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Japan Report

(FOUO 7/81)

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ECONOMIC

BRIDGESTONE TARGETS U.S. AIRCRAFT TIRE MARKET

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 17 Nov 80 p 9

[Text] Bridgestone Tire starts, in full scale, export to the United States of aircraft tires which require highly sophisticated technology to fulfill their performance requirements. Already, United Airlines with the largest supply of aircraft in the free world and other airline companies have practically completed performance evaluations. Bridgestone projects the export of tires for large passenger airliners and transports to be opened for business some time between the end of this year and next year. The company shares 15 percent of the European aircraft tire market. Based upon this achievement, Bridgestone intends to advance into the United States, aiming to pocket a 30 percent share of the U.S. market which is said to enjoy an annual new demand of over 30,000 tires.

Bridgestone Tire started exporting aircraft tires to Europe in 1972, and presently receives purchase orders from all major airline companies, Lufthansa, British Airways, Scandinavian Airlines, Sabena, KLM, etc. Tires exported are primarily installed on large-size aircraft, DC9, DC10, Boeing 727, Boeing 737, Boeing 747, Tristar 1011, etc. The annual demand in Europe for large-size aircraft tires is about 25,000 tires, and last year, this company gained a 25 percent share of the market. Their share is increasing yearly.

Export to the United States started around 1978 when tires were delivered to various U.S. airlines on a test basis for performance evaluation from technical and economical aspects. Though U.S. airlines tend to stress not only the quality of the product but also the economical efficiency in particular, Bridgestone tires this year have passed the performance evaluation tests one after another given by United Airlines, to begin with, Eastern Airlines, Frontier Airlines and Texas International Airlines. This success paved the way for the beginning of full scale export. Additionally, Pan American is currently conducting a performance evaluation.

In the last couple of years, Uniroyal and Firestone have retreated successively and Goodrich and Goodyear have emerged virtually to monopolize the American aircraft tire market by themselves. Bridgestone Tire is scheming to snuggle up to share the market, and is hoping to "secure a 30 percent share of the market in the future."

In the large size aircraft tire business, competition for weight reduction and miniaturization is intensifying. Simultaneously, safety which can endure the breaking forces is required. Bridgestone Tire installed a large tester built in accordance with the U.S. Federal Aircraft Bureau's standard in their Tokyo plant, and succeeded by repeated testing in producing tires which passed the performance evaluation of each company.

In parallel to the expansion of exports to the United States, Bridgestone is planning to seek a tie-up with an aircraft tire retread (reclaimed tires) maker. Worn aircraft tires are retreadable about five times, and retreading service is a deciding factor for making the tire sales.

Japanese industries entertain high hopes for expanding aircraft exports, and pledge, "After automobiles, send aircraft." Bridgestone Tire intends to monopolize the market when Japanese aircraft exports advance into a full-scale operation, by implanting beforehand an international image for their aircraft tires through the expansion of their exports to the United States.

8940
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SCIENCE AND TECHNOLOGY

N-II ROCKET TO BE LAUNCHED IN FEBRUARY

Used for Launching Satellites

Tokyo DEMPA SHIMBUN in Japanese 11 Dec 80 p 2

[Text] On the 10th, it was officially decided that the first liftoff of the large liquid rocket "N-II" is scheduled for 4 February of next year. The rocket has been developed by the National Space Development Agency to be used for launching satellites for practical use such as the meteorological satellite "Himawari." This target date was confirmed after the Space Activities Commission (chairman, Director Nakagawa of Science and Technology Agency) acknowledged the rocket launching plan for January and February of the next year presented by the NASDA and the Institute of Space and Aeronautical Science of the University of Tokyo.

The N-II is the latest rocket with a stationary satellite launching capacity approximately 2.5 times larger than the currently used N rockets. A stationary satellite such as "Himawari" used extensively for weather forecasting and an experimental communications satellite "Sakura" weigh about 350 kg, and they require launching services rendered by the United States. However, the completion of N-II makes it possible to launch these satellites from Japan.

N-II is a 3-stage system rocket with a total length of 35 meters and a total weight of 32 tons. The greatest feature is the high precision "inertial guidance system" loaded on the first stage to control the flight. The cost of the one rocket amounts to about 10 billion yen.

N-II rocket No 1 to be launched from Tanegashima Space Center in Kagoshima Prefecture will carry a Model 4 engineering test satellite. This satellite is used to verify the N-II performance and to test space machinery and equipment such as the newly developed plasma engine. With the success of rocket No 1, the launching of a stationary meteorological satellite No 2 which is the same as "Himawari," will be the challenge for next summer.

Besides these attempts, the NASDA will liftoff small "TT500A" rocket No 2 during this experimental period to conduct metal material tests such as compounding a new alloy in space.

On the other hand, the University of Tokyo plans to launch a scientific satellite No 7 using a Mu 3S rocket No 2 from Kagoshima Space Laboratory, Uchinoura, Kagoshima Prefecture. Solar activities will be most vivid from the end of this year to the beginning of the next year, and this satellite will be launched in conjunction with these predicted activities in order to closely observe solar superficial explosions

Safety Assured

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 5 Dec 80 p 15

[Text] The Third Subcommission (Chairman Tsutomu Ashida, president of Fukui Institute of Technology) of Space Activities Commission, which has been investigating the safety of the N-II rocket to be launched for the first time from Tanegashima Space Center by the National Space Development Agency in January or February of next year, has finally concluded recently that "The safety can be fully assured under the present warning zone and radio systems." The NASDA after being informed of this good news, will engage in full-scale preparation for the liftoff. N-II rocket is a 3-stage rocket which can launch a satellite weighing about 350 kg into a stationary orbit, and is one size larger than N-I rocket which has been used to launch satellites for practical use in the 1970's. It is characterized by the designs for augmenting the solid supplementary rocket, for enlarging the first stage propellant tank, for upgrading the performance of the second stage liquid rocket and for improving the precision of the guidance and control system (inertial guidance).

The NASDA is planning to use this rocket to launch meteorological satellites, broadcast satellites and communications satellites scheduled for the first half of 1980's. Rocket No 1 has just been completed recently, and it has been so arranged that early next year a test satellite will be launched to a perigee height of 230 km and an apogee height of 36,000 km.

With this in the background, the Third Subcommission has been investigating the safety associated with the launching, especially the affects on the neighboring area if and when missions fail and fuels explode on the ground or satellites deorbit and fall away in the middle of a mission.

There are 3 major differences concerning the safety evaluation between rockets N-I and N-II: (1) a sizeable increase of propellant (an increase of solid supplementary rockets from 3 to 9, an increase of the second stage propellant from 4,730 kg to 6,000 kg and an increase of the third stage motor propellant from 560 kg to 1,500 kg); (2) a change of flight path; and (3) a discontinuance of security command (command radio) transmission.

Up to the present, the warning zone set up by the Tanegashima Space Center for the launching day was within 2.2 km radius from the liftoff site. "Even if all the stages of the rocket explode simultaneously on the ground, the blast pressure along the outer edge of the warning zone will never harm human bodies and will hardly demonstrate any effects on materials. The area to be affected by radiant heat and fallout is estimated narrower than the area to be affected by the blast," they said, and concluded that the warning zone set in the past would be sufficient to accommodate the potential power of the increased propellant.

Also, for assuring safety when rockets fall to earth, a radio link (wireless communication circuit between a rocket and a ground station) is necessary to detect abnormal conditions of the rockets and accordingly provide safety measures. From the N-I launching experiences, this link will be accommodated if the angle of elevation of the ground station antenna is above 2.5 degrees. Consequently, the currently available communication system is said to provide the radio link without fail.

In respect to the security command issue, an inertial guidance system which is more reliable than the radio guidance for the N-I, is adopted for the N-II, and the Subcommission also concluded that this system was immune from any safety problems.

8940
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SCIENCE AND TECHNOLOGY

NEW CERAMIC; MULTIPROCESSOR; FACSIMILE COMMUNICATION SYSTEM DEVELOPED

Tokyo NIKKEI ELECTRONICS in Japanese 8 Dec 80 pp 95-96

[Text] Ceramic, Hybrid IC, Mounting Technique

Ceramic Mounting Base Board Having a Thermal Conductivity as High as 0.7 cal/cm-s-°C

A ceramic having both high thermal conductivity and good electric insulating property, thermal conductivity as high as 0.7 cal/cm-s-°C and specific resistance as great as $2 \times 10^{13}\Omega$-cm, has been developed by the Hitachi Research Lab of the Hitachi Works. This ceramic consists of SiC and its thermal expansion coefficient is approximately the same as that of Si crystal. The said company is carrying out an investigation concerning its application as a mounting base board of high density and high power IC. This new ceramic has a thermal conductivity between those of Cu and Al. The thermal conductivity of Cu and Al are 0.9 and 0.56 cal/cm-s-°C, respectively. The thermal conductivity of this new ceramic is 10 times better than an ordinary ceramic, alumina (0.05 cal/cm-s-°C), which is being widely used as thin or thick film hybrid IC base board. For example, the thermal conductivity of beryllia is 0.62 cal/cm-s-°C. However, its thermal expansion coefficient of 8.0×10^{-6} 1/°C is large compared with $3.5\text{-}4.0 \times 10^{-6}$ 1/°C for Si single crystal. In contrast, the thermal expansion coefficient of SiC ceramic is 3.7×10^{-6} 1/°C which is comparable with that of Si single crystal. The thermal expansion coefficient of alumina is also large, $6.5\text{-}7.5 \times 10^{-6}$ 1/°C. Therefore, SiC base boards are especially suitable for parts with large area or for direct bonding of pellets where heat dissipation is an important factor. An ordinary SiC has a relatively small specific resistance of the order of 5-50 Ω-cm and its thermal conductivity is also small, of the order of 0.15 cal/cm-s-°C. The said research laboratory has not yet made it clear why it was able to raise both its thermal conductivity and specific resistance. Its commercialization is expected to be realized within 1 year at the earliest or 2 years at the latest. Its price is expected to be 20-30 percent higher than alumina.

Microprocessor, Multiprocessor, Pattern Recognition

Development of Multiprocessor Consisting of 33 CPU

A parallel processing system consisting of 33 microprocessors has been developed by Tokyo Industrial University.

The microprocessors used are Z-80 microprocessors. One of which is used as the master processor and the other 32 are used as the slave processors. Its main application is the high speed processing such as similarity calculation and extraction of characteristics as often encountered in the pattern information processing. Since the calculation involves a great deal of integration and summation, a special LSI (TDC 1008J of TRW) is added to each processor in order to improve its speed. The master processor and its slave processors are coupled by both common bus and variable ring. The common bus is used for high speed master-slave and slave-slave transfer. The variable ring is somewhat slower than the common bus. It is used for local transfer between adjacent processors using a ring-shape transfer circuit of variable length. It is suitable for data transfer during sorting and FFT computation. A single slave system can carry out an inner product of two 256 dimensional vectors in approximately 400 μs. The system as a whole can solve a system of 128 dimensional, first order, simultaneous equations 20 times in 1 second. Programming uses an extended C language.

Facsimile, Electrostatic Recording

High Speed Facsimile With a Resolving Power of 16 dot/mm and a Recording Rate of 1 ms/line

A high speed facsimile device having a main scan resolving power of 16 dot/mm, an auxiliary scan resolving power of 15.4 line/mm, a reading rate of 2 ms/line, and a recording rate of 1 ms/line has been developed jointly by the Matsushita Electrical Transmission Equipment and the Matsushita Electrical Industry. The device has a keyboard, and is suitable for application in a data network with a data transmission rate of 56 kbyte/sec or less. High efficiency coding is achieved by means of 2-line bundle run length coding format. The transmission control program uses HDLC. The reader section uses 2 sets of 2048 byte self-scan type CCD (MN8027 of Matsushita Electric Industry) in order to realize a reading rate of 2 mw/line. The recording section uses multistylus electrostatic recording format. The diameter of a single recording stylus is 40 μm, and 4096 such styli are arranged with a gap of one-sixteenth mm between styli (a total width of 256 mm). The high recording rate of 1 ms/line is achieved by making the electrostatic capacity of the electrode small.

Nonvolatile Memory

Lower Voltage Nonvolatile Memory Made Possible From Introduction of Band-gap Gradient in the Insulation Film

An attempt to lower the writing and erasing voltage of a nonvolatile memory cell of floating gate type by imparting a gradient to the energy band-gap of the first insulation film from 7.9 to 5.1 eV was made by the Fuji Communications Research Laboratory, and the results will be presented at the 1980 International Electron Devices Meeting to be held in Washington, D.C., in the United States on 8 December. The first insulation layer is formed from direct nitriding of the Si base board followed by oxidation. Its structure is of mixed film-oxide film type consisting of Si base board-nitride film-nitride film plus oxide film. The band-gap changes gradually from 7.9 eV at the oxide film to 5.1 eV at the nitride film. The thickness of the insulation film is approximately 10 nm. Writing is made easier by reducing the band-gap of the insulation film on the Si base board side, while the holding characteristics are maintained by leaving the gap of the insulation film on the polycrystalline Si side intact. Writing and erasing can be done with voltages of 10 V/10 ms and 12 V/10 ms, respectively.

Facsimile, Communication Method

Facsimile Communication System With Data-Image Transformation Capability Being Developed

Nippon Denki is in the process of developing a communication system which is capable of transforming various informations stored in a data base into facsimile image information.

This is a union between facsimile communication system and on-line data communication system. It made possible access to the data base contained in a data network from a facsimile terminal. Placing an image transformation subsystem between the facsimile network and the data network, services such as construction of fixed format documents or graphs including stock market information and sales information can be offered. An inquiry from a facsimile terminal to the data base causes transformation of various graphs or sentences into image information of a synthesis of these as a response. The image transformation subsystem consists of minicomputer (NEAC-MS50) and 20 Mbyte disk containing patterns for carrying out the data-to-image transformation. The data network interface at the rate of 4.8 kbyte/sec and the facsimile network interface at the rate of 48 kbyte/sec. At present, a system to be installed at the Yamato Securities and expected to begin service next August is being developed. The inquiry-response time between facsimile terminal and data base takes approximately 4 minutes.

Semiconductor Manufacturing Technique, Etching, Microprocessing

High Selectivity Etching of Polycrystalline Si Without Side-Etching

The Central Research Laboratory of the Hitachi Works revealed in a technical exhibition held by the said company a method of etching polycrystalline Si using microwave plasma. By this method, the base material SiO_2 can be etched with a high selectivity (a measure of etching rate difference) of 30-100 times with very little side-etching (etching in the lateral direction). The selectivity of a photostat is of the order of 6-10 times, while that of Si_3N_4 film is 10-30 times. The gas used is SF_6. With a 2.45 GHz microwave (60-80 W), discharge becomes possible at a pressure as low as 10^{-4} torr. On account of the low pressure, the mean free path is longer and the ionization ratio is higher. The ions which participate in the etching action will be injected vertically into the base plate. The ions become directional due to an ion sheath (a voltage difference of approximately 20 V and approximately 0.1 mm in length) formed on the surface of the base plate and, as a result, side-etch effect is significantly reduced. Since the injection energy used is a relatively small 20 V, the base plate is seldom damaged by it. Moreover, since the ionization rate is high, the rate of gas flow can be as small as 1 cm^3/min (see this journal, No 159, pp 33-37, 2 May 77). Micropatterns cannot be formed very sharply on a polycrystalline Si if the side-etch is too excessive.

9113
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SCIENCE AND TECHNOLOGY

NEW DEVELOPMENTS IN JAPANESE ELECTRONICS INDUSTRY

Tokyo NIKKEI ELECTRONICS in Japanese 8 Dec 80 pp 267-268

[A brief description of new developments in the Japanese electronic industry]

[Excerpts] Toshiba to build a super-LSI plant in Oita; equipment investment to total 10 billion yen.

Tokyo Shibaura Electric Co, Ltd plans to build a super-LSI production line in its Oita plant (Oita Prefecture), investing approximately 10 billion yen in equipment. As the first step in that direction, the company in October began construction of the No 4 clean room in the Oita plant, investing about 2 billion yen. This is to be followed by additional investment within the fiscal year of several billion yen to introduce LSI production equipment capable of minute processing. By the second half of the fiscal 1981, it will have invested a total of 10 billion yen and production of super-LSI will have begun.

Tokyo Sanyo completes construction of LSI plant; production of super-LSI to begin in summer 1981.

Tokyo Sanyo Electric Co, Ltd has completed the construction of a 6 billion yen LSI plant within its main office plant in Yuraku-gun, Gumma Prefecture; production will begin next spring. The new plant is a 2-story steel-frame structure with 6,500 m^2 floorspace. By the summer of 1981, the company expects to start producing super-LSI which it is now developing. With the completion of the new plant, the monthly production capacity of IC and LSI will double to 20 and 40 million units, respectively, and their combined share in the total sales of the semiconductor division will increase to about 70 percent.

Fuji Electric increases investment in semiconductor-related equipment; 3 billion yen for current fiscal year.

Fuji Electric Co, Ltd will invest an additional 6 million yen in semiconductor-related equipment during the current fiscal year, raising its total investment to 3 billion yen. Furthermore, since the demand for its amorphous solar battery, introduced this August, is good, the company is studying further increases and adjustments in equipment investment in order to strengthen the production facilities for this item. Among other things, the current proposal aims at increased production of "seren" and enhancing the power-transistor assembly line.

Oki Electric to begin production of 64 K RAM next November.

Oki Electric Industry Co, Ltd has announced that it plans to produce 200,000 units of 64-K bit MOS RAM monthly as of the third quarter of the coming fiscal year. The unit will carry the trademark "MSM 3764," and will have 2 maximum access hours of 150 ns and 200 ns; it will operate on a 5 V single power source and will consume 250 mW (maximum) in its operation. Shipments will begin next October, and the company plans to produce 200,000 units monthly between November and March 1982 when full production is realized.

KDD succeeds in practical application of obstacle point detection system for underwater cable.

Kokusai Denshin Denwa Co, Ltd (KDD) has successfully developed a technology for detecting, from land, obstacle points along underwater cables. The range of error is 20 m. The system utilizes the so-called FS (frequency scanning) type distortion shuttle testing method. By periodically altering the repeated frequency of a pulse sent from the cable station, the system can pick up the variance in reflected distortion waves, which depends on the location of the obstacle. This enables the system to detect the obstacle point.

Kyo Ceramics develops ceramic package with 1/10 the α-ray of existing models.

Kyoto Ceramics Co, Ltd has recently developed a new ceramic package for IC and LSI which emits less than 1/10 of the α-rays emitted by existing models. The new product will be marketed in the near future. The company presently supplies the "surdip" [phonetic] type [packages] but the newly developed model indicates that it has succeeded in commercializing the layer type as well. The use of alumina as base does not differ from the existing models, but the company says that such radioactive impurities as uranium and tritium have been almost totally removed from the raw materials used.

Mitsubishi reveals GTO with 2,500 V resisting pressure and 1,000 A control current.

Mitsubishi Electric Corporation has developed a GTO (gate turn-off) thyristor "FG 1000 A 50" capable of controlling principal current up to a maximum of 100 A and a high resistance level of up to 2,500 V. It will be sold beginning next April. The price per unit is about 1 million yen. The maximum capacity of the existing unit is 600 A and 2,500 V. The turn-off time is 15 μs; the turn-off gain, 5 μs. The increase in capacity was achieved by improving the highly technical process of dispersing impurities.

Fine Ceramics conference formed to develop ceramics with wide range of application.

Nine private companies, including Tokyo Shibaura Electric Co, Ltd and Asahi Glass Co, Ltd, and one [industry] organization have recently formed the "Fine Ceramics" Conference" (chairman--Tomio Tanatsugu, vice president of Toshiba).

The objective of the conference is to develop new nitride and carbide ceramics capable of resisting high temperatures and sudden cooling. The Ministry of International Trade and Industry regards this area of development as one of the important themes in the "next generation of technology." The ministry is hopeful that such products will also be used for automobile engines and gas turbine generators in the future.

9710
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SCIENCE AND TECHNOLOGY

LEVEL OF 'TECHNOLOGY' QUESTIONED; ORIGINALITY LACKING

Tokyo BUNGEI SHUNJU in Japanese Vol 58 No 12, 19 Dec 80 pp 332-349

[Article by Katsuto Uchihashi, critic on economic affairs: "An Illusion That Japanese Technology Is 'First Class'"]

[Text] Blanks in the Blueprint of "Ayame"

Japanese engineers who engage in space development often encounter strange-looking drawings.

In blueprints filled with fine lines and countless symbols, there are some "white spaces" left empty like broken open clouds. These hollow parts, which look like a picture of a watermelon emptied of its fruit but left with its ring, are commonly called "black boxes."

Most recently, artificial satellites have been composed of around 40,000 different parts. Among them, sophisticated parts and devices which cannot be managed by our technology at home are entrusted to spot purchases from U.S. aerospace manufacturers. These key components (central parts), which are made available at the time of purchase under the condition that they are "not to be opened up," are what we call "black boxes." Black boxes are present every where in the satellite body proper and in rockets.

According to the National Space Development Center, a black box is defined as "a manufactured product purchased under the condition that it will be used in its sealed state." Its secret (know-how) is, it is said, protected by mutual trust based upon "official documents exchanged between Japan and the United States" (official documents concerning cooperation between Japan and the United States in the matter of space development).

As a result, Japanese engineers in charge of satellite and rocket assembly are unable to know, needless to say, the internal structures, the details of the manufacturing technology and, in extreme cases, the inspection items of the devices to be housed in the "white spaces."

All an engineer has to do is to fit the actual black boxes, arriving one after another, in the satellite proper or on the rockets according to the procedures indicated in the drawings.

"A terminal is sticking out (from inside the black box); then we get a wiring diagram instructing us which wire is to be connected to this terminal. But we don't know at all what's inside the device." (the center concerned)

In short, the position of the terminal to be connected by the outside wire is illustrated on the line which indicates the outline of the "black box." Engineers responsible for the assembly merely connect the wire to the terminal, exactly following the instructions given--for instance, "Connect wire A to terminal A, and wire B to terminal B...."--as they compare the American-made device and the American-made drawing.

A black box is a sort of "untouchable" to Japanese engineers.

In February of this year, there was an accident associated with one of these black boxes.

This incident has already been made known. Experimental stationary communications satellite "Ayame No 2," launched from Tanegashima Space Center at 5:35 pm on 22 February, suddenly stopped transmitting radiowaves and disappeared into the depths of space at 1:46 pm on the 25th, after 3 days of smooth flight to the target point.

Including "Ayame" (model No 1 failed to separate the third-stage rocket), which failed on account of rocket trouble just about a year ago, 2 satellites worth a total of 25 billion yen were frittered away like dust into space within a year. Four months later, the director of the board of the National Space Development Center resigned.

The manufacture of "Ayame No 2" (ECS) was contracted to the Mitsubishi Electric Corporation's Kamakura workshop, just like the previous "Ayame."

The company has had experience in the past as prime contractor (main contractor of the National Space Development Center) of many satellite projects--namely, "Kiku" (ETS-II), "Ume" (ISS) and "Sakura" (CS). The engineers of the Kamakura workshop, who had confidence in the quality control of the key components, stared bluntly at the sky and remarked scornfully, "Everything went all right except the one last thing, which blew the whole thing up."

Their frustration is understandable, since it was disclosed that the failure of "Ayame No 2" was caused by the "apogee motor," one of the black boxes untouchable to the engineers.

The apogee motor is a "solid fuel rocket" which is incorporated in the satellite body. This motor furnishes the propulsion which enables a satellite to enter into a subsequent "circular drift orbit" by itself when it reaches an apogee. This is one of the most important key components for the satellite, and is equipped with functions which can be easily converted to a missile.

The apogee motor, critical as described above, suffered abnormal combustion after being ignited, and as a result it is presumed that "Ayame No 2" deorbited far off course and was lost in space.

Naturally, a barrage of criticism was directed at the project. The opposition party questioned the project persistently and even brought the subject to the floor of the Diet (Committee for Settlement of Accounts, Lower House).

"What was done to test the apogee motor before accepting it? Is our domestic technology so inferior that we cannot manufacture a little thing like an apogee motor?"

Well, to make the story short, we are only asking for "what is not available" if we demand a 100-percent perfect test or a domestically produced apogee motor, as long as the present level of domestic technology is all we rely upon. It is beyond our present domestic level of technology to conduct a 100-percent inspection, and it is far beyond our ability to manufacture and make use of the apogee motor per se. (According to joint research by the center and the Nissan Motor Co, Ltd, the target date for the achievement of domestic production is set for the earlier part of the decade starting in 1985.)

This fact itself, that the presence of "black boxes" is inevitable in satellites and rockets to be launched by Japan, can well serve as a measuring stick to evaluate objectively the level of our national technology in general. In order to clarify this point, it is felt necessary to clarify the actual conditions of the "Ayame No 2" case.

Have We Overtaken the United States?

"Japanese technological capability has now reached the world's top level in virtually every field, and it is about to surpass the American level even in the most advanced technological industries."

In recent days, proud and confident arguments such as "our technological capability has surpassed the American level" are being circulated with a lot of fanfare.

I am afraid even people far away from the scene of technology and research and development are unconsciously starting to entertain this bullish sentiment: "There is nothing to be afraid of from the advanced European nations and America."

True, not a few European and American giant industries are starting to feel the blow and are helplessly shutting down factories because America and the EEC nations cannot fight off the Japanese imports, and trade disputes have developed one after another in many industrial sectors such as automobiles, electronics, shipbuilding....

Our technological capability must surely have reached the world's superclass level, since it gives such strong competition to the exports and sizable damage to the European and American powers. As proof, tour groups interested in observing Japanese industries are rushing in from European nations and the United States. In this way, the image of "Japan as a technological superpower" is amplified. However, I wonder to what extent this theory of Japanese "superiority over America" is supported by facts.

Now, let us go back and talk about the actual case of the experimental stationary communications satellite "Ayame."

Complex steps and systems are required for a single artificial satellite to take flight in space.

A project normally proceeds as follows: 1) conceptional design; 2) preliminary design; 3) selection of manufacturers (selection of prime contractors and subcontractors); 4) basic design; 5) specified design; 6) acceptance test; 7) completion of satellite; 8) transportation to launch site; 9) test at launch site; 10) installation of apogee motor (in case of stationary satellite), thruster fuel injection (in case of same), etc. There is an interfacing with rockets between steps 2 and 4.

Speaking of "Ayame," the conceptional design of step 1 was in the hands of Ford Co, and the preliminary design of step 2 was shared by Mitsubishi Electric Corporation and Japan Electric Company, Limited.

Each of the two Japanese companies submitted a "proposal" to the National Space Development Center which included even a cost proposal and appeared to go like this: "We will take this method for development, and the reliability control will be handled in this manner. The estimated cost will be...." In the end, the Mitsubishi Electric Corporation won the title of prime contractor. Thereafter, the Mitsubishi Electric Corporation received the conceptional design from Ford and was entrusted with the progress of the steps starting from the basic design of step 4.

Nonetheless, the truth of the matter is, it actually went like this: "On the surface, Ford made the conceptional design and the Japanese side was responsible for all the steps starting from the preliminary design. However, in the case of "Ayame," the American side did practically all of the designing. The Japanese side merely helped and learned the technology while working on the design." "Design responsibility," which is called design authority, was completely in the hands of Ford.

Well, what about the "apogee motor" in question? Where the design authority is in the hands of the American side, the procurement sources for the apogee motor and the subsystems are entirely committed to the decision of the American side.

The Ford Company, using its own judgment, selected "Aerojet Company," known as the world's first-class manufacturer of apogee motors, and indicated a desire to supply Aerojet's product to Japan. Our National Space Development Center agreed to these terms. (The apogee motor manufactured by the Aerojet Company was guaranteed for its high reliability as an item approved by the center.)

The article was delivered. The actual apogee motor gave the impression of a Halloween ghost at first glance--like an upside-down megaphone carrying a volleyball at the mouthpiece.

"The Japanese side does not understand why the apogee motor is shaped like that, the reasons for using this particular shape, and how it was designed. The component composition of the solid fuel inside the shell is, of course, not known. Everything belongs to the secret know-how of the Aerojet Company."

The only thing said to have been delivered to Japan with the article was some directions--papers instructing where the apogee motor should be installed in the satellite, how to set it up, and what can be done with the shield to meet the expected heat to be generated. The difference in the level of technology between the two countries is clearly evident.

Then, how did we inspect the article before accepting it?

The checking method used by the Japanese side was "nondestructive testing," which exposed the article to X-rays while it was rotated to detect cracks and bubbles on the solid rocket contained inside. (Both defects are likely to develop while transporting the article, and cause abnormal combustion.)

Couldn't you test it further than that? asked one concerned with the project.

"Not possible; we did not have the testing technology."

In order to detect a fine crack which could cause the abnormal combustion that led "Ayame No 2" to fail, more sophisticated technology was required. They did that on the American side before they shipped the article to Japan. They had the technology to do it. What kind of finished product testing method was used?

Actually, there are skirts made in the shape of a "petal" on the plane at the base of the completed apogee motor. A large tool which looks like an ear cleaner is inserted through this spot, it uniformly scrubs the surface of the solid fuel inside, and takes samples of the materials.

A small amount of the powder (solid fuel) scrubbed and collected is burned to examine its caloric value.

If there is a crack on the powder, there will be a delicate difference in caloric value. The presence of cracks can be determined by scrutinizing the development of the caloric difference at each site.

We Can Manufacture an Identical Article, but....

Why can't we do this sequence of operations in Japan? A specialist gives an explanation.

"Scrubbing is not what is difficult. The difficult part is the caloric analysis of the scrubbed and collected samples burned in a vacuum, since propulsion in a vacuum is the issue concerning a rocket.... However, the technological software and hardware for making such a tester do not exist in Japan. Furthermore, the slits inside the apogee motor are shaped like a petal for the purpose of achieving better solid fuel combustion. The truth of the matter is that we cannot ask and find out about why the slits are shaped like that, what kind of shape can achieve the maximum combustion efficiency, or what kind of methods can be used to find it, since these questions all fall in the category of the know-how of the Aerojet Company."

If we were asked to make an identical article, it might be possible for us, given our present technical capability, to produce an apogee motor with the same appearance. Why the apogee motor should look like that, however--the root know-how--would never be deciphered. That is the context of the explanation. (As will be discussed later, the essence of our national technology has been like this at any given period of time.)

And yet, it is said, this troublesome apogee motor is only a minor case as a black box.

At least, an apogee motor delivered with a simple drawing showing an outline of the inside, can be inspected with X-rays. Therefore, some say that an apogee motor is not a black box in the strict sense.

In comparison, not a few black boxes with literally unidentified contents are hidden in the "guidance and control system" inside the rocket.

This system is in the second-stage rocket, which plays the important role of imparting spin or changing the position of the satellite. The "Gyro Standard System" and "VCS (velocity cutoff switch)" incorporated in it fall into that category. They are typical examples of an integral black box, and they can never be covered by domestic technology.

Well, as I write this subject to this extent and effect, some may question "whether it is proper to use the aerospace industry for a comparison of technology. It is understandable that Japan cannot catch up, since the aerospace industry requires highly sophisticated military technology, the forerunner of the most advanced technology along with atomic power and nuclear fusion."

Certainly, such an opinion is acceptable and makes sense in the light of a "Japan stripped of its military power." Nevertheless, military technological items are at the same time not necessarily adorned completely from head to toe with military technology. We cannot overlook the fact that extensive fringe areas are formed by a cluster of general technology which may involve machinery and equipment for the civilian sector.

In fact, satellites and rockets contain some components which are far from the reach of Japan in the field of technology that belongs to general technology and super sophisticated processing technology. Let me give you a few examples.

Antennas (K-band antenna, C-band antenna) are attached to the head of a satellite. Antennas always keep turning to face the earth. With turning antennas, a bearing will be required on the spot where the antenna contacts the satellite body.

The Japanese bearing industry is doing such a good business that it is causing trade disputes in the EEC market, and it is natural that we take it for granted that domestically made bearings are used for the joints. Well, we are fooling ourselves.

It is beyond the capability of our own technology to manufacture bearings which can permanently work without oil at a constant and coefficient friction.

We have no alternative but to rely on an American industry named Ball Aerospace Company (old name, Ball Brothers) for the oilless bearing employed on that spot of the satellite.

Also, the flat deck (board in the central section) of the satellite is constructed in a honeycomb structure, and a very thin aluminum alloy sheet is used for the top and the bottom. These types of goods also cannot be accommodated by domestically manufactured products. Although it is not that we do not have the metallurgical technology in Japan to roll at a low temperature, we somehow cannot manufacture an aluminum alloy sheet that can meet the required performance, no matter how hard we try.

Here is another example. The pipe of the thruster tank used for the "second propulsion system" of a rocket is required to sustain a reliability of 99.99 percent for unmanned rockets and 99.9999 percent for manned rockets.

Methods used to perform the reliability test on the manufactured pipe, from the application of pressure to the testing method, are all categorized as know-how and are forever kept undisclosed from the Japanese technical engineers.

Up to now, in space development where sophisticated advanced technology is concentrated, black boxes exist everywhere; I wonder what this implies.

Needless to say, the aerospace industry can establish itself only after it works closely with the computer electronics industry. This is because electric machinery and equipment supported by highly advanced computer technology and high electric communications technology are required for the guidance and control of satellites and rockets.

Conversely speaking, at the present time it seems that an independent aerospace industry cannot be set up unless it has access to the most advanced large-scale computer communications technology and balanced massive peripheral technologies that form the skirts of the system.

The fact that "Ayame" (No 1 and No 2) contained numerous "black bloxes" in the heart of the satellites and the rockets does indicate, I believe, the reality that the standards of Japan still remain on a level that is dependent upon and far behind American technology in the area of these advanced and peripheral technologies.

War Over Chips

Clearly examining the lineage of our technology, we will soon realize that there is no significant difference in the substance of our posture in becoming involved with technology and the Japanese model technology produced as a result between the prewar period and the postwar period, or even today when we claim that we are "a technological superpower."

Before the war, our technological capability advanced greatly in the period from 1935 to 1940, and echoed the surge of one peak. When you look at the content, however, three characteristics can be found that are clearly associated with the brittleness of the technology itself.

First, the technological progress was extremely unbalanced. The areas which progressed really made great advances, whereas the areas which were left behind remained pathetically way back. Even taking the single area of aircraft technology as an example, Japan was said to have reached the international level in hydrodynamics and structural dynamics but was highly unreliable in electronic machinery and equipment including radio detectors and hydraulic systems.

Secondly, according to the traditional pattern established, technological development did not have many purposes but always had a single purpose to be pursued with determination. Research and development with latent value, without a definite purpose in a field which is likely to offer something unknown, were never given a chance. In those days, everything was executed in the name of a "military purpose."

Thirdly, in association with this, our technology aimed only at practical applications, and basic research which leads to the creation of technology itself used to be neglected. As a result, research and development competitive in improved technology and applied technology prevailed throughout Japan.

I feel helplessly surprised to find that everything we do today fits into what we did in the past, if only the concept of prewar "military adherence" is replaced by "commodity adherence" (recently, commodity adherence has been the sweeping trend, even in universities and public research institutes).

Here, after all, the prestigious "semiconductor" can be named as a typical example of (import) technology that had always been assimilated in a form adhering to the demand for "commodities." Nowadays, Japanese businessmen at every step of the ladder have been familiar with the catch phrase "Japan-U.S. Semiconductor War."

The implanted image sweetly whispers that Japanese technology will monopolize the market in the field of semiconductors--a market in which we fought neck and neck with the United States, threatened them, and now have emerged as the winner. This may be a quite unexpected tale for the people whose head is swollen with such an image, but it is a fact that our prewar pattern of imbalance, lack of basic research, and commodity adherence is fully inherited by the technical development of the "semiconductor."

A technological developer who pioneered the era of electronic desk calculators in Japan and who sits at the very top of semiconductor technology confides: "It is only part of the story to say that Japan looks like it is competing evenly with the United States in the world of semiconductor technology. Japanese power is exercised in only a very small part of actual semiconductor application, adhering to the demand for a certain specific commodity." (Director Shige Asada, Sharp Corporation)

Of course, there is a reason why Japan's achievements "appear larger" than what they really are, in spite of its small contribution to "technology."

"It so happens that the applicational and merchandising field of the semiconductor--in other words, the market facade--is presently concentrating on certain fields in which Japan is good. Precisely because commodities in fields of technology in which Japan excels are in great demand at the present time, Japan looks good and competent."

Such a phenomenon--dominance in a market, in contrast to a marginal contribution to technology--often occurs between technology and the market.

If standardized and mass-produced semiconductors are manufactured at full speed and flood the market, as is the specialty of Japan, this may somehow give the impression, to the eyes of the people who see things only in terms of quantity, that "Japan is strong" and "Japan has surpassed the United States."

From the course of the overall progress of semiconductor technology, the current market happens to have reached a stage wherein mass-produced, standardized goods are in the mainstream. Such is the interpretation by the engineers who live in the world of semiconductors.

"Returning to the technology map, Japanese semiconductor technology is merely an island in the overall world map. Comparing technical capability with presence of mind encompassing the outlook of the waiting markets (markets waiting to be tapped), the overwhelming power is in the hands of the United States, I am sure." (Asada)

Let me explain in more detail.

It is often said that the semiconductor war is fought over chips. The super-LSI war is fought for many more transistors for the memory capacity of the chips.

This is exactly true. Yet the semiconductor war is not entirely of a war over chips. It is merely a first world war, figuratively speaking, judging by its disposition. The second world war will start in parallel with it.

For example, the war over chips will be instantly obsolete if at this moment a powerful "material revolution" of the semiconductor itself breaks out, kindled by the question of whether or not there is a more suitable raw material as a semiconductor to replace the silicone presently in use.

And engineers now know well that this possibility is no longer a hypothesis on paper.

Multipolar Power Relation

For example, a high-speed element which may be created by utilizing "gallium and arsenic compound" or "amorphous" may be a potential candidate as a new material. With these questions posed, the United States is actively setting forth into basic research on the respective materials, beginning with an inquiry deep into the properties of matter itself.

In contrast to this, specialists conclude that, unfortunately, hardly any private research institutes in Japan inquire into a material--say, amorphous--by first digging into the "properties" of amorphous itself.

However, needless to say, it is quite unknown whether or not gallium-arsenic or amorphous can be immediately connected to the semiconductor material revolution. American industries have started research, motivated only by the potential. It is virtually impossible to find in Japan an enterprise that is willing to invest manpower and money for basic research of this nature. Stand by and wait for the U.S. results. Once a favorable result is indicated, never lose a second but leap up to follow suit. This scenario was the basis of the Japanese style in the past, and it is still the same today.

On the other hand, how about the equipment which produces the semiconductors themselves? After visiting numerous production sites, I realized first the fact that practically all equipment on hand in the semiconductor production plants is American-made.

Recently, a great renovation is gathering momentum in the field of super-LSI manufacturing technology. The traditional exposure technology by "light" is starting to take a step forward in the direction whereby ultra-fine patterns are produced by "electron beams."

However, the "electron beam exposure system" that does this job is manufactured almost exclusively by the American Itek Company. The speed with which manufacturer can import the Itek system ahead of others is said to affect the competitive power of semiconductor manufacturers. (A similar system was voluntarily developed at the Joint Research Institute of the Super LSI Research Union, which was recently dissolved. However, those that are practical are virtually all American-made.)

A long time ago, in connection with the importing of polypropylene technology in the petrochemical field, a "pilgrimage to Monte" (Japanese industries rushed to the gate of the Italian Monte Catini Company) commotion once broke out.

Now, "waiting for Itek" is whispered in the semiconductor business world, modeling after that. This comes from the long waiting list which blocks the immediate acquisition of the actual product, even when the electron beam exposure systems are ordered from the Itek Company. A manufacturer who succeeded in obtaining the system one step ahead of the others is, to tell the truth, really relieved: "We acted fast to pave the way. Thanks to our discretion, we are saved."

This electron beam exposure system is only one example. Many engineers acknowledge that "Silicon Valley" is still at the top, not only in semiconductors but also in the most advanced devices which manufacture semiconductors per se--for instance, the device which facilitates the growth of a very thin single crystal film on the surface of a silicon wafer (material for semiconductor), the device which controls by microcomputer everything in the process by which photosensitive resin is painted on the wafer and the treated wafer is developed, and the device which removes hydrogen bubbles from the wafer.

As clarified above, if your eyes are glued only to the tide of the war enveloping the mass production of semiconductors and the maximization of memory capacity on a chip, the true power relation in the "Japan-U.S. Semiconductor War" can be hardly perceived.

I think we can enter into a true discussion of whether or not we have surpassed our opponent not in that manner but only after we begin to look at the multipolar power relations, such as the progress of semiconductor utilization technology, the semiconductor material revolution, and semiconductor manufacturing system technology.

Unfortunately, these alone may not yet really be satisfactory.

Many other most advanced technologies are required as peripheral technologies which influence the future of semiconductors. One of them is the super-sophisticated processing technology," called "nano technology." A "nano" is a unit of extremely small size--one one-thousandth of a micron. (One micron is one one-thousandth of a mil.) This technology has become necessary in the fields of space satellites, introduced at the beginning of this article, nuclear fusion, nuclear power generation, and most recently in the field of grooving videodisk originals by using ion beams.

Now, I say, this same "super-sophisticated processing technology," where even the size of one nano makes the difference, has been mobilized in the super-LSI manufacturing sites. The emergence of the super-sophisticated processing technology will further demand the development of peripheral technology to make instruments and tools which can measure the size of one nano exactly on the dot. The conventional material processing technologies will rapidly be outdated, and a new material treatment technology which controls the movement of atoms themselves must instead come upon the surface.

The progress of the peripheral technologies will be linked inversely to the change in the world of the super-LSI itself.

As described above, in the semiconductor war during the super-LSI era, it is absolutely not possible to win totally by having only one area of technical capability in which one excels proudly and superbly.

The outcome of the semiconductor war will be determined by the height of balanced comprehensive technology standards, including peripheral technologies. Even on these points, our national technology level is far from that of the United States.

"The most advanced technology of America hardly comes to the surface at any particular given point of time. The manufactured goods which lead semiconductors all disappear directly into the net of the demand by the military who ordered them. It is most likely correct to think that all the semiconductors that are presented to the market and exposed to our eyes are those brought down to the level of goods for the public. Just like solving a riddle in a mystery story, readers cannot measure the size of their latent powers submerged below the surface until the story ends." The foregoing is the belief commonly shared in the foremost line of Japanese semiconductor technology.

How then can we declare that "Japan has surpassed America" when our national semiconductor technology is still dragging "commodity adherence," "imbalance," and "absence of basic research" in its mentality?

Of course, it is expected that objections may be raised to this strict point of view: "I hear that Silicon Valley is actually hard-hit by the force of the high-quality Japanese goods produced by high technological capability."

It is true that at one time, it was persistently reported that the venture businesses of Silicon Valley suffered from the double blows of offensive exports by the Japanese semiconductor manufacturers and European capital's offensive in an attempt to buy the businesses.

As soon as the rumor of businesses "for sale by owner" was reported, this news immediately gave the impression that "Japan is superior" in the Japan-U.S. semiconductor war. It is the impression of "Japan driving America into a corner."

However, the very subject of the rumor, Silicon Valley, is neither desperate not depressed. This is because there are undisclosed circumstances over there that are essentially different from the simple-minded "win or lose" mentality of the Japanese people.

Among the venture business of Silicon Valley, there is the "Zilog Company," which became the topic of talk after it came under the wing of the giant Exxon.

Intel Company was created by Fairchild, which invented roots technology for semiconductors. It is well known that this Intel produced Zilog through a division.

When President Federico Fergin of this company visited Japan, he told an engineer of a business tieup partner firm: "We asked Exxon to back us up, since an enormous amount of capital is required to develop the tools (for the microcomputer utilization technology). Now we are ready to engage in new development."

It is definitely the genuine Japanese sensitivity to interpret the sales and purchases of businesses and the import of capital as selling oneself to "giant capital" or surrendering to the European army. We must learn that actual businesses move in a world different from such a sensitivity.

With the money given by the parent company or the money procured from a third party, a venture business is started, and after it is expanded, its stock is opened to the public. That is the pattern of the birth and growth of venture businesses.

In this respect, the candid state of our semiconductor industry is summarized: "Using technology and production equipment purchased from America, the Japanese people--an excessively workaholic and diligent species rarely seen in the world--are totally devoted to manufacturing standardized and mass-produced goods at full speed and are frantically selling the products back to the originator." In other words, it seems like we are drawing a picture of the world's best "wage-earning processing industry."

For those who complain of the harshness of this expression, there is nothing I can do but ask them to wait and see the consequences in the future-- after 1990. However, I would like to request that they listen attentively to the following prediction by a first-line engineer about the future outlook of the "Japan-U.S. Semiconductor War."

"The new super-LSI technology about to be born now will not be sold by itself to Japan. They are resolved to keep the utilization technology in their own hands, and the devices will be sold as a set with the utilization technology. This is the strategy about to be adopted by America for the semiconductor war. In the future, the function of semiconductors will be sophisticated and diversified, and their performance will improve rapidly. Tremendous amounts of human energy and capital, probably as much as to involve hundreds of engineers in years of research, are required to materialize software which can make the best use of the progress in the function of semiconductors. How many Japanese enterprises can stand that kind of preliminary investment? Eventually, development of software will be monopolized, and on the other hand, the actual semiconductor (hardware) production sites will be dispersed throughout the world. Japanese semiconductor makers have no choice but to move toward earning by means of mass production, once more using devices equipped with software and 'manageware' purchased from America."

According to the production structure based upon macro-analysis of the world's supply and demand, even in semiconductors which lead the technology-intensive industries, Japan seems to proceed deeper and deeper in the direction of appearing like a "nation of wage-earning processing industry."

In a dimension totally different from the mentality of talking about whether we "won" or "lost," those Japanese engineers and researchers who actually deal with the technology feel a serious, escalating "sense of crisis."

Only Two Noteworthy Technologies Exist

A sense of crisis is felt intensively among those who know technology. The closer the engineers and researchers are to the actual scene, or the more specialized the specialists are, the fewer are those who think "Japan has surpassed America."

"Japan Techno-Economics Society" (Corporation President: Toshio Doko) took a poll by distributing questionnaires to 450 top management officers in charge of technology and development in private enterprises in July of this year (questionnaires returned: 204).

What about the results?

They answered as follows to the question: What about Japanese "standards of noteworthy and original research," compared to the advanced European nations and America?

(Japanese) standards outstanding	0.5 percent
Slightly higher	8.4 percent
On the same level	18.2 percent
Slightly behind	65 percent
Considerably behind	7.5 percent

This translates out that more than 70 percent of the total answered that Japan was "behind Europe and America."

What do they say about the reasons for this tardiness?

Some 57 percent of the total answered: "Because private enterprises have not poured their energy into basic research, which becomes the core of the noteworthy and original research," while 47 percent answered: "The government's science and technology policy has not supported this kind of research" (more than one answer).

This is what the men in top management positions of technology and development willingly admitted.

Many respondents gave the following two reasons as factors which have inhibited basic research: private enterprise's attitude toward research and development is to put a priority on short-term profit (78 percent); the uniform school education system ignores individuality (67 percent).

Only one respondent contended that the present "research system" has no problems.

What do these poll results indicate? Throughout the era of high economic growth, a decade starting in 1965, the science administration and general enterprises in Japan adamantly disregarded "basic research." Zealously pursued the "instant golden egg" which quickly turns into commodities from hand to mouth and brings profit to the enterprises.

During this time, "applicational research" and "developmental research" boomed instead of "basic research."

The traces of this are explicitly impressed on the structure of research expense outlays.

The ratio of "basic research expenses" (nationwide) to research expenses registered 30.3 percent in 1965, but it reduced sharply to 13.5 percent in 1977, and the same figure was reduced to a marginal 4.7 percent in private enterprises. Compared to this, "development and research expenses" allocated to research for improvement of technology imported from America and Europe and for existing technology was at a high level of 75.7 percent in the same year.

Japan left the highly risky, roundabout "basic research" to Europe and America, while [Japan] herself searched viciously like a hawk for the results of the research. If she found technology with good potential use in the West, she immediately flew high, flapping her wings, brought the material back in her beak, and rolled it out in front of the engineers of her companies working for development. Without any loss of time, "applicational research" and "developmental research" commenced.

By avoiding the largely unpredictable "basic research" and devoting herself to efficient development, the competitive power in the cost of the finished commodities became strong, as a whole. This is merely a situation where the model of so-called "handstand research" was put into practice by Japan. If the results of this research had been pleasing in all respects, the sense of crisis indicated in the poll data would not have appeared. The truth of the matter, however, is quite to the contrary.

First of all, "developmental research" and "applicational research," which have been Japan's specialties, are starting to reach an impasse. Applicational research cannot be initiated without the introduction of a basic patent which becomes the seed of the research. European and American manufacturers are singing louder in a chorus not to sell patents to Japan.

Secondly, as a consequence of ignoring "basic research," "bargaining power" is lost from the technology of our country (some say we did not have it from the beginning...). When cross-license contracts are demanded by Europe and America, we have no technology to exchange.

In the midst of a corporative posture which gives wholehearted devotion to "developmental research," earnest researchers who emphasize "basic research" are mistreated, and an air of desolation is thickening.

These oppressive substantiations of the facts should be reflected in the sense of crisis which has finally begun to be felt by the top management of technology.

An institution entrusted with the task of glancing extensively over the world of our national technology and discovering and developing excellent seeds of national technology (linking them to development and merchandizing) is the "New Science and Technology Research Development Corporation of Japan" (started in 1961 as a special corporation under the jurisdiction of the Science and Technology Agency).

Promising research results are searched out from university laboratories, national research institutions, and private enterprises; financial aids are awarded and meanwhile wait for the chance for commercialization. In this manner, they try to nurture the seeds of original technology.

What has the corporation achieved? Corporation Planning Office Chief Officer Genya Chiba summarized:

"In the past 20 years, we searched throughout Japan, dug out seeds of technology, and mediated for commercialization. Well then, what was the nature of the technology we handled? Unfortunately, 95 percent was technology for improvement. Original technology constituted 5 percent. Even that's not accurate enough. If national technology is more rigidly classified, only 2 cases out of 200 can be called genuinely original to Japan--namely, research and development of ultrafine grain and continuous manufacture technology for a luminescent diode. Even if the criteria for classification are slightly relaxed, 10 cases at most can be called original Japanese technologies."

Many of the technologies handled by the corporation were submitted to it with the claim that they were unique Japanese original technology. When Mr Chiba investigated, however, 95 percent of them were found to be already on the family tree of European and American technologies.

"Here are the characteristics that symbolize the total picture of our national technology," analyzed Chiba.

"The first kind is those which perform slightly better than the original seed as a result of an improvement given to the technology. Secondly, those which have the nature of reducing the production process if utilized and eventually can reduce the cost. The originality is sensed not in the technology itself, but rather in the method of 'supplementary testing' wherein literature presented elsewhere is collected, follow-up experiments are conducted using slightly different methods, and the results are fed into profitable undertakings."

Incidentally, the New Science and Technology Research was brought into the world with the British "National Research Development" serving as the original model.

Although the terms "English disease" and "English decline" are commonly heard, England is a country which develops excellent original technology in the world, and her tradition which created penicillin and jet engines is said not to have entirely withered.

The recently discussed CT scanner and cephalosporin, etc, were all brought into this world from the technological roots of this country. Chiba consistently advocates: "We must start a new movement toward basic research and creative technology and development."

Self-Support Ratio and Domestic Production Ratio

By the way, it is now a certain matter of fact that the production of automobiles and steel (numerical quantity) has finally reached the world's No 1 rank ahead of the United States this year. It is argued that our national technical competence, combined with the strong export competitive power, made these achievements possible.

It now happens that a securities company that persistently recommends defense stocks and its research department are trying to create a "technology era" using the same scenario. Countless copies of materials are being distributed throughout Japan.

This of course is not the first time that the "question of technology" has been called front and center.

Around the eve of the Second World War, articles stressing technical capability and productive capacity appeared incessantly in newspapers and magazines.

A paper titled, "Should We Be Afraid of American Economic Sanctions?" seemingly is a typical example of such an article. It stated, "Japan has become a major producing nation. The booming of heavy industries demonstrates this fact.... This means that Japan no longer is dependent on foreign nations for the major part of steel, fertilizers, weapons and ammunition, and machinery." (HANASHI, January 1940, published by Bungei Shunusha). By applying various statistical fgures, it tried to prove that "we have nothing to fear from the United States."

At that time, many advocates--including economists respected for their common-sense--based their positions on two points: first, the remarkable advancement of "technical capability," and second, the potential self-sufficiency in resources as a result of the Greater East Asia Co-Prosperity Sphere.

As an example of the remarkable technical advance given as the first point, more than a few people argued: "A synthetic petroleum industry is about to become possible."

The previously mentioned article also made people feel very confident, encouraging them [by saying] that if the United States acted against exporting oil to Japan, we could meet our needs by [importing] Mexican crude oil, since the Japanese oil-refining capacity had advanced remarkably in recent years, and further, by writing, "We have succeeded in developing artificial petroleum technology which extracts oil from conglomerate and coal which is inexhaustible in Manchuria."

"Even if the United States stops our oil supply, we will never be critically damaged," vouched the article, because of the superior technical capability and strong productive capacity in our hands. Public opinion, which was encouraged by the escalating "question of technology," might have backed the decision for war.

There we can witness an established pattern, which starts with self-admiration and proceeds to overconfidence and further to self-fantasy.

Of course, these series of "questions of technology" did not necessarily discuss the superiority of technology by using fabricated materials.

"Japanese Economy in War and Reconstruction" (written by J. B. Cohen, translated by Hyoe Ohuchi), which is known to have been compiled by many Americans using Japanese materials, presents the following three points as reasons and background situations which made Japan positive.

They are: first, domestic productive capacity was drastically expanded in preparation for war. Self-sufficiency in the Greater East Asia Co-Prosperity Sphere was in progress (the Japanese people themselves believed that self-sufficiency was substantially being completed). Additionally, the power of "propaganda" was quite effective.

To sum up, a remarkable development of technical capability and productive capacity was part of the fact. But the advocates had failed to perceive a large gap which might have existed between the numerical basis (official) that indicates progress and the actual conditions. Thus, overconfidence worsened to self-fantasy.

For example, the book presents some data.

It points out that the self-supply ratio of tin was actually 28.8 percent, in contrast to the reported 1361.6 percent. Similarly pig iron was actually 16.7 percent instead of the reported 100.6 percent. Oil, which was discussed in terms of its potential self-sufficiency, managed to maintain a level of 20.2 percent.

Besides the gap between the numerical figures indicated with pretended objectivity and the actual conditions, it was later discovered that a more important point was overlooked by the comments of that time comparing Japanese and U.S. technologies.

They had forgotten to include the dormant energy of American economic power in their discussion.

Let me give you as example the comparison of Japan-U.S. battleships (total displacement):

	Japan	America	Japan-U.S. ratio
Start of the war	894,000 tons	1,440,000 tons	69.5 percent
2d year	972,000 tons	2,807,000 tons	35.3 percent
End of the war	274,000 tons	4,274,000 tons	6.4 percent

"Iwanami Lectures" (Japanese History)

While Japanese battleships remained virtually at the same level in the 2d year, by the end of 1943 America had taken a giant leap and doubled the figure. The American economic potential which can be brought forward once an emergency should arise is plainly shown.

Of course, we do not have to mention that the economic capacity and production structure of Japan and the United States have changed fundamentally and are different now compared to those days. I do not intend at all to conclude that we are in the same situation as we were before and during the war.

Yet it is possible to see similar errors in today's "question of technology." One of these errors concerns the evaluation of the "latent power" of American technology, and the other is the figures of the "domestic production ratio" of our country often referred to in advanced technology industries.

One engineer said: "American researchers and engineers are engaged in free research in its true sense. Each of them has plenty of energy, chooses his own theme as he pleases, and finds a method for creative research. In comparison, we in Japan do the same research but are only free to move around in a state where the players on the field are already in position. Almost in a condition of total solidarity, we rush toward the given goals while guessing the company policy and the boss' intention. On the surface, the two powers may closely resemble each other. But once an emergency arises, and the field players take their position in the American research arena, we do not mean too much. The level of inner energy is different. It is like the Brownian movement in matter moving into all directions. Once it is directed to one set direction, the volume of the charge makes the difference."

On the other hand, the "domestic production ratio" is the figure which resembles, in its characteristics, the "self-support ratio" often used on the eve of an all-out war.

Innocently believing the figures disclosed, we use them, for instance, in the following context: "Look at these figures; our national technology standard has reached this level even in the fields of space development, nuclear industry, and advanced technology." If we try to prove our advanced state of technology standards using the publicized "domestic production ratio," we may fall into the same trap as we did with the "self-support ratio" of the old days. It is not strange for everyone to wonder how we can ever make the same mistakes today, when all the information is open to the public, contrary to the prewar days, when information was not disclosed.

Nonetheless, the "Phantom of the Domestic Production Ratio" is actually walking about in the daylight.

Partially Imported "Domestically Produced Goods"

Here is another example.

For instance, speaking of our country's nuclear power generation, which finally achieved the world's second highest level of power generation capacity last year, next only to America, the Science and Technology Agency announced publicly: "The ratio of domestic production in nuclear power plants has reached the 99-percent mark." Even electric power companies proudly exclaim: "In Fukushima No 2 Nuclear Power Plant, No 1 unit is 97-percent domestically produced, No 2 is 99-percent domestically produced, and No 3 and No 4 will be 100-percent domestically produced." (Tokyo Electric Company)

Can we really believe this?

According to the PR of the electric companies themselves, they say the higher the ratio of domestic production, "the safer the nuclear plant. A high domestic production ratio leads to safe operation of nuclear reactors, and if an emergency happens we can cope with it in Japan." With such an address, the figures for domestic production ratio they have referred to must be very accurate and be supported by strict calculations to be awarded the status of the most important index. However, when I went around this time to get information on the basis for calculating the "domestic production ratio," I was endlessly sent from one place to another, and in the end I could not even hope to get confirmation of the man who was in charge of the calculation of the "domestic production ratio."

Among the key components of nuclear machinery and equipment, the "primary coolant pump motor" is more or less the champion of hardware. This determines the size of the output.

Also, in the Three Mile Island accident case, this coolant pump motor triggered the failure.

Well, then, is this vital "primary coolant pump motor" really domestically produced? According to the government announcement, it is classified as a "domestically produced item." However, if we carefully read the "Atomic Power Yearbook" and the like, we will notice "partially imported" in small parentheses in a note at the very end.

What does partially imported mean? It is ambiguous from the announced data alone.

Actually, only the motor is domestically produced. Part of the pump and the shield (a vital part which protects the coolant stored inside from seeping out during the operation of the nuclear reactor), which require more important and sophisticated technology as components, are dependent on imports. This is the true color of the item classified as "partially imported."

There are too many components classified as "domestically produced" with a footnote "partially imported."

The champions of the software--the brain for the nuclear power plant operation--such as the "neutron measurement control system" and the "recirculation flow rate control valve" are all "partially imported." The truth of the matter is that in all cases parts are imported, assembled in Japan, and classified as "produced domestically."

Is this what we call our 99-percent "domestic production ratio?"

The same is true for space development. The "domestic production ratio" in this field is not the number of parts but is indicated, they say, by the percentage of the absolute sum (in money), whether or not the means of payment was in "yen" or in "dollars." "This figure is the data for the budget approved by the Ministry of Finance, and is absolutely processed on a budget base," explains the New Science and Technology Research.

Once you find out that the content of "domestic production" is the grand total of 1) those products that are made completely by domestic technology, 2) those products that are made at home by importing foreign technology, and 3) those products that are bought from abroad but assembled in Japan, you will never ever think of using these figures as proof of "Japanese supremacy over America."

Now, speaking of the so-called postwar flower of "domestically produced aircraft," the YS-11, in reality its engine was made by Rolls-Royce, its propeller was made by Hamilton Standard, its tires were made by Goodyear, its instruments were made by Collins Bendix, and everything from its radio machinery and equipment to its glass and duralumin were all imports (the glass was produced domestically later on). Only the seats and the electric wire were produced in Japan.

Even this passed amiably as "domestic production," since it was assembled in Japan. If this same treatment is not accorded in nuclear plants and space satellites, it is certainly unfair, isn't it?

There are many other blunders of "phantom figures."

"Taking a look at the recent figures of the technology export-import balance, the increase in exports is larger. Japan finally has entered an era where she can sell technology." This is the kind of article we often encounter. Yes, if we only pay attention to the figures, such a trend is certainly not unrecognizable.

However, even taking as an example the "patent-fee income" in the technology export column, do you know that "personnel expenses" are included in items accounted for?

Those increases are the iron and steel plant exports to the developing countries. Accompanying the exported goods, Japanese engineers and technicians are sent to the local destinations. Engineering fees (part to be paid by the buyer) are calculated by including their personnel expenses and are accounted for as know-how income.

Today, when we are developing large-scale iron and steel plant exports here and here, it is a natural conclusion that the absolute sum of technology export income is growing. This is not, however, the same as selling excellent "technology" like hotcakes.

Also, for example, it is said that Japanese automobiles have swept over the American market. But the truth is that the sale of cars is concentrated on the popular models with a small engine displacement of 1600cc and below owing to their good fuel consumption efficiency. It is not that Japanese cars over 2000cc are pushing American cars aside. The sale trends compiled by the auto manufacturers themselves tell the story very clearly. We must keep our eyes wide open to catch the offshoot of the "self-support ratio."

The Permanent Wage-Earning Processing Country: Japan

Now, the strength that Japanese products show in iron and steel, automobiles, electronics...is derived from the superiority of "quality control" and "production technology."

The "quality control" superiority is determined largely by the differences in the quality of labor and the quality of skills in the production sites before we talk about the quality of "technology."

In the countries where society is required by the Employment and Opportunity Act and the like to accept the participation of a fixed number of minorities in production sites, the observance of these regulations is known to lower the quality in quality control, and so naturally conditions will become disadvantageous.

Nevertheless, should not the attitude of European and American enterprises in trying to engage minorities in industrial society, in spite of the apparent disadvantage in doing so, be regarded as an indication of a compassionate human society in an advanced stage of development?

On the other hand, it is possible to establish a way of thinking that creative technology is not the only technology; technology for improvement and production technology also constitute technology.

However, as long as we intentionally hold onto those points of view, we can never escape from the "bog of technology," in which we keep competing with the industries that exist in foreign markets and the industries that may come into the foreign markets, beating them in quality, earning by quantity, and playing the cards through efficiency. Our eventual destination is "Japan as a permanent wage-earning processing country."

Yet, to our embarrassment, "beginning today to conduct basic research in pursuit of creative technology" is not something we can commit ourselves to at this moment. The points made in the previously mentioned poll--that the reform of education, production structure, and research systems is required before anything else can be done--convey the circumstances as to why we cannot bring ourselves to do so.

It seems that we can awaken ourselves from "self-fantasy" if we sit down and evaluate more honestly the efforts to develop highly original technologies or the challenges to creative technologies which will give us more bargaining power, instead of claiming: "We have surpassed America." What do you think?

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END