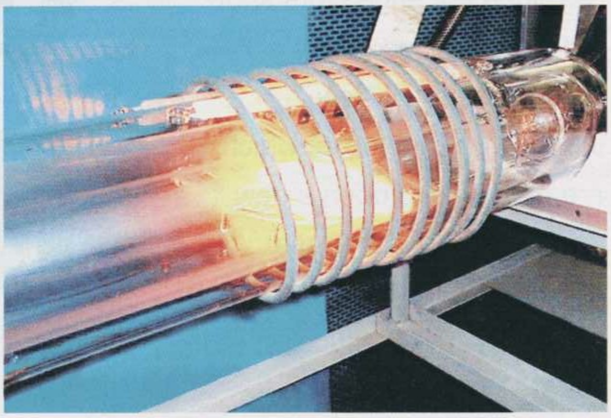
Japanese Manufacturing Industries Have Latent Power

By Nishizawa Junichi

Japanese industry before World War II was at a level far below international standards. Japan's main exports at that time were raw silk and silk fabrics, followed by sundry goods, specifically, tin plate toys. Copper came third. Japan extracted what scanty copper ore resources it had from its very small mines, smelted them and exported copper and in this way made ends meet in foreign trade.

In basic academic research, however, Japanese scientists had more than enough accomplishments of top international level, though this fact was little known to the rest of the world. As shown in Table 1, Japanese scholars accomplished a great deal in research that was higher than international levels. Regrettably, however, not many of these accomplishments were used industrially. The few that were used industrially included glutamic acid flavorings, polyvinyl alcohol fibers, un-loaded cable, and ferrite.

The Yagi antenna, invented in 1926, emits a strong microwave beam if it is connected to an Okabe type magnetron oscillator. The fact that this beam is reflected if it hits a metal object was discovered in 1936 by Matsuo Sadakuro, an assistant at the Yagi Research Institute. These three combined would make a radar, but no one in Japan combined them for this purpose. Instead, radar was developed in Britain and was used to help shoot down German bombers. This technology was transferred to the Massachusetts Institute of Technology in the United States, and the Radiation Laboratories were established. After World War II, the technology was applied to television and microwave ovens, and when it arrived in Japan, it eventually resulted in the development of a major industrial sector. In this way, radar technology made its trip around the globe.



Equipment for high purity silicon crystal growth; used for manufacturing the Static Induction Transistor (SIT) and Static Induction Thyristor (SIThy)

Ferrite was discovered by Dr. Takei Takeshi at the Tokyo Institute of Technology. Takei, who had been studying for a time at the Material Research Institute after graduating from Tohoku University, had returned to his alma mater, Tokyo Higher Technical School, as a member of the teaching staff when the school was being upgraded to university status and renamed the Tokyo Institute of Technology. At TIT, he was instructed to separate zinc from iron and incidentally discovered ferrite when he was attempting to separate zinc by using iron's magnetic characteristics. Takei announced his findings after conducting an enormous number of experiments. It may be said that he completed almost all the basic studies on the basis of which Dr. Louis Eugene Felix Neel later developed the ferrimagnetism theory and was awarded the Nobel Prize in Physics in 1970.

Later, Saito Kenzo, one-time Director-General of the Science and Technology Agency, began ferrite production on an industrial basis, and this led to the establishment of a company known today as TDK Corporation. However, Japan lagged behind Western countries in industrial production of ferrite and in other respects, with the result that Philips of the Netherlands seized command of the world ferrite market.

In a nutshell, Japan made stunning progress in the field of basic research in science in less than 50 years since the Meiji Restoration but before World War II, it failed to foster the growth of industry on the basis of its accomplishments and to convert the results of research into means to boost the country's economic strength, because the country lacked the ability to industrialize.

It is said that the U.S. helped Japan reconstruct its economy and industry after World War II in order to make this country a bulwark against communism in Asia, where it was then thought to be a great danger of Communism spreading. Whatever the motivation may have been, the U.S. helped Japan immensely in reconstructing its economy. Production control was the main area where the U.S. helped Japan. Dr. W. E. Deming came to Japan and extended guidance in this crucial field. He not only permitted his book on this subject to be translated into Japanese, but also donated the royalty income from the translation. With the donation as the fund, the Deming Prize was established. The prize is awarded to organizations that achieve superior results in quality control.

Thanks to such contributions, Japan has risen to the top international position in production technologies. Some Japanese, forgetting the special guidance extended by the U.S. and the desperate endeavors by the Japanese themselves, have begun to say that the Japanese are skilled in industrial production by nature.

Throughout the postwar years, Japan has scored major successes in the production of goods. Whatever superior machinery may be used for mass production, experience in improving accuracy in production by handiwork is invaluable. Japanese could exploit the characteristics of machines to the utmost with meticulous care. Moreover, they frequently improved the machines they were using, and superb machines for mass production even began to be produced. However, when the people who knew every detail of processing had retired from the forefront of industrial production and were succeeded by people who had been scoring successes without special training, progress began to slow.

The 1980s, when Japan's production technologies astonished the U.S., Japan's teacher, was exactly such an age. It was an age when self-assessment by the Japanese began to go awry. In the U.S., then-President Ronald Reagan erred in important decisions on economic affairs by following the advice of his economic brain trust which consisted of adherents of the Keynesian school of economics, and ignored the necessity of manufacturing industries. In Japan, too, there was a growing body of opinion that proposals of a similar purport should be made to the government.

The people who advocated this view, however, forgot the fact that Japan is a country with very few natural resources and differs totally from the U.S., which is endowed with almost every type of natural resource and where curbing extraction immediately leads to the preservation of resources.

The U.S. is the greatest agricultural country in the world. Even if it were to abandon its secondary industries, it could still keep its economy afloat. Manufacturing industries are the only lifeline for the Japanese economy. It should be remembered that it is nonsense to compare Japan, which is like a single-bottom ship, with the U.S., which has a triple bottom.

Even though U.S. manufacturing industries are beginning to lose their pioneer spirit in the development of state-of-the-art technologies, the U.S. completely dominates the leading-edge sectors of software industries. With the 'Sputnik shock' as a trigger, the U.S. in 1976 transformed its education policy into one that attaches top priority to fostering the growth of highly creative individuals, and this has had favorable effects. By seizing the lead on the software side, U.S. industries have begun to regain their vitality.

After the war, Japan introduced democratic education, a system which lacks depth, from the U.S., adhered to the policy of molding all students into one and the same type, and still did not recognize its baneful effects even after the U.S. changed its education policy. As a result, pre-war education, which produced many creative researchers, has declined. As shown in Table 1, it is no exaggeration to say that the only brilliant scholar produced in postwar Japan is Dr. Tonegawa Susumu, who left Japan when young and received his higher education overseas. Many researchers in Western countries say that the creative power of Japanese scholars who received postwar education is inferior.

Table 2 is a list of new products developed in Japan. The main part of the list is based on a work by Moriya Masaki, and what was omitted has been supplemented by myself. As already said, there were few cases in pre-war Japan where creative research results were exploited on an industrial production basis. The table shows that products which can be called innovations were developed gradually in post-war Japan. This was because MITI extended powerful guidance to industry to encourage the development of new products. Japanese manufacturing industries, which gradually expanded their share of overseas markets with their high-quality, low-price products, often robbed foreign manufacturers of their market shares because their products were based on foreign technologies introduced into Japan, and as a result came under strong criticism. Under such circumstances, MITI had to extend guidance to Japanese manufacturers and strongly urge them to develop new products that were not imitations of something else.

Regrettably, however, as shown in Table 1, new products are mostly developed at universities and national research institutes, even though researchers at such institutions work under rather unfavorable conditions. A survey by Germany after World War II has revealed that this is something common to all industrialized countries. Universities and national research institutes in Japan have been left in the destitute condition of the early post-war years, as few people thought of turning them into centers of creative research. Instead, there was a strong body of opinion that it would cost less to go to Western countries and purchase patents than conduct creative research from scratch and develop new products and new processes.

It was natural that endeavors by Japan to quickly increase its production capacity caused trouble to manufacturing companies in the rest of the world and even affected foreign government budgets, with those for research and development being curtailed. Even in Britain, called the Mecca of creative research, then–Prime Minister Margaret Thatcher drastically slashed the government budget for research and development. As a result, Japan, which was almost parasitically dependent on Britain in the field of research, waned in creative research and shared the same fate as the host country when it was enfeebled and went into decay.

Asian countries industrialized rapidly, with Asian people's rising incomes constituting a powerful incentive for industrialization. Rising labor costs in Japan forced many Japanese manufacturing companies to shift their production bases to developing countries with lower costs, and Japan, too, suffered industrial hollowing-out.

At this stage, the U.S. changed policy and once more promoted research and development, where the country is at its strongest. As a result, it recovered its economic strength at astonishing speed, and it is now often said that the U.S. is enjoying almost unending prosperity. Even during the days when research and development was neglected, the U.S. had to retain a large cadre of researchers mainly for military purposes, and this has

Japanese Creative Discoveries and Inventions

Year	Name	Item(s)
1885	Nagai, N.	Ephedrine
1889	Kitazato, S.	Pure culture of tetanus bacilli
1894	Takamine, J.	Taka-diastase
1897	Shiga, K.	Dysentery bacilli
1901	Takamine, J.	Adrenaline
1902	Kimura, S.	Z-term
1903	Nagaoka, H.	Atomic model in the form of Saturn
1903	Takagi, T.	Abelian domain in the field of rational imaginary numbers
1908	Ikeda, K.	Patent for the glutamic acid flavorings manufacturing formula
1909	Takamine, J.	Patent for the Taka-diastase manufacturing formula
1909	Tawara, R.	Tetrodotoxin contained in blowfish poison
1910	Suzuki, U.	Orizanin
1911	Noguchi, H.	Spirochete culture
1912	Majima, T.	Determination of the urushiol structure
1915	Yamagiwa, K. and Ichikawa, K.	Artificial cancer
1917	Honda, K.	KS steel
1917	Torigata, U. et al.	Duplex telephony (simultaneous Tx & Rx)
1919	Eguchi, G.	Electret
1920	Takagi, T.	Class–field theory
1922	Oguma, K. and Kihara, H.	Number of human chromosomes
1926	Yagi, H.	Yagi antenna

Year	Name	Item(s)
1928	Nishina, Y.	Law of Compton scattering
1928	Okabe, K.	Traveling wave oscillation in split-anode magnetron
1930	Kato, Y. and Takei, T.	Ferrite ferromagnetism and magnetic field cooling
1932	Matsumae, S.	Unloaded cable
1932	Mishima, T.	MK steel
1934	Honda, K., Matsumoto, H.and Shirakawa, Y.	New MK steel
1935	Yukawa, H.	Meson theory
1936	Matsuo, T.	Electromagnetic wave reflection by aircraft
1939	Sakurada, I. et al.	Polyvinyl alcohol
1943	Ogawa, T.	$BaTio_3$ ferroelectric phenomenon
	Tomonaga, S.	Super-many-time theory
1945	Nozoe, T.	Tropolone
1950	Watanabe, Y. and Nishizawa, J.	PIN diode, PNIP transistor, PIN photo-diode, APD and ion implantation method
1950	Owaki, K.	Traveling-wave oscilloscope
1953	Nishijima, K.	Concept of strangeness
1957	Esaki, R.	Esaki diode
1957	Watanabe, Y. and Nishizawa, J.	Laser and semiconductor laser
1964	Sasaki, I. and Nishizawa, J.	Fiber optical communication and GRIN optical transmission guide
1968	Yoshida, S.	Trinitron

Product Development in Japan (mainly by Moriya Masaki)

Patent for the glutamic acid flavorings manufacturing formula	new (original)	1908	success
Telephotograph	improvement	1928	"
Non-loading cable	new (original)	1936	"
Ferrite	new (original)	1937	partial success
Zero fighter	improvement	1939	success
Polyvinyl alcohol	new (original)	1939	"
Liquefied coal	improvement	1943	partial success
TV	independent	1926	success
Electron microscope	improvement	1942	"
Pin diode	new (original)	1958	partial success
RF bias magnetic recording	independent	1950	success
Electric calculator	improvement	1956	"
(vacuum tube) Fujic			"
Transistorized radio	independent		"
Transistorized TV	independent		"
Parametron	new (original)		failure

NC machine tool	improvement		success
Shinkansen (Bullet Train)	new (original)		"
Synthetic leather	new (original)		"
Trinitron	new (original)	1968	"
Automatic postal-code reader-sorter	new (original)	1968	"
Electronic desktop calculator	improvement	1964	"
Quartz wrist watch	new (original)	1969	"
Home VTR	improvement	1965	"
Clean heater	new (original)	1969	"
Carbon fiber product	improvement	1973	"
Saticon	new (original)	1973	"
Dicing saw	improvement	1975	"
Auto–focusing camera		1977	"
Normal paper copying machine	improvement	1970	"
NMR–CT	improvement	1982	"
Card type electronic calculator	new (original)	1983	"
Liquid crystal display	improvement		"

now begun to pay dividends. It was fortunate for the U.S. that the Berlin Wall collapsed and the Cold War ended, enabling it to shift those scientists who had been engaged in weapons research to peacetime civilian industries. In the sweeping structural changes taking place in industry at this threshold of the 21st century, the time was ripe for the U.S. to foster further growth of information and telecommunications industries, and capital investment in research and development in these fields has had dramatic effects.

Japan has at long last begun to have second thoughts about the harmful effects of its uniform education which casts all students in one and the same mold, and yet fierce competition continues among students in multiple choice tests, in which the students have to choose the correct answer from several possibilities and vie with each other in the amount of knowledge they possess. The results of such examinations not only determine their university rating but also affect their careers in society after graduation. Moreover, this practice has spread to South Korea, Japan's neighbor, and even to China, where the written examination was invented in ancient times and ruined the country. This is a deplorable situation. Tracing studies throughout the world from old show that there are no cases where researchers who excelled in memory subjects at school displayed any great creative abilities in the world of learning.

In post-war Japan, creative research was neglected for too long, and researchers engaged in basic research were too poorly paid and too coldly treated. As a result, it has become very difficult now to find young researchers. Tracing studies show that students who studied under superior teachers often display their abilities and accomplish something great in the world of learning. This finding has strong credibility, as it is backed by a large number of examples.

Next, I want to consider the Japanese position. Global warming due to the sharp increase in the amount of carbon dioxide in the atmosphere, about which a warning was issued long ago by the late Dr. Yamamoto Giichi, a professor at Tohoku University, has come to be recognized, though belatedly, by the public, and this is welcome. To prevent global warming, however, energy consumption must be curbed. Southeast Asia was expected to see a surge of industrialization and to be a major market for Japan. However, if the region's rate of industrial development is curbed as a result of the global trend toward energy saving, this could result in a grave crisis for Japan, since industrial production is this country's only lifeline.

However, if Japan can succeed in developing and bringing to market energy-saving plants and equipment before other countries, this could resolve the difficult problem of how to arrest the increase in carbon dioxide emissions into the atmosphere and at the same time make the lives of Southeast Asian people more healthy.

In the context of confrontation between industrialized countries on one side and developing countries ranging from Southeast Asia to Africa on the other, Japan occupies a pivotal position. Japan will perform a major role in the international community and satisfy its expectations by developing such equipment and supplying it to other countries while endeavoring to forge a compromise between the two sides and set a carbon dioxide cutback target.

All countries and all peoples must make what contributions they can to the world in their respective capacities. For Japan, which as a country without resources must pay high costs for transportation of raw materials and manufactured goods, this is the most important international contribution it can make.

To answer any possible criticism that my argument is abstract, I will say a few words about a new switch named the semiconductor thyristor. This switch has been tested at our laboratories for more than 10 years. 1997 was the 150th anniversary of Thomas Edison's birth. Edison's greatest achievement was supplying clean energy by generating electric power and transmitting it as direct current along electric wire. But his company went bankrupt after his system was defeated by Westinghouse's system of supplying alternating current. However, Edison's DC transmission system had a distinguishing characteristic. It could transmit electricity for a distance of 10,000 kilometers. Our thyristor can convert DC current into AC with 99% efficiency. Therefore, it can transmit electric power generated at a torrent in the mountains 10,000 kilometers away as DC current and convert it into the AC current of the Westinghouse system at the place of consumption. General use of such a system would mean that even one drop of petroleum, or one nuclear reactor, would become unnecessary.

Japan is in an ideal position to produce products that embody new scientific technologies. Japan has an understanding of the positions of both East and West. It has a nationwide network of education and research. If it provides education that attaches importance to individuality, which was the case before and during the Meiji Period and up to the pre-war era, it will rapidly produce results. Further, the current wage system should be changed to one based on ability, an excessive concentration of able people at one location should be discouraged and promotion based on merit encouraged. Japan is a country which made a miraculous comeback from the debris in the wake of its defeat in World War II and attained considerable prosperity in only 50 years. The international community thus has great expectations regarding the contributions Japanese manufacturing industries can make to overcome the problems the world is now facing.

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