future demand for semiconductor silicon, principally for super LSI, is expected to grow 20-30 percent annually. In order to cope with this, Shin-Etsu Semiconductor will increase its equipment investment rapidly for the next 2-3 years.

In addition to Shin-Etsu Semiconductor, Shin-Etsu Chemical has Naoetsu Electronics Industry and Nagano Electronics Industry as subsidiaries for wafer processing of semiconductor silicons; also, there is SEH Malaysia in Malaysia. The number of

employees in the domestic and overseas semiconductor departments, including those in Shin-Etsu Semiconductor, is already about 2,000. Although it falls short of the 2,400 employees of the main Shin-Etsu Chemical, it is still a significant number.

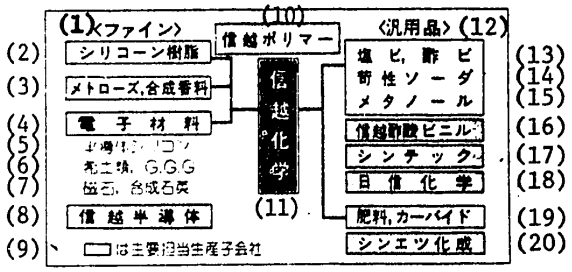
In addition, it is now investigating the possibility of extending its operations into the United States. It has purchased 50,000 tsubo [1 tsubo = 3.305 square meters) in Vancouver, in the United States, and is studying the feasibility of building a single-crystal silicon plant. Its SEH Malaysia is already exporting silicons to the United States, but its intention ultimately is to meet the increase in demand in the United States, including that from Japanese enterprises in the United States.

Recently, GGG [gadonium, gallium, garnet) and synthetic quartz have been added to Shin-Etsu Chemical's list of new electronics materials. The GGG has already been applied to fixed-memory of electronic switching systems. It has a memory capacity far superior to that of semiconductor silicon, and because of its great future various companies have begun production. There is a demand for synthetic quartz for use in photomask materials and optical fibers.

Including these new products, the sale of electronics materials is expected to grow steadily at an annual rate of 25 percent; by 1986, sales are expected to reach 90 billion yen.

Shin-Etsu Chemical deals in other fine chemical products, such as joining agents for construction, building materials, food, and pharmaceuticals, [metorose ?] (domestic market share, 90 percent) for coating, and synthetic perfumes such as jasmine. Shin-Etsu Chemical treats them as fine chemicals; however, in comparison with electronics materials and silicon resin, the rate of increase is low and the scale is small.

It is strongly expected that Shin-Etsu Chemical, which is always a step ahead in business strategy, will move ahead with its goal of achieving a 50-percent fine-chemical share of all products and will strengthen its production structure.



Key:

1. Fine Chemicals
2. Silicon Resin
3. [Metorose ?], Synthetic Perfumes
4. Electronics Materials
5. Semiconductor silicon
6. Rare-earth substances, GGG

[Key continued on following page]

7. Magnet, synthetic quartz
8. Shin-Etsu Semiconductor
9. Indicates major subsidiary company in charge of production
10. Shin-Etsu Polymer
11. Shin-Etsu Chemical
12. General-Use Products
13. Vinyl Chloride
14. Sodium Hydroxide
15. Methanol
16. Shin-Etsu Vinyl Acetate
17. Shintec
18. Nisshin Chemical
19. Fertilizer, Carbide
20. Shin-Etsu Kasei

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SCIENCE AND TECHNOLOGY

MITI TO ESTABLISH BIOTECHNOLOGY PROMOTION COMMITTEE

Tokyo NIHON KOGYO SHIMBUN in Japanese 12 Sep 81 p 2

[Text] Major Effort by MITI To Promote Biotechnology Industry; Committee To Be Established Next Year; Representatives of Chemical Industry To Formulate Basic Long-Term Policy

MITI plans to establish a "Biotechnology Promotion Measures Committee" (tentative name) in FY-82 to promote bioindustry. Although bioindustry is expected to make great progress in the future, Japan is behind in investigation of the direction of future progress and safety measures in this field. Therefore, a committee composed of representatives of the chemical industry, persons of knowledge and experience, and related government officials will be established to create basic long-term policy. For initial research expenses for 1982, 5 million yen will be appropriated.

Bioindustry is an industrial field in which biological functions and reactions, especially of microorganisms, will be used on a large scale for industrial purposes. This industry is still in an initial stage; throughout the world, it has only appeared in parts of the medical and pharmaceutical products industry. However, it is expected to expand a great deal from the late 1980's into the 1990's in such wide-ranging fields as 1) fine chemicals, 2) basic chemical products, 3) resources and energy, 4) food products, and 5) the environment.

In the United States there are already plans for large-scale application of biotechnology in technological development. For example, there is a plan to change the method of manufacturing ethylene oxide, a raw material for synthetic fibers, by an ethylene heat oxidation reaction to a manufacturing method using microorganisms as a catalyst in 3 years' time. If this U.S. development is successful, it will be possible to manufacture ethylene oxide at normal pressure, and this will be a great contribution to energy conservation. In Japan as well, an aggressive approach to these developments is required, so the present plan to organize a committee of specialists was conceived to study future trends.

Also, because microorganisms are used in bioindustry, it is essential in developing this field to institute safety measures to prevent leakage from laboratories and research centers and to protect human beings and the environment. MITI plans to have the committee study these problems as well.

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SCIENCE AND TECHNOLOGY

CONCEALED IMAGE TRANSMISSION METHOD DEVELOPED

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 21 Sep 81 p 3

[Text] New Secure Communication Method Developed by Professor Tominaga et al of Waseda University; Industrial Espionage Throws Up Hands

In the field of facsimile, which is one of the three "divine objects" of OA (office automation), a new method of communication developed for the purpose of "keeping things secret" has been the topic of conversation recently. As the amount of information in society increases, many problems are expected to crop up. That is, there is urgent need for transmission of confidential documents by means of facsimile transmission, for measures to counter the theft of documents and "eavesdropping" on microwave millimeter wave transmission, and for protection of images (documents) transmitted which are of value to a third party. A new concealed image transmission method has been developed by a research group headed by Professor Hideyoshi Tominaga, Department of Electronic Communication, Faculty of Science and Technology, Waseda University. The "concealed image transmission method" developed by this group uses a format that may be called a "hidden image" conversion method. Secrets can be kept and certification (confirmation of document exchange) can be accomplished conveniently by this new method. It has caught the attention of many, because development of such software enables the confidential management of various "documents" according to their importance even after the OA document management has entered the paperless age.

Documents and Images Protected, Jumbled Transmission, Sharp Reception

Facsimile transmission is a method of transmitting images such as documents by electronic means over a distance to a receiver. The original document that is to be transmitted is scanned with a light, and the black and white density of the image is converted into electric signals. At the receiving end, the electric signals are converted back into the corresponding image. However, facsimile equipment used in an office is shared by many for economic reasons and is used for transmitting various types of documents including both confidential documents and open letters. Under such circumstances, if a document that must be kept secret can be transmitted with jumbled signals which can only be decoded by the rightful receiver with a certain key into a clear image (document), then the confidentiality of the document can be maintained.

There are many applications of this method. For example, it can be programmed to detect whether the seal of electronic mail has been broken by a third party or not, or only a portion of the document such as the signature may be concealed by the jumbled signals so that only the rightful receiver is able to reproduce the signature. Thus, the transmission of documents which could be of value to a third party, such as tickets, entrance tickets, and checks, can also be carried out, and "many other new uses may crop up," says Professor Tominaga.

The basic principle of the method is as follows: the arrangement of the image (letter) point and the arrangement of black and white are mixed up so that the rearranged signals have the appearance of a jamming signal. The change in arrangement can be accomplished by changing the order of scan lines according to a random number generator and repeating this pattern periodically. In an actual machine, this becomes part of the logic inside the shift register before codification.

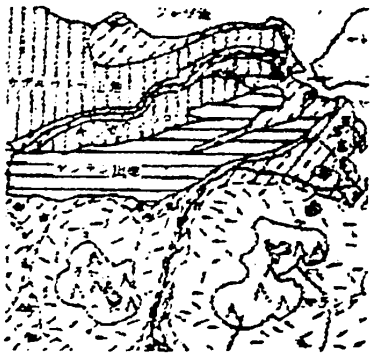
The decoding key used by the receiver for reproduction of the image consists of the same random number generator. With this key, a register logic which is the reverse of the transmitter is created so that the scan lines are restored to their original arrangement.

There are infinite variations of this rearrangement scheme, and if the period of random number generation is increased, the process required to decode it also increases proportionately. However, the standard proposed by the CCITT (Consultative Committee for International Telephone and Telegraph) is centered around a technology which is aimed at shortening the fascimile codification of the image information in order to imrpove the circuit efficiency. A technology in which the random number generation is made more complex runs counter to the effort to make codification more efficient. Therefore, the problem is how to reconcile these two. That is, the algorism for arrangement change must be decided by the codification efficiency and the content of the document.

The method for arrangement change may be varied according to the degree of secrecy desired. One of the methods is called shuffling. The original manuscript (Figure A) is shuffled into random order by a single scan line as in shuffling a deck of cards (Figure B); or points may be rearranged on the same scan line (Figure C); or points may be rearranged between different scan lines (Figure D); or blocks may be rearranged as a unit. [Figures not reproduced] This process of randomly changing the arrangement is called scrambling. The scrambled signals appear to a third party as nothing but noise.

Concealed image transmission is a method of transmission of a more advanced degree than the scrambled signals. The signals transmitted by this method consist of the scrambled signals of a confidential document superimposed on the normal signals of an ordinary document. Unless one knows the decoding key, the signals appear to him as an ordinary transmission with garbles. "As the algorith for removal of garbled information in order to improve the image becomes more commonplace in the future, the unsuspecting third party will throw away a large quantity of concealed images disguished as garbles," says Professor Tominaga.

Reproduction of this concealed image is achieved by turning it over so to speak, that is, by interchanging the position of an apparent image on the front with the



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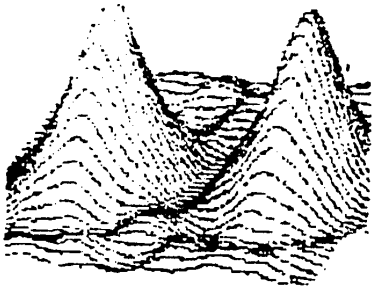

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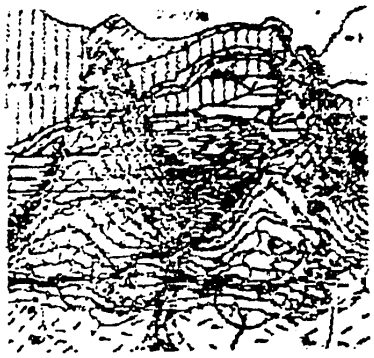

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[Drawing] To transmit a manuscript (1) by means of concealed transmission, (2) is superimposed on (1) and transmitted; the output of this transmission is shown in (3).

hidden image on the back. Thus, by reversing the arrangement order of the front and the back, the image on the front becomes scrambled while the image on the back becomes unscrambled. The concealed image may consist of a superposition of several sheets of images or just a single sheet. In the case of a single sheet of image, the key section of the document such as the signature may be scrambled and scattered in the form of garbles somewhere in the document.

Certification may be cited as another effective application of the concealed image transmission method. Certification is a process of confirming receipt of a document by the receiver. An additional scrambled image is superimposed onto the scrambled signals of the document which is being transmitted. After the rightful receiver has decoded the scrambled signals with an appropriate key, the reproduced additional image is then sent back to the original sender. Thus, certification can be carried out smoothly if the sender and the receiver make arrangements beforehand.

The high speed facsimile machines used today are standardized by the CCITT as G-III (Group III). The next generation of G-IV facsimile machines reportedly will be facsimile machines with an internal memory. The purpose of having a memory is to increase the effective utilization of the circuit and to transmit a larger volume at a higher speed. With the memory function available, the technique of superimposing several images which is essential in the concealed image method can be introduced easily and the application of software for confidential transmission can be accomplished. Furthermore, in the future, when all documents and information are stored in the computer memory and the so-called "paperless office" is a reality, the equipment itself can be shared by everyone, with the confidential and non-confidential documents intermixed. In such circumstances, the document management can be easily carried out by takint appropriate secret protection measures in accordance with the degree of confidentiality. Meanwhile, communication by such means as microwave and millimeter wave is expected to grow in the future because of the low equipment cost per circuit. Aside from military secret communications, other users of communications via electronic waves are beginning to attach importance to the concealed communication technique.

Finally, this group plan to present a paper describing their results at the "International Symposium on Image and Document Communications" in Paris in November.

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END