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Yuki NAKAJIMA†

Abstract

Toward the end of World War 2, British and U.S. governments created a joint program to investigate German technology and requisitioned numerous technical documentations, some of which were opened to public as technical reports. Japanese industries, refereeing them to as the “PB reports”, tried to obtain and utilize them for their postwar recovery until they started enthusiastic technology introduction by technology licensing in 1950’s. This study describes the dissemination process of PB reports in Japan and evaluates their impact.

A few engineers mainly in chemical industry who were belonged to companies, universities and national research institutes recognized the great value of PB reports, and then pressed Japanese government to introduce them with a State budged. Not only the individuals, but also the governmental organs established in the postwar democratization process of science and technology played important roles for policy making of package purchase of PB reports from U.S. government in 1952.

In the case of dyestuff and caustic soda, some joint R&D groups were organized in academic circles and industrial associations to share the information from PB reports which contained classified factory data of IG Farben, Bayer and so on. Japanese companies utilized them to domesticate German chemical products and develop their original technologies. On the other hand, the case of electronics parts shows that small companies which could not afford to introduce technology from foreign companies by their own received benefit by the reports and got an opportunity for their development. As a result, a technology gap between Japan and advanced countries which had widened during the war were reduced till the end of 1950’s.

Key Words: Japanese business history, technology transfer, PB reports, chemical industry
JEL: N45, N65, N75

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1. Introduction

One of the main reasons for Japan's technological development after WWII is believed to be the enthusiastic introduction of technology from advanced countries. During the war, given the situation that Japan was isolated from the international scientific and technological exchange network, it fell far behind advanced countries. After its defeat in the war, Japan attempted to re-introduce technology into the country. Many studies have focused on technology licensing between foreign and Japanese companies and its crucial role in improving product quality and production efficiency in various industries such as iron and steel, electronics, chemicals, etc., especially from the 1950s to the 1960s.

In order to successfully acquire these technologies, Japanese companies first had to find technology that was appropriate for introduction into the country. Technology historian Tetsuro Nakaoka emphasizes the importance of previous studies conducted by Japanese companies. Japanese companies did not search aimlessly for foreign technology. The research activities of these companies were well developed, and helped them to understand the specific technological problems that they faced before they made license agreements. As a result, they were able to accurately apply the technologies that they introduced, resulting in a dramatic and immediate improvement in their technology[1]. Therefore, R&D activities in Japan during wartime and the rehabilitation period should not be ignored when studying Japanese postwar technological development.

Immediately after the war, when they could hardly come by the latest technical journals that were published in foreign countries, Japanese engineers in various fields took every possible measure to obtain technology information from abroad. A precious source for them was "PB reports." PB reports were technological documents published by the U.S. government from 1946 onwards, most of which had been requisitioned from factories based in Nazi Germany. American historian, John Gimbel, who comprehensively studied the process, claimed that these technologies were a blessing for not only the military but also the private sector in postwar America[2]. This forced technology transfer from Germany to the U.S. was peculiar to the occupation period. Moreover, these documents were not intended for exclusive American use and were scattered all over the world. Therefore, through these PB reports, German technology was first transferred to the U.S. and then to other countries, including Japan. In this "two-step" technology transfer process, the latter step seems to not have received much attention in previous studies that have dealt with technology transfer. As mentioned above, Japan was one of the countries that tried to obtain PB reports and apply them to their postwar industrial recovery and development. Although science historian Shigeru Nakayama has already mentioned PB reports[3], no research has precisely estimated the value of these reports in Japan's postwar technological development. This study describes the dissemination process of the reports in Japan and evaluates their impact.

It is not sufficient to focus only on a company's business activities. There were other related parties involved in the process, such as politicians, scientists, engineers, academic societies, public and governmental institutions, and business associations. Some of these parties had been conducting

R&D activities since the prewar period or had established themselves during wartime mobilization. Although a comprehensive examination of these players is beyond the scope of this study, their activities will be referred to only to the extent that they relate to the PB reports. In the next section, based on John Gimbel's work, the outline of the PB reports is described briefly. The process of the introduction of these reports into Japan is described in Section 3. Case studies in Section 4 illustrate the impact of PB reports on technological development, mainly in the chemical industry around the 1950s.

２． PB reports

According to Gimbel, Britain and America created a special military unit in 1944, the "T-forces," to gather German technological information. They also created a "Combined Intelligence Objective Subcommittee (CIOS)," whose duty was to select targets for the T-Forces with the support of the "Technical Industrial Intelligence Committee (TIIC)" on the American side. TIIC consisted of more than 10 subcommittees that represented various industries. A large number of people from the business field became members and recommended numerous targets to investigate and capture[4].

After the War, many technologists who had joined these investigation programs were discharged from military service. However, they enthusiastically claimed that the technologies they had found in occupied German areas were much superior to those of American industry. They recommended, as a result, that the U.S. government continue and expand its investigation programs. Meanwhile, in August 1945, President Truman ordered the disclosure of scientific and technical information that had been developed with governmental funds. The newly established interdepartmental "Publication Board" screened the investigations to be released and then put reference numbers on them with the initials "PB," to publish. In contrast to the Army, which was reluctant to disclose information, the Department of Commerce was the most enthusiastic to disclose information in order to promote postwar industrial recovery. The department created an "Office of Technical Service (OTS)" to investigate German technology themselves. The OTS selected and recruited specialists from various industries in America through "Technical Industrial Intelligence Branches (TIIB)"; these specialists were then dispatched to Europe. In Europe, the "Filed Information Agency Technical (FIAT)" supplied equipment for transportation and communication and helped in the interrogation of German engineers[5].

FIAT and OTS together analyzed the excavated material. In order to promote the use of PB reports, the Publication Board and its successor, the OTS, offered this information to the general public through the weekly "Bibliography of Scientific and Industrial Research Reports." Even after the investigation in Germany was completed and FIAT was closed in July 1947, the Department of Commerce carried such activities on till the end of July 1948, when the OTS drastically downsized their operations. The government, however, decided to make the documents and microfilms available to the public[6]. The U.S. government maintains till date the policy of disclosing research results developed with governmental funds and continues to issue technical report series and bibliographies, as shown in Table 1.

By the early 1950s, the volume of reports was over 100,000, comprising 7.4 billion pages. The documents requisitioned in Germany accounted for an overwhelming majority (Table 2). The release of reports on German technology peaked in 1948 and drastically decreased from 1949 onwards[7]. Even after FIAT closed in 1947 and the OTS' operations were downsized, there remained a large volume of material to be analyzed. To complete their mission, the OTS gave up checking all the reports one-by-one and assigned PB numbers not to each report, but to "microfilms" that contained about a 100 reports each. The total volume of microfilm was over 5000 reels, which contained numerous reports to be disposed of without complete analysis or detailed abstracts. Therefore the bibliography issued around this period was also useless and caused engineers inconvenience in locating the appropriate reports[8]. In Japan, however, persons and organizations cooperated to solve this problem.

The reports dealt with a variety of technological subjects, mainly chemistry, electricity, aeronautical engineering, and mechanical engineering. Moreover, the reports contained not only abstract or scientific knowledge but also concrete industrial technology such as descriptions of manufacturing methods that contained precise designs of equipment. For example, the German engineers at IG Farben, who were interrogated by a U.S. investigation team, had served the company in important positions (Table 3). The information they provided was received with surprise not only by the Americans but also by the Japanese.

３. Introducing PB reports to Japan

A series of bibliographies, not original reports, were distributed by the U.S. government and sent to Japan in 1948. The National Diet Library (NDL) in Japan received and stored these bibliographies, which were not made public right away[9]. It is unclear why they were kept unpublicized or who first received the reports in Japan. Masamitsu Yoshimura, a chemical consulting engineer, claimed that Mitsubishi Chemical Company accidentally received information about the bibliographies from NDL in the summer of 1949. A researcher from the company recognized the value of these bibliographies on the first reading; the researcher then transcribed these bibliographies at the research institute. After the bibliographies were explored, some PB reports were selected and purchase orders for copies were made directly to the U.S. government in the winter of 1949. The company utilized the purchased reports to reduce the production cost of sulfadiazine, an effective medicine for bacterial diseases such as pneumonia, gonorrhea, and suppuration[10].

Meanwhile a few Japanese engineers were becoming aware of the existence of American documents that were technologically important. They frequently visited the CIE library, which was established in Tokyo in November 1945 by the Civil Information and Education section, GHQ/SCAP. The main purpose of this library was to make foreign magazine back issues available to Japanese citizens. After the war, engineers could access foreign journals only here[11]. Among the engineers from the chemical industry, Eiji Nakabachi, a technical official at the Tokyo Industrial Research

Institute (TIRI), visited the CIE library almost daily to check the latest technological articles. He noticed that a lot of the research published in America quoted PB reports. At first, he could not figure out what "PB reports" were or how to get them in Japan. One day in 1950, however, he accidentally got hold of a copy of a PB report; he was surprised to discover that the report contained important factory data from IG Farben and precise production know-how of an organic dye. He made several copies to distribute to Japanese chemical companies[12]. However, there was still no way for him to check other PB reports. In February 1952, he heard that a department in GHQ/SCAP that was concerned with patent management had presented the bibliographies to the Japan Patent Office (JPO). He immediately visited the JPO to check the bibliographies and discovered that there were many other reports that contained top German manufacturing secrets. For example, he recognized the existence of 60 microfilms on operating procedures in the IG Farben factory; the original documents contained over 50,000 pages. He also found some reports that had the seal "Streng Vertraulig (strict secrecy)," which dealt with an important analytical method. TIRI decided to import a copy of over 10,000 pages[13]. TIRI was Japan's foremost national research institute and had a long R&D tradition in the chemical field, dating back to prewar days. Under Nakabachi's instructions, the dyestuffs laboratory at TIRI imported several hundred reports and issued reference summaries for the Japanese chemical industry[14].

Some engineers got the chance to go to America on a technology inspection tour. A technical official at the chemical department in the Ministry of International Trade and Industry (MITI) went to America in 1950 and brought back several PB reports related to plastic technology. He did his official duty by distributing them widely in the Japanese plastic industry; the information was received with surprise[15]. In the soda industry, Tatsuzo Okada, a professor at Kyoto University, visited America between September and December in 1950 and returned to Japan with PB reports. The Japan Soda Industry Association (JSIA) delivered copies of these reports to member companies and organized a joint-research group to study them[16].

These cases are probably the earliest encounters of Japanese engineers with PB reports. The existence of PB reports gradually became known in the society of Japanese engineers and scientists. However, it was still not easy for individual Japanese to purchase reports in foreign currency. Therefore the package purchase of all PB reports was suggested. Masamitsu Yoshimura was the key person behind this initiative. Yoshimura had visited the JPO at the same time as Nakabachi and had also recognized the importance of the PB reports. He was a column writer of scientific and technological topics for NIKKEI news. His article in May 1952, which introduced PB reports, caused a sensation. As a result of his petition to purchase all the reports from the U.S. government, NDL organized a committee to investigate and evaluate the reports[17].

There were two organizations that were related to this process, the Science Council of Japan (SCJ) and the Scientific and Technical Administration Commission (STAC), both were established in 1949. According to science historian Tetsu Hiroshige[18], Japan's scientific system was severely criticized as the main cause of Japan's defeat: the confrontation of Japan's administrative organ, the inconsiderate bureaucracy for science, the factional strife by scientist themselves and so on. On the other hand, it was also pointed out that the newly postwar science system should be the main contributor for postwar economic recovery and the birth to a cultured nation. Under the initiative of scientists who had close connections with Harry C. Kelly at the Scientific and Technical Division, Economic and Scientific Section (ESS/ST), GHQ/SCAP, the Committee for Reform of Science Research Structure decided to establish SCJ[19]. SCJ aimed to discuss important matter on science and technology and recommend desirable policy to government on behalf of scientists of the country. STAC was established under the Prime Minister's Office to strengthen administrative cooperation between ministries in the field of science. Some scientists include physicist Seiji Kaya, Ryokichi Sagane and chemist Naoto Kameyama who were the professors of Tokyo Imperial University and enthusiastic to reform Japan's science system argued that they should enter the policy-making of the government and claimed a powerful scientific administrative agency which scientist could participate as a principal. But as a result of heated discussion with an opposition group who emphasized that scientist should try to distance themselves from politics, SCJ and STAC couldn't get biding force to government and became only a consultative agency[20].

However in the case of PB reports, SCJ and STAC could be influential to the government. SCJ, at an administration committee held in June 1952, resolved to recommend that the Japanese government purchase all the PB reports. It then filed a petition with the Prime Minister, Shigeru Yoshida. This idea had been suggested by the Chemical Society of Japan headed by Kameyama who was mentioned above and also the President of the SCJ[21].

On the other hand at STAC meeting, Kaya, represented the SCJ, submitted a request to the Ministry of Finance for a budget to purchase all the PB reports[22]. He emphasized that the PB reports contained so much important technical information that he was worried that the U.S. government would stop issuing them before the Japanese government's decision to purchase them came through. The Ministry of Finance replied that they would consider this subject and would shortly come to a conclusion[23].

The National Diet responded quickly to the request from the SCJ. Before the discussion on purchasing the reports began, Hideo Maki, a professor in the Faculty of Engineering at Tokyo University, had mentioned the PB reports about vat dye at the House of Councilors, which was held in March 1952. He explained that research on vat dye had progressed dramatically in recent years because PB reports had revealed all the secrets of German chemical technology, which Japanese companies could apply domestically[24]. In July, just after Yoshimura's article had received much attention, the House of Representatives passed a resolution to request the government to purchase all the PB reports immediately[25]. A few days later, the Librarian of the NDL mentioned that he was aware that many concerned parties—such as MITI, JPO, and SCJ—had been enthusiastically studying the bibliographies. He said that the NDL had also been considering importing all the PB reports[26]. A proposal for their budget was presented to Parliament at the end of the month[27]. As a result, by the end of the year, over 69 million yen from a supplementary national budget for fiscal year 1952 was assigned for the import of the PB reports. This political measure enabled all Japanese citizens—that is, those from both big chemical companies and small companies in various industries—to utilize PB reports for their R&D activities.

４． Case Studies

Although it is a nearly impossible to comprehensively investigate the usage pattern of the reports in Japan at the time, according to research conducted by NDL in 1955, 60% of users comprised scientists and engineers in the field of chemical technology[28]. The following cases show how PB reports were applied in postwar technological development.

In the dyestuffs industry, TIRI continued reviewing many reports, especially those related to IG Farben's products. Among the 149 kinds of acetate rayon dye sold by the company under the trade name "Celiton," TIRI analyzed 140 kinds for their chemical structure, mixture of dispersant, and production techniques[29]. The PB reports were indispensable to other researchers in the Japanese chemical industry in their R&D activities. A researcher in a major chemical company, Nippon Kayaku Company, recollected that his main job at the time had been to decipher German chemical technology through the PB reports[30].

In the prewar days, Japanese companies had only been able to produce low-quality direct dyestuffs. The German company Bayer was the lone supplier of high-quality products, under the brand name "Sirius." However, after the war, Nippon Kayaku Company began to develop high-quality dyestuffs. PB reports helped the company to understand the chemical structure of Sirius dyestuffs and to develop effectively new dyestuffs. The company continued to collect reports and other foreign patents about dyestuffs. They recognized the usability of an intermediate product that was stocked in their factories for improving light fastness. On the other hand, the black direct dye that was then used for machine-sewing-cotton did not have enough color fastness for washing, and it easily ran color on shirts. Having obtained technological information from the PB reports, they began to develop a new black dye with high washing fastness. They consequently expanded their market to the spinning industry. Their domestication of "Sirius" class high-quality dyestuff rapidly progressed after the 1950s. Due to their R&D activities, the company was awarded the Okochi prize in 1964, which is given for distinguished achievement based on excellent inventions and ideas[31]. In another case, by referring to PB reports, a new production technology for dye intermediate was introduced into Japanese companies. This technology contributed to reducing the consumption of sulfuric acid, which led to a reduction of production costs[32].

The caustic soda industry recovered rapidly after 1950 from wartime damage[33]. As shown in Table 4, their manufacturing plants were converted from an ammonia soda process to an electrolytic soda process in the 1950s. The electrolytic process generated chlorine as a by-product, which could be used as a raw material in producing vinyl chloride. The industry was growing very fast during this period. Although caustic soda had mainly been used to produce rayon, the scale of production was not as large as that of vinyl chloride. As a result, the sales of chlorine products became more important than those of caustic soda. Therefore, Japanese chemical companies expanded their production capacity by introducing the electrolytic process[34].

The most important equipment used in this method was the electrolytic cell. There are basically two types of cells, the mercury process cell and the diaphragm process cell. Professor Okada pointed out that the diaphragm process cell had developed mainly in America and accounted for over 95% of their production capacity just after the War. On the other hand, the lower price of mercury prompted the development of the mercury process cell in Germany. IG Farben had enthusiastically developed these cells in response to the growing demand for chlorine during wartime[35]. Table 4 indicates that the mercury process cell became popular in Japan. Although the mercury process cell created less impurities and an exceedingly better product, this technology consumed more electric energy, which could have been reduced by expanding its electric capacity[36]. As mentioned earlier, Professor Okada had visited the U.S. in 1950 and brought back PB reports on soda technology. He had visited Dr. W. C. Gardiner at the Mathieson Alkali Company and chemical consultant, Robert B. MacMullin, who had worked for the U.S. Chlorine Industry Team (which had been dispatched to Germany under TIIB)[37]. Okada had been studying IG Farben's mercury process cell since 1946. Then some soda companies, such as Ajinomoto and Mitsui Chemical Company, cooperated with Okada under the auspices of JSIA. In prewar days, domestic soda companies kept their technology secret, and few technology disclosure and exchange between them was allowed. However as the wartime economy got deepened, soda companies had to make use of domestic highest technology in order to increase the production of soda with less material and some technological research council and informal gatherings started in April 1941. After defeat of the war, as soon as JSIA was established in 1948, technological expert committees were founded in the field of ammonia soda process and electrolytic soda process which were renamed and expanded in 1950[38]. JSIA became a base of technological exchange for domestic soda companies which longed to get foreign newest technology information such as PB reports. An engineer at Ajinomoto recollected that the PB reports were full of originality in the operation data, the design specifications and the improvement technology. He gleaned most of the ideas and knowledge in the field of electrolytic techniques from them[39]. On the basis of technology developed by IG Farben and Mathieson Alkali Company, Japanese companies improved the mercury process cell and their technology came to be regarded as the world's highest level around 1955[40].

In addition to the chemical industry, a case of electronics industry proves that PB reports contributed to the development of Japanese small firms. A German company, Bosch Corporation had developed "Metalized Paper (MP) Condenser" during the war. MP condenser was smaller than existing one by 70%, and had a "Self Healing Action", an innovative recovery mechanism from damage. In Japan, captain Ito Yôji of the Naval Technical Research Institute ordered to investigate them in 1944. Professor Saitou Yukio of Tokyo Institute of Technology and some big electronics companies such as Hitachi also started investigating them[41]. Despite of their effort, the condenser couldn't be in practical use before the end of the war.

On the other hand, there were a lot of small firms which produced electronics components as subcontractors of big companies which produced electric wave weapons. After the war, with rising demand for components assembled in radio receivers, not a few companies began developing their original technology[42]. Among such small companies, Matsuo Electronics Company founded in 1949 with only 7 members started their business by producing condensers for radio receivers. They sold their product to merchants in Osaka prefecture then expanded customers to big electric and electronics companies such as Yokogawa Electric and Sony. The company recognized that MP condenser would have had high potential demand because reduced size components were suitable for assembling more a precision electronics instrument such as television set. However the PB number can't be identified, the company's history describes that PB report was only information they could obtain about MP condenser and they tried to develop just by following it. The company started to produce the condenser from January 1954. Just two month later, Sony ordered them and required to deliver 30 thousands condensers within one month for assembling their transistor radios. As a result, Matsuo Electronics Company expanded product facility and customers rapidly[43]. This episode implies that even the small company could get a chance to develop and keep up with larger electronics company by utilizing PB reports.

5. Conclusion

The technology gap between Japan and other advanced countries had widened during WWII. As we saw in the case of the chemical industry, the PB reports supplied important information to Japanese engineers. On the contrary in Germany, the dyestuff industry was unable to develop new products and remained at the same technology level as that in the PB reports even at the end of the 1950s[44]. PB reports reduced the technology gap between Japan and Germany[45].

It should be noted that the U.S. investigation team requisitioned not only documents but also numerous machines and equipment. Moreover, they took many German technologists back to the U.S.[46]. The U.S. government and industries could comprehensively utilize this technology information. On the other hand, all the information Japan could obtain was in document form. With these constraints, Japan made its best effort to utilize the PB reports.

First of all, a few engineers in various fields, such as universities, public and national institutes, and consulting businesses, recognized the importance of the reports. Some technical officials and academicians especially played an important role by never trying to withhold information. On the contrary, they actively delivered PB reports to the concerned people. Such openness seems to have been a result of their official positions. To understand their quick response to the reports, their research experience during wartime should be investigated. The following questions have yet to be answered: On what subjects was research conducted? How did they recognize the limits of their research capabilities during wartime science and technology mobilization?

In addition to the individuals, SCJ and STAC requested the Japanese Government to purchase all the reports immediately. These institutions were established in the democratization process of Japanese science and technology, which was promoted by GHQ/SCAP after Japan's defeat in WWII. Such process was motivated by Japanese scientists' wish for the modernization of science system. However as Hiroshige claimed, their wish and criticism for Japanese science system can go back to wartime science mobilization which also required to modernize science and technology for the development of weapons[47].

Joint research in JSIA also goes way back to wartime. Some recent studies have pointed out that a number of joint research studies—not only between companies but also between companies and universities and between military and other governmental institutes—played a very important role in technological development, especially in postwar Japan; many of these research studies had been organized during wartime[48]. The social changes between wartime and the reform period or the systemization of science and technology should not be ignored in an understanding of Japanese postwar technology development.

Having been available all over the world, PB reports must have been used in various countries and areas. This study only concerns Japan. To identify the impact of PB reports, the cases of other countries should be studied. In this way, the patterns of technology transfer in various countries can become more discernable.

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[42] Yuki Nakajima, “Sengo Nihon niokeru Senmon Buhin Meka no Hatten -1945~60: Denshi Buhin Sangyou no Jirei [The Progress of Specialty Components Makers after Wold War 2 in Japan:Electronic Components Industry from 1945 to 1960],” Keiei-shi Gaku [Japan Business History Review], 33/3 (1998, Dec.).

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[44] Eiji Koike, “Sekai no Senryo Kogyo (1) [The dyestuff industry in the World Part 1],” Senryo to Yakuhin [Dyestuffs & chemicals], 4/12 (1959, Dec.), 697.

[45] To estimate the significance of PB reports more precisely, more case studies in various industries should be gathered. In some technology fields that progressed rapidly after WWII, such as electronics and petro-chemistry, PB reports seem less reliable.

[46] Gimbel, op. cit., Chap. 3, Chap. 6.

[47] Hiroshige, op. cit., 252-253.

[48] See, Hiroshige, op. cit., 204-206; Hiroshi Aoki and Atsushi Hiramoto, “Kagaku Gijyutsu Douin to Kenkyu Tonarigumi: Dainiji Taisen Ka Nihon no Kyodo Kenkyu [The Mobilization of Science and Technology and ‘The Research Neighborhood Groups’: Research Collaboration in Japan During World War II],” Shakai-Keizaishi Gaku [Socio-Economics History], 68/5 (2003, Jan.); Minoru Sawai, “Senjiki Nihon no Kenkyu Kaihatsu Taisei: Kagaku Gijyutsu Doin to Kyodo Kenkyu no Shinka [Research and Development in Wartime Japan: Mobilization of Science and Intensification of Joint Research],” Osaka Daigaku Keizaigaku [Osaka Economic Papers], 54/3 (2004, Dec.).

Tables

Table 1: Bibliographies of technical reports issued by the U.S. government	
The data of first issue	Title
1946, January	Bibliography of Scientific and Industrial Reports
1947, January	Bibliography of Technical Reports
1954, October	U.S. Government Research Reports
1965, January	U.S. Government Research & Development Reports
1971, March	Government Reports Announcement
1975, April	Government Reports Announcement & Index

Sorce: National Diet Library OPAC (http://opac.ndl.go.jp/index.html)

Table 2: The total number of PB reports and its pages from January 1946 to January 1952

Country	Reports		Pages	
	Number	%	Number	%
Germany	55,772	52.2	5,255	70.3
United States	44,629	41.8	1,762	23.6
Japan	3,262	3.1	322	4.3
Great Britain	1,600	1.5	47	0.6
Others	1,582	1.5	91	1.2
Total	106,845	100	7,477	100

Source: Morio Uehara, "PB ripoto ka Beikoku Seifu Kenkyu ripoto ka [PB reports or U.S. government research reports?]", Saiensu Laiburary [Science Library], 5/4-5 (1959, May), 56.

Table 3. German engineers interrogated by the investigation team

Company and Factory	Person's name	Position
Anorgana G.m.b.H. Gendorf	Dr. Tapperman	
I.G. Farben Höechst	Dr. Spiker	Chemist in the Division of Technical Applications
	Dr. Otto Wegwitz	Head, Electrolytic plant, Inorganic Division
	Dr. Fritz Bachran	Chief, Inorganic Division
	Dr. Rothweiler	Head, Methyl plant.
	Dr. Eggert	Assistant, the Methyl plant
	Dr. Huber	Head,Caustic Dehydration
I.G. Farben Rheinfelden	Dr. Carl Liebich	Plant Manager
	Dr. A. Hermann	Superintendent, Elrctrolysis
	Dr. H. Heres	Superintendent, Caustic Concentration
	Dr. E. Renshler	Superintendent, Liquid Chlorine and bleach
	Dr. J. Jung	Superintendent, Organic division
I.G. Farben Ludwigsahfen	Dr. Pfannmuller	Director, Inorganic Division Ludwigshafen
	Dr. Honsberg	Superintendent, Chlorine Electrolysis
	Dr. Hans Retschy	Superintendent, Liquid Chlorine and Caustic Soda
	Dr. W. Huhn	Superintendent, Alcl electrolysis
I.G. Farben Huels (chlorine operation)	Dr. Paul Bauman	Plant Manager
	Dr. Oswin Nitzchke	Division head
	Dr. Ing. Erich Buttgenbach	Superintendent, Cl2 and NaOH
I.G. Farben Leverkusen	Dr. August Wingler	Head, Azo department
	Dr. Bencker	Superintendent, Chlorine electrolysis
	Dr. Klebert	Head, Inorganic Division

Source: Joint Intelligence Objective Agency ,FIAT Final Report No.431 Survey of The Chlorine and caustic plants in western and southern germany (PB 7747), (Washington D.C. 1945), 1,15,18,28,40, 43,45,48.

Table4: Production Capacity of caustic soda

(1000t)

Year-end	Ammonia	Electrolytic		
		Total	Mercury	Diaphragm
1939	415.8	236.9		
1946				
1947				
1948				
1949	261.0	199.0	85.8	113.2
1950	261.0	226.0	92.7	133.3
1951	301.0	261.0	112.9	148.1
1952	301.0	297.2	134.3	162.9
1953	301.0	327.5	164.5	163.0
1954	301.0	361.1	197.9	163.1
1955	301.0	389.1	220.3	168.7
1956	390.6	492.6	299.9	192.7
1957	390.6	626.5	418.0	208.5

Source: JCIA, Nihon no Kagaku Kogyo Sengo 30-nen no Ayumi [A 30-years History of Japan Chemical Industry after the war](Tokyo 1979), 63.