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CHAPTER SEVEN

Noguchi Jun and Nitchitsu: Investment Strategy of a High-Technology Enterprise

BARBARA MOLONY

In 1868, as the Meiji period (1868–1912) began, Japan's countryside was largely untouched by the technologies then rapidly developing in the West. In little more than a century, Japan has become an archetypal high-technology society and economy. The course of Japan's technological development was, of course, radically affected by World War II and its aftermath, but its basic contours were already evident before the war. By then, the defining characteristics of a technologically advanced society and economy were underway. These included the creation of a sophisticated consumer population, the recognition of the need to import and innovate technology to remain competitive, and the establishment of research organizations and a school system to create a pool of scientists and engineers able to commercialize new ideas.

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Perhaps most important, there were entrepreneurs willing and able to build Japan's high-technology industrial structure. As in the West, the innovators who created the technologically sophisticated products and molded the character of the businesses producing these products were scientist-entrepreneurs. Also as in the West, the most representative high-technology industry of the late nineteenth and early twentieth centuries was the chemical industry. The chemical industry required—and engendered—sophistication among consumers; it encouraged innovation and imitation of technology; it benefited from well-trained employees; and its companies were some of the first modern multi-unit firms in Japan and the West. Among such modern enterprises in Japan, none is more significant that Nippon Chisso Hiryō (Japan Nitrogenous Fertilizers, hereafter called Nitchitsu), founded in 1908 by scientist-entrepreneur Noguchi Jun (1873–1944).

Nitchitsu and other companies like it pioneered the most advanced technologies in fields like electrochemicals (chemicals produced through the use of electricity). Virtually none of the developments in these fields came from the larger and wealthier zaibatsu. To be sure, tiny chemical companies like Nitchitsu prospered and became immense corporations themselves within three decades—and were therefore called "new zaibatsu" (*shinkō* zaibatsu)—but their origins as innovative firms dedicated to commercializing technology determined the manner in which they later grew and diversified. Companies like Nitchitsu, and not the zaibatsu, were, both in character and structure, the predecessors of the innovative new corporations of postwar Japan. It is often asserted that "the zaibatsu pioneered the commercialization of modern technologies in Japan" at the urging of the government and that government ministries collaborated closely with the zaibatsu because they believed them to be the firms best equipped for rapid adoption of technology.[1] But this is only part of the story. The zaibatsu were not themselves innovators in all key areas. However, they often did have relationships with companies that were innovators. In the case of Nitchitsu, Mitsubishi Bank lent large sums at critical times, and top managers in Mitsubishi had significant personal investments in the chemical company. It would be no exaggeration to say there were times when Nitchitsu owed its continued solvency to Mitsubishi and other lenders. But Nitchitsu was an independent company, and Noguchi Jun and his

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managers did not feel bound to solicit their benefactors' opinions when making company decisions.

Indeed, investment decisions—that is, decisions concerning how resources could best be allocated to promote the company's well-being—were made in conformity with its business strategy. When determining whether to use a new technology, Noguchi and his managers assessed their access to resources, labor, capital, and specialists skilled in application of technology. Established technologies often spawned new ones, and managers of companies like Nitchitsu had to decide whether to diversify by investing in spun-off technologies. Failure to invest when the company had adequate resources to do so could produce a lag in innovation and ultimately in competitiveness. Thus, investment in innovation was often driven by the availability of a particular technology. Choice of technologies had other effects. Some technologies required resources obtainable only from public officials, so their selection also helped define the company's relationship with government officials and determined, in the case of a colonial country like Japan, the connection between business strategy and imperialism. In particular, the type of technology Nitchitsu developed required close ties with government and encouraged investment in Korea and other Japanese-held territory.

This chapter will examine the investment strategy of one of Japan's most important technology-intensive companies. It will indicate the important role played by this non-zaibatsu firm in high-technology innovation. It will also suggest some of the reasons for the interaction of government and business, and tell how one Japanese entrepreneur became involved in colonial expansion.

NOGUCHI JUN AS INNOVATIVE ENTREPRENEUR

A quarter of a century separated the founding of Noguchi Jun's chemical company from the beginning of its cooperation with colonial authorities in the development of Korea. Noguchi was an independent scientist-entrepreneur, but ties to influential men in politics and business aided his company throughout the period. Whether businessmen or politicians were more important to him at any given time depended on strategic needs of his developing company. During its early years, Nitchitsu raised most of its funds by selling shares to investors, but loans were vital at certain crucial times when the

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company's solvency was threatened. It was then that Noguchi approached businessmen. During the 1930s, alternate sources of capital, in particular loans from semi-governmental banks, substituted for Nitchitsu's previous reliance on private-sector banks, especially Mitsubishi Bank. Thus, Noguchi's ties to influential businessmen decreased in importance. His ties to government officials followed a different pattern. When his company needed more reliable sources of electricity to expand production, Noguchi sought the approval of government officials to develop hydroelectric power. Unlike his need to cooperate with private financiers, Noguchi's need to work with government officials to obtain water rights increased as Nitchitsu's technology demanded ever-increasing supplies of electricity.

Noguchi Jun was not a chemist by training. Like several other important entrepreneurs in high-technology industries in Japan, he had graduated from the Faculty of Engineering of Tokyo Imperial University (Class of 1896).[2] After college he worked for an electric company in Sankyozawa in the Tōhoku, where he was joined by another Tokyo graduate (Class of 1898), Fujiyama Tsuneichi, in experimenting with the manufacture of calcium carbide, a product used in lighting.[3] Indeed, Fujiyama produced Japan's first calcium carbide at Sankyozawa in 1901. Noguchi had left the electric company in 1898 to join an American trading firm in Tokyo, and then settled down for a couple of years to work with the Japanese branch of the German Siemens-Schuckert company. After several more short-term jobs and a trip to the United States during the Russo-Japanese War, Noguchi decided to return to Japan to begin his own enterprise. Two friends working in the gold mines of Kyushu urged him to develop hydroelectricity for ventures like their own. Hydroelectricity was a new industry at the turn of the century. Coal had supplied the energy to produce most of Japan's electricity until the 1890s, and conversion to water power was seen as imperative to increase generation and lower the cost of energy.[4] Noguchi found his Kyushu friends' suggestion attractive, and appealed to other friends for capital to start his own hydroelectric plant. He succeeded in persuading a friend who was a Tokyo banker to advance him ¥100,000.[5] This loan permitted Noguchi to found his first company, Sogi Electric (capitalization ¥200,000, with ¥50,000 paid up), in January 1906.

Sogi Electric surprised Noguchi by producing more electricity than the goldminers and other local customers could use. This

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offered Noguchi the opportunity to return to his earlier interest in producing calcium carbide, a process that required a large amount of electricity. Noguchi invited his old friend Fujiyama, who was still in the north, to join him in using Sogi Electric's surplus electricity to produce the chemical at his new plant, called Nippon Carbide Company, established at Minamata in March 1907. Demand for electricity soon outpaced its supply, but the potential profitability of carbide production was sufficient to persuade Noguchi to expand generating capacity to facilitate it. When the expansion placed the firm on the verge of bankruptcy, he solicited a small but timely loan from a Kagoshima businessman to save his company.[6] Although the decision to expand appeared ill-advised to some at the time, this bold strategic decision resulted in the firm's becoming Japan's largest producer of calcium carbide by the end of 1907. Surmounting their solvency problems, Noguchi and Fujiyama embarked on a program of technology acquisition.

The two scientists were most interested in a new German process, commercially exploited for the first time in Italy in 1906, for using calcium carbide in the manufacture of calcium cyanamide, a nitrogenous fertilizer.[7] This was significant for two reasons. First, the young engineers' understanding of a process only recently developed in Europe was an index of the rapid advances of scientific education in Japan; adoption of new technology is not possible with inadequate training. Second, they chose a product that linked a traditional industry—farming—with the most advanced form of industrial technology. Noguchi and Fujiyama calculated that the market for a synthetic nitrogenous fertilizer was limitless in a predominantly agrarian country like Japan which relied on such natural imported nitrogenous fertilizers as soy cakes and dried fish. They lost no time traveling to Berlin and Italy to negotiate for the rights to the fertilizer license. When they arrived in Europe, however, they encountered powerful competition from negotiators from Mitsui (Masuda Takashi) and Furukawa (Hara Kei).[8] While the European license holders were impressed by the young scientists' knowledge and their previous success with calcium carbide, they were naturally concerned about their lack of capital. Fortunately for Noguchi and Fujiyama, they had some powerful supporters in Europe. One of Noguchi's mentors from his days with Siemens, Hermann Kessler, former head of the Japanese branch, had returned home and was by 1908 an influential

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man within the German company. The German firm happened to be the Italian manufacturing company's principal stockholder. Kessler not only praised Noguchi, but may also have persuaded the Italians that Noguchi planned to develop the license with the safe financial help of Mitsui.[9] In the end, the Europeans chose to award the license to the two unknown young men rather than to the wealthy zaibatsu.

Noguchi and Fujiyama now had the right to the license, but they could not afford to pay for it. The license was extraordinarily expensive, costing more than the total worth of Noguchi's investments in Kyushu. Noguchi entered negotiations with Mitsui, as Kessler may have suggested, in search of aid. But Mitsui's offer to pay for start-up expenses in return for 50 percent of the first shares issued doomed the negotiations.[10] Noguchi refused to give up so much of his company. He therefore turned to friends and relations in the financial communities of both Osaka and Tokyo for help.

Noguchi first appealed to a relative, Hori Tatsu, a member of the Board of Directors of the Tokyo-based Japan Mail Steamship Company (Nippon Yūsen Kaisha, N.Y.K.). Hori asked Kondō Renpei, President of N.Y.K., how he might help Noguchi. Kondō then solicited the advice of Toyokawa Ryōhei, head of the banking division (later Mitsubishi Bank) of Mitsubishi Gōshi Kaisha. Sufficiently impressed with Noguchi to support his venture, Toyokawa made a large personal investment in the new company, Nippon Chisso Hiryō, created by the merger of Sogi Electric and Nippon Carbide in 1908. Toyokawa's terms were far more flexible than Mitsui's. He agreed that "Noguchi and Fujiyama should keep as many shares as they can. Mitsubishi will take care of the rest. We will give them sufficient financing also."[11]

Toyokawa not only promised to help Noguchi, but also introduced him to Iwasaki Hisaya, President of Mitsubishi Gōshi Kaisha, and Nakahashi Tokugorō, President of Osaka Merchant Steamship Company (Ōsaka Shōsen Kaisha, O.S.K.). All these influential men helped develop Noguchi's enterprise. All were investors; it is significant that Iwasaki and Toyokawa invested as private venture capitalists rather than as representatives of Mitsubishi. A later Mitsubishi Bank president, Katō Takeo, remarked that Iwasaki often lent his support, independent of Mitsubishi Gōshi, to promising entrepreneurs.[12]

These introductions helped Noguchi in less tangible but equally important ways as well. Noguchi became a protégé of Nakahashi

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Tokugorō, one of the most influential men of affairs in Osaka. Born in Noguchi's birthplace, Ishikawa prefecture, Nakahashi had graduated from Tokyo University ten years before his young friend. Nakahashi was as conversant with the world of politics as with commercial circles. He later became a potent force in the Seiyūkai, one of the two major political parties before World War II, and held various Cabinet portfolios. Both his political and financial ties were of help to Noguchi.[13]

The Mitsubishi investors wished to protect their investment and therefore placed three Mitsubishi managers on the first Board of Directors. O.S.K.'s Nakahashi became President of Nitchitsu in 1909.[14] Nevertheless, Noguchi and Fujiyama, together with Ichikawa Seiji, Noguchi's long-time friend, classmate, and a research partner in Sankyozawa, retained control of daily operations and decision making for Nitchitsu. It was Noguchi who decided what types of technology would be used and what kinds of plants would be built.[15] Noguchi used several sources of funds rather than relying entirely on Mitsubishi. He invited other individuals and banks—in particular, his classmate at the First Higher School, Watanabe Yoshirō, President of Aichi Bank—to invest in Nitchitsu. He also received aid in 1910 from a government lending institution, Nihon Kangyō Ginkō (Japan Hypothec Bank), whose vice-president, Shimura Gentarō, was a brother of Watanabe Yoshirō.[16] Thus, although men from Mitsubishi were clearly important in Noguchi's company, Noguchi maintained independence in decision making by diversifying his sources of managers and of capital. Since Nitchitsu continued to prove it was a viable venture during the next decade, Mitsubishi managers remained relatively disinterested investors.

Between 1908 and 1912, Noguchi made some crucial decisions. Most important was the 1909 plan to use calcium cyanamide as a raw material in the manufacture of ammonium sulfate. Ammonium sulfate was a more marketable fertilizer than calcium cyanamide; farmers had had several years of experience with the product and preferred it to calcium cyanamide. A simple method of making ammonium sulfate involved breaking calcium cyanamide into limestone and ammonia, then combining the ammonia with sulfuric acid. To apply this method, Noguchi constructed a pilot plant near Nitchitsu's Osaka headquarters in 1910 and invited an Italian specialist to help Fujiyama solve problems of production. Noguchi and

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Fujiyama had already begun to express different opinions about how to market Nitchitsu's products; calling in an outside specialist exacerbated tensions in their relationship. Fujiyama then left to establish his own electrochemical firm in Hokkaido (Denki Kagaku Kōgyō).[17] At the same time, a freak flood destroyed a plant under construction in Niigata, leaving Noguchi with large capital losses.[18] At the end of the Meiji period, therefore, Noguchi had to make some crucial decisions about what types of investment to pursue to save his company.

Noguchi recognized as early as 1909 that progressing to the next higher stage of technological development, manufacture of ammonium sulfate, was far more profitable than producing calcium cyanamide. His funds remained insufficient to carry out his plans as late as 1912; government decisions during that year, however, solved his financial problems. The Railroad Board of the Ministry of Communications, interested in obtaining already-developed sources of electricity to use in the electrification of railroads in Kyūshū, acquired ownership of Noguchi's Sogi generating plant and parts of his manufacturing plant at nearby Minamata. Nitchitsu made the best of the negotiations with the Railroad Board. The company netted ¥1.57 million for the facilities, but, because the Railroad Board was not yet ready to use Nitchitsu's plant, the company continued to function as usual, paying only a small fee to the Board for use of the electricity. Nitchitsu's supply of electricity was further augmented in October 1912, when the government approved Noguchi's earlier request for the right to develop hydroelectric power at yet another site in Kyushu.[19] Relations between Nitchitsu and the Railroad Board remained cordial; personal connections smoothed any possible friction. Nitchitsu President Nakahashi was a former head of the Railroad Board; the Railroad Board's head during the negotiations with Nitchitsu later left to become a member of Nitchitsu's Board of Directors;[20] and Noguchi and his colleague Ichikawa claimed to welcome the chance to work "for an enterprise benefiting the nation."[21]

Sustained by government aid in 1912, Noguchi was ready to implement his plan to manufacture ammonium sulfate. He lost no time in setting up the necessary generating plant. By 1914, his second major chemical plant came on stream at Kagami, producing Japan's first commercial ammonium sulfate by the electrochemical method. The technology at the new Kagami plant surpassed that at the old Minamata plant, inducing Noguchi to upgrade Minamata to Kagami's

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level. Noguchi's timing was fortunate. Just as the output from the two plants was expanded, fertilizer shortages became acute in Japan because European imports were cut off by World War I. In 1915, when Noguchi could better afford it, ownership of Nitchitsu's original facilities reverted to the private company from the Railroad Board. Compounding the company's success during World War I, Nakahashi persuaded his sometime colleagues in the government to lift export controls on fertilizer to permit Japanese manufacturers to claim the lucrative Southeast Asian market temporarily abandoned by the warring Europeans. This combination of events allowed extraordinarily high profit rates for the company, profits used not only for higher dividend payments to shareholders but also for later technology acquisition[22] (see Appendix A).

Expansion of the company brought new concerns to Nitchitsu's management. Labor was one such concern. The greatly expanded work force and the demanding amount of work required of each worker worsened labor relations.[23] Noguchi's relations with his middle managers proved more successful than those with his blue-collar employees. White-collar workers' sense of identification with the company was encouraged by the structure of the plants. Each of his two plants, Kagami and Minamata, was divided into sections corresponding to the technological processes involved in manufacture of ammonium sulfate by the "three-product cycle" used at Nitchitsu (see Appendix B). The three-product cycle was the process linking calcium carbide to calcium cyanamide to ammonium sulfate. Each of the first two was a raw material for the next stage of production; all were marketable products in their own right. The head of each production section held concurrent posts at both plants, which were essentially replicas of each other.[24] Thus, Minamata's manager in charge of generation of electricity served in the same capacity at Kagami.

Commuting by managers between facilities had two major effects on the training of management. First, it created a sense of company integration, even as Noguchi's enterprise expanded in Japan and Korea. Second, commuting by top managers produced devolution of daily operations to lower levels of management. This permitted a large number of technically trained employees to acquire managerial skills in subdivisions structured along lines of production. In time, these manager-technicians rose to higher positions in the company.

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Furthermore, their skills were in demand; technically trained men could move to other companies or government positions. Even members of the Board moved to establish their own firms or take positions in the government. Because not all employees felt obliged to stay with the company, rewards were offered for technical expertise and perseverance in management. Noguchi's responsive creation of pleasant working conditions is frequently mentioned in white-collar employees' accounts of their years at Nitchitsu.[25]

A second problem Noguchi faced during the 1910s was financial. As demand for fertilizer grew during the World War I cutoff, Noguchi returned to his stockholders every year for authorization to increase capitalization or to borrow for current expenses.[26] It should have been apparent that European recovery after the war would eventually lead to massive importation of cheaper fertilizer, thereby making it difficult for Nitchitsu to pay off its loans with (predictably) lower profits. Nevertheless, Noguchi kept borrowing. Wartime profits were so high and start-up time for expanded capacity in plants run on the three-product cycle relatively so short, that Noguchi could project sufficient return on his investment even if the Europeans recovered quickly. What appeared to be short-sighted borrowing during the war, then, paid off; Noguchi's firm remained in the black even during the years of reinstated imports. Through these decisions, Mitsubishi bankers supported Noguchi; for the next two decades, Mitsubishi remained at the center of a consortium of banks—also usually including the Aichi and Yamaguchi Banks—underwriting Noguchi's requests for bonds and loans.

EXPANSION AND DIVERSIFICATION AFTER WORLD WAR I

Noguchi Jun began to contemplate upgrading his technology after World War I. During the war, high demand for fertilizer obviated the need for a production method more efficient than the three-product cycle. To remain competitive after the war, however, Noguchi had to develop more profitable methods of production. Most governments involved in the war had spent large sums of money on research in electrochemicals, especially in ammonia, the main component in both fertilizers and explosives. Ammonia was viewed as strategically necessary to a war economy. Noguchi was aware of the advanced research

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by which ammonia could be produced directly from nitrogen and hydrogen, using a catalyst and enormous quantities of electricity, bypassing the calcium cyanamide stage. He wrote articles on that procedure as early as 1914.[27] Methods developed by government-sponsored and private researchers in the United States, the United Kingdom, France, and Italy were all modifications of an elegantly simple method created by Germans Fritz Haber and Karl Bosch, requiring sophisticated machinery capable of withstanding high temperatures and pressures.[28]

Though Noguchi may have wished to obtain the Haber-Bosch license to upgrade his technology, another group of potential investors began earlier negotiations for the license. This group—called after their formal organization in 1923 the Eastern Nitrogen Association (Tōyō Chisso Kumiai)—had originally coalesced during the war as an informal association interested in purchasing the license for ammonia from America's General Chemical Corporation.[29] One important member company was Mitsubishi Gōshi Kaisha, the parent company of Mitsubishi Bank. The men at Mitsubishi Gōshi were either unaware or unconcerned that their involvement in the Association might adversely affect a company dependent on Mitsubishi Bank loans. Conclusion of the war shifted the interest of the members of the Eastern Nitrogen Association to the original German method, the Haber-Bosch, recently made available to Germany's former adversaries. The German possessors of the rights, Badische Anilin und Soda Fabrik (BASF), began negotiating a license with the Japanese group.

Just as the group was considering the extraordinarily expensive license, the Japanese government obtained the license as spoils of war and made it available for private development. Although Japanese developers would be required to pay only a nominal fee to the government for transfer of the license, they would continue to owe prohibitively large royalties to the German firm. None of the members of the Eastern Nitrogen Association believed it could afford the high payments. As a result, they were slow to exploit the license, and, by 1923, a price war between English and German producers attempting to capture the Japanese market prevented its profitable use. Members subsequently negotiated a deal with the German nitrogen producers' syndicate whereby Association members would receive an ad valorem royalty of 2 to 3 percent on imported ammonia, and

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Mitsui, Mitsubishi, and Suzuki Shōten would replace H. Ahrens of Kobe as the importer of German fertilizer in return for members' not using the license.[30] Because Mitsubishi Gōshi earned money for not producing, it had little incentive to produce ammonia until market and investment conditions improved during the following decade. But the interests of Nitchitsu suffered, though not for the first time. Three years earlier, Nitchitsu's fertilizer distributors—most of them related to Mitsubishi Trading Company—had already hurt Nitchitsu when they failed to pay the company the contracted price per ton because they said the market would not support high fertilizer prices. Bearing the cost of overproduction themselves, Nitchitsu leaders realized they had to lower costs.[31]

Noguchi formulated his response to competition from inexpensive imports marketed by some of the members of the Eastern Nitrogen Association during a trip to Europe in 1921. Traveling to Italy to consider renewing Nitchitsu's nearly expired license for calcium cyanamide, Noguchi detoured to visit the laboratory of Luigi Casale, a scientist struggling with new commercially viable ways of making ammonia.[32] Impressed, Noguchi negotiated for the license to use Casale's methods. Casale was still experimenting with ammonia and had not yet produced on any large scale, but discussions with Noguchi persuaded him that the Japanese engineer had the expertise to start commercial production. Casale demanded a steep price for the privilege, about ¥1 million, which Noguchi, though the top managing officer in Nitchitsu, was unwilling to authorize alone. Requesting additional time to consult with his colleagues in Japan, Noguchi paid a deposit of 10 percent for a two-week extension of the decision period.

He immediately telegraphed his colleagues at company headquarters in Osaka. They were taken by surprise by Noguchi's precipitous actions, and called a meeting of the entire Board of Directors. Most thought Noguchi's action deserved further study and began to consider some of the requirements of the new technology. Finding an appropriate site for a plant for synthesizing ammonia under the new license was essential. The Casale method required even greater quantities of electricity than the less sophisticated three-product cycle already in use at Nitchitsu. Good sources of electricity were secured through Noguchi's contacts with Kenseikai politicians in Miyazaki prefecture, who persuaded the Seiyūkai Cabinet to change

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the rules for transmission of electricity to help Noguchi.[33] For an unexplained reason, Casale waited until Noguchi's return to Italy in December 1921, far more than the two weeks agreed upon, and transferred the license to Noguchi on receipt of 10 million lira (about ¥1 million). Construction began in April 1922, and the new plant at Nobeoka came on stream in September 1923. So successful was Nobeoka that the Minamata plant was refitted with Nobeoka's modern technology. Since the Kagami plant was poorly situated to permit conversion to the Casale method of production, its machinery was transferred to other branches of Nitchitsu and its building sold to another chemical firm.[34] By 1927, the output at Minamata had reached three times that at Nobeoka, but Noguchi was ready for further growth, both through product diversification and through expansion to colonial soil.

During the 1920s, Noguchi developed policies in two new areas. First, he ventured into Korean production. The ways in which this policy was implemented eventually alienated Noguchi from his benefactors at Mitsubishi Bank. He could afford to lose the zaibatsu bank's support because the technology of his main product, ammonia, lent itself to strategic uses of interest to other potential benefactors in the colonial government. Ammonia production was an important part of munitions production, and the high-pressure processing technology for ammonia could be used in manufacture of synthetic oil and other strategic products. Moreover, his need to develop hydroelectricity in Korea was shared by the Japanese authorities wishing to industrialize the peninsula; this strengthened Noguchi's cooperation with government authorities.

A second radical change, in the late 1920s, was structural. Nitchitsu had until then been a company making principally ammonia and ammonium sulfate. Expansion had been accomplished through replicating technology and creating similar plants subdivided into sections by productive function. Though perhaps a successful way for a young firm to grow, this was hardly conducive to rapid generation of new technology. During the late 1920s and into the 1930s, Noguchi abandoned this method of expansion. As he diversified, he established separate facilities for different types of products. But each of the new products was chemically related to the others; each was a derivative of some other Nitchitsu product. Until 1937, Noguchi minimized involvement in products that did not have similar produc-

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tion methods; even his non-chemical investment was in support of already produced chemicals. For example, he expanded vertically by investing in transportation—a railroad—for his chemical products, as no railroad was available to his Hungnam plant in Korea. Shared interests were also fostered by regularly scheduled conferences which brought together scientists from various Nitchitsu subsidiaries.[35] Because all worked on technology similar to their colleagues' in other subsidiaries, all understood the goals and problems of others. The resulting highly efficient cross-fertilization of ideas produced far more successful innovation than had been possible under the old company structure. Just as a changing structure fostered innovation, conversely, technological developments accelerated Nitchitsu's structural conversion to a conglomerate—called a "new zaibatsu" by contemporaries—consisting of a parent company surrounded by numerous subsidiaries in Japan and Korea.

Noguchi encouraged diversification in products technologically close to already-manufactured products because it made sense from a scientist's perspective. But it also made sense from a manager's perspective. Studies done decades after Noguchi's diversification indicate that diversification increases profitability, but only if the relationship among diversified fields is close. Wide-ranging diversification diminishes performance.[36]

The first type of related diversification was in rayon. Against the advice of the rest of the Nitchitsu Board of Directors, Noguchi acquired the license for a German method of rayon manufacture. More than half a decade later, Noguchi's decision bore fruit, but low product quality initially kept the rayon operation in the red.[37] His decision to develop explosives also encountered snags; these were legal problems in obtaining government permission to manufacture explosives, eventually overcome through the help of friends in the government. Ability to make munitions later recommended him to necessary supporters like Ugaki Kazushige, Governor General of Korea. Another technology developed at Minamata during the late 1920s was for acetic acid, a basis for plastics, using mercury as a catalyst. In this case, success preceded tragedy. Though the new method appeared efficient and advanced—and together with explosives, rayon, and nitrogenous fertilizers recommended his enterprise to Ugaki—it also polluted the land and water around the village of Minamata, poisoning its population by the 1960s.[38] The ultimate evil of mer-

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cury poisoning was not foreseen when the process was developed, and so acetic acid joined the group of technologically related but non-fertilizer products whose combined sales (but not profits) surpassed those of fertilizers by 1935.[39]

Accelerated growth accompanying innovation and diversification demanded new sources of electricity. Most Japanese rivers were already developed for hydroelectricity by the late 1920s, and talk of nationalization of electrical generation and transmission had entered political discussions. Furthermore, dumping by European fertilizer makers had resumed with increased vigor and with some degree of cooperation by Japanese trading companies which benefited from expanded transactions in fertilizers. To respond to this last challenge, the manufacturers had to find ways to cut costs. Noguchi's solution to both problems was to develop the potentially rich hydroelectric sources in Korea; Korean electricity would replace the soon-to-be exhausted sources of new supply in Japan, and on-site manufacture in the colony would shave several yen off the cost of labor and electricity per ton of fertilizer.[40] Thus, continued use of electrochemical technology increasingly required colonial expansion and was closely tied to economic imperialism. But colonial investment meant seeking to develop rivers for which Mitsubishi held the operational rights, a potentially risky decision for Nitchitsu. In the end, Noguchi was able to retain fertilizer markets in Japan, to diversify sufficiently to compensate for possible losses in fertilizer profits, and to ally himself closely with colonial authorities.

MAINTAINING A MARKET WITH CARTELS AND COOPERATIVES

Noguchi was also successful in retaining Nitchitsu's share of the market in Japan. European dumping had been increasing in the 1920s against the backdrop of political discussion of the merits of controlling prices and distribution of fertilizer. Farmers' organizations had been lobbying with political parties for price controls and marketing reforms. At the low, controlled prices that would help the farmers, only the cheaper European products could earn profits for their manufacturers. The political parties and the bureaucrats were torn, therefore, between aiding the farmers and destroying the domestic fertilizer industry. The problem was complicated by the presence of

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middlemen; the large importers of European fertilizer were, at the same time, also the main distributors of fertilizers in Japan and, in several cases, struggling new fertilizer manufacturers themselves. Most Japanese manufacturers were, as a result, dependent on these companies for distribution. In 1930, the European manufacturers, exhausted from having to compete with each other, formed two international cartels for fertilizer, one for ammonium sulfate and one for calcium cyanamide. Of the fertilizer-producing nations, only Japan and the United States were excluded from the cartels, the United States for legal reasons and Japan because it was the main target of the European exporters.[41] The import problem worsened. Noguchi and other producers argued before cabinet members that, since it was in the farmers' interest that Japan have a viable fertilizer industry, imports must be restricted.[42]

But restrictive measures would fail if they were directed only at the European producers competing for the Japanese market. Indeed, actions taken by the Japanese importers and distributors of fertilizer were even more responsible for the serious import problem than those of the European manufacturers. It was the Japanese importers and distributors who controlled price and quantity of imports. In fact, Japanese farmers could have purchased fertilizer even more cheaply without the distribution middlemen. The experience of American exporters is informative in this regard. At the end of the 1920s and into the 1930s, American-made ammonium sulfate was generally cheaper than the German or British product. Yet, the Americans' market share in Japan dropped from 59 percent in 1923 to 20 percent in 1924, and to 10 percent in 1928.[43] Japanese importers apparently favored certain foreign firms. Thus, restrictions directed against foreign exporters alone would not solve manufacturers' problems. Stronger measures, including sales through marketing cartels, the use of farmers' cooperatives, and agreements with foreign companies, were necessary to undersell foreign products and control marketing.

Cooperatives were established in 1923, but played only a small role in fertilizer distribution until the Ministry of Agriculture and Forestry announced the Fertilizer Distribution Improvement Regulations in August 1930. These regulations were decided by the Cabinet and implemented by the bureaucracy; the Diet was not involved, which prevented political fights and expedited implementation. The

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regulations provided government subsidies for private cooperatives amounting to ¥4,083,065 over a ten-year period. The funds were to be used by cooperatives to buy fertilizers directly from manufacturers. As fertilizer prices continued to erode between 1930 and 1932, manufacturers turned to direct negotiations with the cooperatives. Close ties with farmers aided manufacturers in two ways. Good relations meant domestic manufacturers had a way of avoiding some of the ill effects of dumping without having to sell through Mitsui or Mitsubishi dealerships. Another benefit for manufacturers was the growth in fertilizer use as direct marketing lowered prices by eliminating the middleman's profits (see Appendix C).

Before benefiting from government programs allowing them to circumvent dealers and importers, the manufacturers had to confront the power of the importers to influence the rules for distribution. This confrontation is evident in the differing approaches of Noguchi Jun, on the one hand, and representatives of other manufacturers and importers, on the other, to the formation of the International Nitrogen Cartel (the Convention de l'Industrie de l'Azote, hereafter I.N.C.) and to the Fujiwara-Bosch Agreement of 1930.

Three of Japan's largest producers of ammonium sulfate reacted to the threat of a European cartel without hesitation, forming the Nitrogen Deliberative Association (Chisso Kyōgikai) in March 1930.[44] The three—Nitchitsu, Denki Kagaku (Denka), and Dai Nippon—were joined by four other non-members in petitioning the Finance Ministry to apply the Unfair Dumping Law (*Futō renbai hō*) of 1910 against the members of the international cartel. Fujiwara Ginjirō, president of Denki Kagaku, was spokesman for the producers' group, and other manufacturers aired their views as well. Noguchi stated that the government had only once helped the fertilizer industry, when it relaxed restrictions on exports of fertilizers during World War I. By not regulating imports now, Noguchi added, the government was losing a valuable source of customs revenue by failing to tax imported fertilizer adequately.[45]

In addition to negotiating with the government, the members of the Nitrogen Deliberative Association also had to compromise with each other because their solutions to import problems varied. Fujiwara Ginjirō and Noguchi Jun began secret negotiations with Hermann Bosch, president of the Japan office of H. Ahrens, importers of German ammonium sulfate, in November 1930. They negotiated

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reductions of German imports from 380,000 tons in 1929 to 200,000 tons in 1930. Moreover, the proposal provided:[46]

(1) That the Japanese ammonium sulfate producers be absolutely prohibited from exporting;
(2) That the Japanese producers form an importing cartel, and agree to take 200,000 tons of imports during the first year of the agreement, followed by scheduled reductions of 50,000 tons each year for the next four years until imports were phased out;
(3) That the import price be set at ¥85;
(4) That the Japanese producers be prohibited from building new plants or expanding capacity;
(5) That all imported ammonium sulfate be sold through Mitsui or Mitsubishi;
(6) And that the agreement be in effect for five years.

Noguchi was not pleased with these terms, however, and withdrew his support. The agreement was, therefore, considered to be Fujiwara's. It has been argued that Fujiwara Ginjirō's terms unnecessarily harmed Japanese makers of fertilizer by stipulating a low import price and by restricting expansion of firms in the process of construction.[47] These included Nitchitsu's plant at Hungnam, Korea. (Because of Korea's colonial status, Hungnam products were considered domestic rather than imported.) Furthermore, Fujiwara was president of two Mitsui-related companies—Ōji Paper and Denki Kagaku—and Mitsui and Mitsubishi Trading Companies appeared to be the major beneficiaries of the Fujiwara-Bosch agreement, as these negotiations were called. This has raised the question of whether Fujiwara took a relatively weak position on import controls because of his relationship to Mitsui.

A closer examination reveals the restrictions to be less damaging than they appear. In 1929, Japanese exports of fertilizer were minuscule—just 0.79 percent of production—and, by 1930, had risen to 5.6 percent.[48] To be sure, exports had grown quickly, but they still accounted for just a small percentage of production. Moreover, imports remained above 300,000 tons in 1930; this left plenty of opportunity to expand sales in the domestic market even if Japanese exports were eliminated, as stipulated in the first provision of the

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agreement. Similarly, the impact of the third provision was not completely damaging; the low import price of ¥85 cut profits, but most firms, including Nitchitsu, did make some profit at that price.

The clause restricting plant expansion was the only injurious one, even for companies related to Mitsui, Sumitomo, and Mitsubishi, which were continuing negotiations to acquire licenses for ammonia at that time.[49] The fifth clause would principally affect the European fertilizer importers by requiring domestic marketing.

Even this relatively benign proposal was rejected by Noguchi, however, who reopened negotiations with Bosch. The resulting Noguchi-Bosch proposal differed from Fujiwara's draft in the following ways: Noguchi would lift restrictions on Japanese exports; Noguchi would eliminate sales of American fertilizer in Japan; and Noguchi would prohibit direct sales by foreign firms to Japanese consumers.[50] Noguchi rejected the suggestion that plants under construction be eliminated.

The Fujiwara-Bosch agreement was therefore revised in April 1931, after consideration of Noguchi's proposals. It provided:

(1) That English and German manufacturers be required to cease direct marketing, and all imports be handled by Mitsui and Mitsubishi, including imports from the United States which had formerly been contracted only to Mitsubishi;
(2) That the agreement be in effect for three years from 1 July 1931;
(3) That British and German imports could total 100,000 tons during the first year, 80,000 tons the second year, and 50,000 tons the third year, unless Japanese-made supply failed to keep pace with demand;
(4) That, although exports of Japanese-made ammonia were not recognized by this agreement, future exports could be negotiated in good faith with the Germans and the British.

These revised proposals were more favorable to manufacturers than Fujiwara's original suggestions. In the end, these negotiations were superseded by environmental changes. The manufacturers' problems were finally solved in 1932, when the devaluation of the yen made imports uncompetitive with domestic fertilizers. By then, the farmers' cooperatives were also running smoothly. Nevertheless, Japanese fertilizer manufacturers decided that they should improve ferti-

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lizer distribution. So they formed a distribution cartel, the Ammonium Sulfate Distribution Association (Ryūan Haikyū Kumiai), whose leading member was Noguchi Jun.[51]

As Noguchi developed effective techniques to counter adverse market conditions, however, he discovered the benefits of greater independence from his distributors. Gradually separating himself from Mitsubishi, Noguchi sought to establish a base in Korea.

NOGUCHI IN KOREA

Disagreements with Mitsubishi emerged over Korean investment. Noguchi was the major private investor and developer of industry in Korea and became known as the "Entrepreneurial King of the Peninsula." Nitchitsu capital accounted for over one-quarter of all investment there as late as 1942,[52] and one of his wartime admirers compared his role in Korea to that of Columbus in America.[53]

Noguchi's interest in Korea had been kindled before World War I when a boyhood friend told him of his plans to generate electricity there.[54] But the Korean Corporation Law of 1911 limited investment opportunities in Korea just as opportunities were expanding at home. There was little reason for Noguchi to think of Korean investment till the mid-1920s. Colonial policy had changed in 1920. Korean agricultural production for export to Japan was encouraged after the Japanese Rice Riots of 1918 indicated the need for greater supplies of rice at home. Increasing output in Korea would require fertilizers. The Corporation Law was abolished in 1920, permitting Japanese investment in the colony.[55] Within the decade, official policy called for Korean industrialization, including electrification of rivers. These policy changes coincided with the needs of Nitchitsu to find new rivers to harness, to develop factory sites near electricity and labor, and to receive encouragement for technological advancement and diversification.

The Government General in Korea had begun studying rivers as early as 1911, and announced that developing hydroelectricity would be profitable.[56] But some potential developers of this electricity failed to act quickly to take advantage of the opportunities. Mitsubishi Gōshi Kaisha, for one, had begun investigating the Yalu and the Changjin, two of Korea's largest and most promising rivers, but made

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no move to harness them.[57] As with other new industrial ventures, the task was left to smaller, less risk-averse entrepreneurs.

Two such entrepreneurs were Morita Kazuo and Kubota Yutaka. Morita, a university classmate of Noguchi's, became interested in Korean electricity development while visiting a journalist friend in Seoul in 1923. On his return to Japan, he called on Kubota, a younger engineer, who had just returned to Japan from Seoul with topographical maps of the Pujon and the Changjin Rivers.[58] Morita's enthusiasm was infectious, and the two became excited by the challenge of developing those rivers. They next applied to Governor General Saitō Makoto for permission to begin their investigation and possible development. But, despite the Government General's avowed desire to produce electricity in Korea, Saitō demanded that Morita and Kubota find industrial customers to make the project economically feasible.[59] Saitō had reasons for this demand. There was another applicant for the project; this was Saitō's way of determining which applicant was better. Morita and Kubota recalled Morita's classmate Noguchi and Noguchi's former partner Fujiyama Tsuneichi. Both were good at their craft, but Noguchi had additional talents—his useful political skills. Noguchi had contributed generously to a Kenseikai politician in a campaign in which Kubota had worked. Kubota felt that Noguchi's ease with politicians would speed project development. Morita and Kubota therefore invited Noguchi to join the project.

Noguchi responded without hesitation. He could finally go to the colony. He joined the project initiated by Kubota and Morita and petitioned Shimooka Chūji, Political Affairs Officer for the Government General, for the water-development rights originally requested of Governor General Saitō.[60]

Noguchi was a successful industrial user of electricity—which Saitō had demanded in granting development rights—and Shimooka liked Noguchi. But there was the matter of the other applicant—Mitsubishi Gōshi Kaisha, Mitsubishi Bank's parent company—a formidable challenger. It had a proven interest in the rivers, having already studied them for generative capacity. Most formidable to Nitchitsu was, of course, the relationship between the two firms. Mitsubishi Bank was Nitchitsu's creditor. Although Shimooka admitted that he did not like large zaibatsu,[61] he permitted Mitsubishi

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to develop the larger of the two rivers, the Changjin, while granting the Pujon to Noguchi. Although Mitsubishi would vigorously object to some of Noguchi's later attempts to expand in Korea, Shimooka's June 1925 decision to grant Noguchi the Pujon was quite acceptable to them. First, they were convinced that developing the Pujon was a good investment for Nitchitsu, and, as Nitchitsu's creditors, Mitsubishi bankers were pleased. And, second, some Mitsubishi leaders were personally pleased, especially the Iwasaki family, who had significant shareholdings in Nitchitsu.[62]

Noguchi wasted no time developing the Pujon project. Within two months he had traveled on horseback through rough, roadless terrain, investigating the source of the Pujon.[63] By 27 January 1926, he was ready to incorporate Chōsen Hydroelectric (Chōsen Suiden) with himself as president. The founding of Chōsen Hydroelectric was a monumental step forward in Japan's electrical generating industry. Although generation fell short of the 200,000 kw. anticipated, the scale of the project—more than 80,000 kw.—far surpassed other Japanese electrical works. The project was also an important stimulus to Japan's machinery industry, since it was one of the first major projects in Japan or its colonies to use Japanese-made machinery.[64]

Even before the hydroelectric plant was operating, Noguchi began construction in May 1927 of its sister chemical plant at Hungnam; this was completed within two and a half years. Chōsen Chisso Hiryō came on line in January 1930, just as world prices for fertilizer were dropping. Interestingly, Nitchitsu profited from the increased production at Chōsen Chisso, despite the world glut of cheap fertilizer, because Chōsen's production costs were low enough to remain competitive. The Chōsen product lowered Nitchitsu's overall average cost to a profitable level. Korean-made fertilizer was much cheaper than the fertilizer Nitchitsu made in Japan. Taxes, wages, and costs of energy were all lower, and Noguchi had eager customers in Korea.

While Noguchi's production soared in Korea, it declined in Japan, and, by 1935, had fallen to just 15 percent of Nitchitsu's total ammonium sulfate output.[65] But Hungnam was not one big fertilizer plant, for it was there that Noguchi was able to diversify. The low costs of electricity, wages, and taxes at Hungnam permitted higher profitability and lessened the risk of investment in applications of spin-off technology. Indeed, as the risk of investment declined, the cost of *not* investing loomed larger. The company main-

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tained its competitiveness by innovating in new areas. Innovative investment was fostered by the profitability of business expansion in Korea. Thus, Korean investment fostered Nitchitsu's competitiveness. Experienced staff, another requirement for expansion, were increasingly available as technically trained employees worked their way up through manufacturing subsections of the company. By the time the Hungnam fertilizer plant came on line, another new Korean subsidiary of Nitchitsu was producing glycerine from Korean sardines to be used in the manufacture of explosives at Nobeoka in Kyushu. (By law, Noguchi was not yet permitted to manufacture explosives in Korea.) In time, numerous such ties would be established among Nitchitsu subsidiaries. Futhermore, twelve major intra-company scientific conferences between 1931 and 1943 brought Nitchitsu scientists together for regular exchanges on ways of using different subsidiaries' products.[66]

Noguchi's plans sounded ambitious and appeared to be successful. But the initial optimism expressed by Mitsubishi bankers for Noguchi's Korean advances began to fade. They were concerned about his ability to repay the large loans needed for his massive construction projects. More risk-averse bankers had replaced the earlier more enthusiastic bankers. Kushida Manzō, with whom Noguchi dealt at Mitsubishi Bank, took a cautious approach to investment during the Depression.[67] This caution was shared by others with Mitsubishi connections. At Nitchitsu Board meetings, they began to object to Noguchi's plans for expansion, while Noguchi's own appointees generally approved his ideas.

Although Noguchi's bold actions would ultimately benefit his company, the more cautious Mitsubishi men appeared, in the early 1930s, far more rational. A drought in the summer of 1930 lowered the water level in the Pujon reservoir, destroying hopes that the project could quickly recoup the enormous investment already made.[68] Although Mitsubishi Bank permitted additional borrowing in 1931, in 1933 the bank decided to terminate its formal relationship with Noguchi, and required him to repay ¥25 million in loans. After a quarter of a century of support, Mitsubishi withdrew a large part of its aid to Nitchitsu. But Nitchitsu remained in operation and even prospered. The company's technological requirements for certain resources and the strategic value of its products led to its increasingly intimate relationship with government officials and permitted its survival.

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NOGUCHI AND UGAKI

Nitchitsu could survive the loss of support from Mitsubishi because of the growing cooperation between Noguchi and Ugaki Kazushige, Governor General of Korea from 1931 to 1936. This cooperation depended on the type of technology Nitchitsu employed for ammonia manufacture—electrochemistry. After 1932, electrochemistry generally became uncompetitive with a new method of ammonia manufacture, the gas method. A decline in access to new sources of hydroelectric power due to restraint of competition through organization of the electrical industry meant that Noguchi's form of technology would become increasingly rare in Japan.[69] The gas method used large quantities of coal rather than electricity and was the method employed by companies like Mitsui and Mitsubishi, which had their own coal supplies when they entered the chemical field in the early 1930s. By contrast, the energy requirements of the electrochemical method demanded a good working relationship with government officials, such as Noguchi had with Ugaki Kazushige, to guarantee access to electricity. Close ties between Ugaki and Noguchi were possible because the Governor General saw an electrical industry necessary for industrialization. Ugaki was also pleased to find an entrepreneur able to cooperate on projects like construction of harbor facilities and to fill government and military contracts.[70] The resulting government encouragement permitted the chemical industry to grow far larger than would be expected under more normal circumstances of industrialization in a developing country like Korea.[71]

By the time Ugaki arrived in Korea in 1931, Noguchi was practically a resident there. Concerned about starting production at Hungnam and fighting the drought of 1930, Noguchi rarely left Korea even to visit his family. He was extremely energetic in acquiring the right to develop the Changjin River, then held by Mitsubishi Gōshi Kaisha, to compensate for his losses on the Pujon.

Acquiring the rights to the Changjin took some time, but Ugaki, who advocated rapid industrialization, did attempt to expedite electrification of the river. This ultimately speeded the transfer of rights from Mitsubishi to Chōsen Chisso. On his appointment as Governor General, Ugaki interviewed the major Japanese investors in Korea. He asked them about their continuing interest in investment.

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In particular, he asked Kimura Kusuyata of Mitsubishi Gōshi Kaisha what his company planned to do with the Changjin.[72] Kimura replied that, as Mitsubishi had already made a significant investment in the project, he wished to have a year to review their accomplishments and projections and to prepare an explanatory report. Ugaki granted the year. Shortly thereafter, in February 1932, Ugaki issued tough new regulations for electrical companies in Korea. These included the government's right to establish national-policy companies to transmit privately generated electricity within the four districts into which Korea would be divided, to approve all construction plans for plants, and to veto selection of upper-level managers in electrical companies.[73] These regulations permitted Ugaki to transfer Mitsubishi's water-development rights in 1932 when company officials decided they had no immediate plans to develop the river.

Noguchi requested the rights to the Changjin immediately after Mitsubishi announced its hesitancy to develop it. Ugaki demurred in granting Noguchi's request because of his concern that Mitsubishi might discontinue financial support for the venture; he was right.[74] But Noguchi decided to risk Mitsubishi's objections. Technological considerations made Chōsen Chisso far more dependent on electricity than Mitsubishi was. Chōsen Chisso was already manufacturing products needing electricity; and therefore any reduction in its supply would lead to a cutback in production and sales. On the other hand, Mitsubishi had not yet begun electrochemical manufacture, so inability to increase electricity supplies could not affect current output of fertilizer and other manufactured goods. Mitsubishi continued to have a less pressing need for electricity, even when it did begin production of electrochemicals, because it used the gas method, which required materials Mitsubishi itself possessed. Noguchi was dependent on the government in ways the more self-sufficient zaibatsu never was. Thus, although Mitsubishi Bank threatened to withdraw funding because of their objection to Chōsen Chisso's fertilizer production during the Depression[75]—and perhaps because Mitsubishi was considering eventual production of ammonia as well—Noguchi's choice of technology demanded that he invest in increasing his generative capacity.

Noguchi went ahead with his application for the development rights. His cause was aided by his employee Kubota Yutaka, who persuaded Government General officials that Mitsubishi's cost projec-

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tions were too high and that Chōsen Chisso could complete the project more efficiently. But, even if costs were as low as Kubota estimated, Chōsen Chisso's debt would be enormous. In the end, Noguchi's decision was aided by several considerations. First, he found alternate sources of financing from other banks.[76] Second, Ugaki permitted Noguchi to acquire the rights for the small sum of ¥400,000; Mitsubishi had already invested ¥1.2 million in the project.[77] Third, Chōsen Chisso was able to use flexible accounting procedures to minimize taxable income even while expanding output.[78] That is, Chōsen Chisso and other subsidiaries of Nitchitsu were legally separate corporations, but were usually wholly owned by Nitchitsu. Nitchitsu was paid fees by its subsidiaries for marketing their products and supplying their resources, thereby lowering the subsidiaries' profits according to the accounting methods the company used. Lower profits meant lower taxable income for Chōsen Chisso. Nitchitsu did not collect dividends for its shares of Chōsen Chisso after 1933; these fees for service were collected instead. Income could, by such accounting methods, be shifted among subsidiaries and the parent company to permit tax savings. Fourth, some of the electricity generated at the Changjin was sold to a National Policy Company, a requirement of Ugaki's regulations, which increased the cash income Chōsen Chisso could expect from its investment in the Changjin.[79]

Noguchi's first consideration—funding—was handled by the government-managed Bank of Chōsen, the Industrial Bank (Kōgyō Ginkō), and the Industrial Bank of Korea (Shokusan Ginkō). The banks underwrote long-term bonds and made regular commercial loans, some of which were repeatedly rolled over. Chōsen Chisso, the main fertilizer company, received most of these loans before 1937, but, thereafter, larger loans were granted to strategically important subsidiaries like Chōsen Oil.[80] The parent company—Nitchitsu—also received separate Bank of Chōsen loans through the bank's Tokyo office. When Chōsen Chisso was merged with the parent company in 1941 under government orders, the amount loaned to Nitchitsu represented the combined total of loans to several of Nitchitsu's operations in Korea and Japan, and thus appeared to make a large leap in 1941, as did all loans from official and semi-governmental banks to other companies involved in high-technology munitions production.

Katō Keisaburō, president of the Bank of Chōsen and an enthusi-

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astic advocate of industrialization in Korea, was Noguchi's most important financial contact. There are several reasons why Noguchi and Katō found it mutually profitable to cooperate. Katō may have been impelled by ideological reasons. Katō took it as his "special mission" to lend to prospective developers, especially one recommended by Ugaki.[81] A commercial bank might have spent more time investigating the potential profitability of each loan. Fortunately for Noguchi, Katō believed nitrogenous fertilizers, related to munitions production, to be strategically necessary.

Katō Keisaburō may also have cooperated with Noguchi because he viewed assistance to Noguchi Jun as an important investment in strengthening the independence of his Bank of Chōsen vis-à-vis Tokyo. The bank faced serious financial problems during the late 1920s. In the wake of the liquidity crisis which forced the bankruptcy of the similarly government-managed Bank of Taiwan, both colonial banks were placed under close scrutiny by the Ministry of Finance in Tokyo.[82] The presidents of both banks had to divide their working time between Tokyo and their colonial headquarters. Katō Keisaburō wished to avoid the stifling effects of intense scrutiny in Tokyo, and felt that a major success in lending in Korea would underscore the effectiveness of the Seoul office as well as provide an indisputable justification for his remaining in Seoul. Katō therefore used the Seoul office to lend large amounts of money to Noguchi. Although later loans to subsidiaries of Nitchitsu were delivered through different branches of the Bank of Chōsen, it was initially important that Katō establish the centrality of the Seoul headquarters.

Noguchi seemed a good risk, and the Bank's president authorized loans to the chemical firm's president. As collateral, Noguchi offered 37,000 of his own shares in Nitchitsu as well as a portion of the fertilizer output of Chōsen Chisso. Other short-term loans to Noguchi came from the Industrial Bank of Korea, but the Bank of Chōsen remained the most important source of funds.[83] Both Korea-based banks also served as agents for other Japanese banks, which could be assured that these agents would offer Noguchi such services as loan transfers and payments of taxes and fees.

Nitchitsu sustained the loss of Mitsubishi's aid because it received government assistance as a company able to cooperate with Ugaki in the industrial development of Korea. So successful was this industri-

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alization that it produced unforseen demographic and sociological changes in the colony. The chemical industry grew by a factor of 100 from 1924 to 1940, while consumer industries such as textiles and food increased only 10 times during that same period. The chemical industry was centered around Hungnam and the Pujon and Changjin Rivers' generating facilities in northern Korea. Consequently, industrial output per capita jumped in the north and stagnated in the south. Population growth was similarly more rapid in the north. Though their productivity increased during the 1930s, most workers in Chōsen Chisso produced little except fertilizer that was of use within Korea.[84] Most of Noguchi's new products were developed with Japan's strategic needs in mind.

STRATEGIC DIVERSIFICATION

Diversification at Noguchi's enterprise occurred in two different phases. The first, from 1932 to 1937, was one of informal cooperation between the military and civilian leaders and the industry. Decisions affecting the company were usually initiated internally by Noguchi, the Board of Directors, and managers involved in daily operations. Company priorities coincident with the ideology of men in the military or administration could be easily implemented, however. Without government-supported loans and official permission to build plants, for example, Noguchi would have had to modify or even suspend his plans for development in Korea. Outsiders like Ugaki, therefore, played an important role in company decisions. Ugaki could suggest certain types of development—such as helping Noguchi locate his Hungnam complex so that it could double as "Japan's first line of defense" against the neighboring Russians[85]—and the Governor General could create the conditions conducive to Noguchi's decision to risk investment.

Cooperation was fostered more by a confluence of goals than by overt coercion by the Japanese government in Korea, though there are examples of government persuasion. When the Japanese and Korean economies were mobilized for war during the late 1930s, however, the government's role in making investment policy became more active. It was during the mid-1930s that the groundwork for later cooperation between the government and the chemical industry was laid; companies like Noguchi's could produce the products

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demanded by the military in the second phase of cooperation after 1937 because they had diversified, with government assistance, during the first.

Diversification occurred throughout Noguchi's enterprise in Japan and Korea, but the most interesting developments were in Korea around Hungnam. In a little more than a decade, Nitchitsu grew from a fertilizer company to a ¥500-million multifaceted chemical company with 26 subsidiaries (1937). Of the two major types of diversification undertaken during the 1920s in Kyushu—rayon and explosives—the latter became an important part of Nitchitsu's growth in Korea in the 1930s. Other areas of expansion included fats and oils, carbide, metal refining, coal-tar derivatives and synthetic fuel, soybean derivatives, and bleach and soda.

Not all were successful ventures. Some of Noguchi's investments in the areas encouraged by officials had less initial success than those in areas selected by company men on the basis of production priorities. Indeed, Noguchi occasionally encountered resistance from his managers when he wished to follow government plans his managers felt were antithetical to company interests. Some of the company's less profitable products were unsuccessful because they failed to have a real market until the late 1930s, others because the company's technological capabilities, the highest in Japan and the colonies and essentially at international levels, still fell short of Noguchi's aspirations.

The first two areas of diversification of product were in the manufacture of glycerine from sardine oil and the carbonization of coal. The waters around Korea were the world's richest sardine fishing grounds.[86] Noguchi found ready use for Korean sardines; he could pulverize sardines as fertilizer and use the fish oil as glycerine for explosives made at Nobeoka. Production of glycerine began in 1932, and Noguchi sent most of this Korean product to Nobeoka. In 1934, however, management in Korea decided that production of explosives on the spot was more practical. But Japanese policy in Korea forbade production of explosives for civilian use; Noguchi would have to obtain a waiver of this restriction. This was easily done. Governor General Ugaki encouraged industrialization, mining, and construction, which all needed explosives. Permission was granted in 1934.

Explosive manufacture combined contributions from several subsidiaries of Nitchitsu. In addition to the Changjin project's contribution of electricity, nearby Hungnam supplied ammonia, oxygen,

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glycerine, and nitric acid. The Pon'gung plant, opened a few years later, sent glycol. Nobeoka continued to send trained scientists and technicians.[87] The finished product was marketed by Chōsen 'Mite Inc. (Chōsen Maito KK—"Maito" was an abbreviation for dynamite). Nitchitsu's operations in Korea were fast taking on the character of a modern multi-unit, vertically integrated firm.

Military scientists were actively involved in research, especially in detonators appropriate to Hungnam's conditions. The Korean plant made numerous types of explosives including carlite, black powder, ammonium nitrate, and dynamite. Within two years of first production, Chōsen Explosives at Hungnam was among a group of companies designated by the military as contributing to the national security and therefore amenable to military direction.[88] By the early 1940s, Nitchitsu was Japan's largest civilian producer of arms and munitions.

Carbonization for production of coal-based products was the other of Noguchi's early attempts at diversification in Korea. Plans for a distillation plant at Yong'an in north Korea were begun in 1931. In the next few years, a variety of derivative products were made from the coal tar produced at Yong'an. Methanol, formalin, and other oil products were of great interest to military procurers. In the early 1930s, however, creating the ability to produce synthetic oil products in Japan appeared ridiculous to many observers. The technology for synthetic fuel was extraordinarily sophisticated; indeed, it was far more sophisticated than the complicated technology for production of ammonium sulfate which it in some ways resembled. Japanese industry enjoyed a plentiful supply of the cheap imported petroleum internationally available in the 1930s from the United States. Noguchi's decision to invest in upgrading his technological level from its primitive ability to carbonize coal to being able to liquify it was, therefore, a major one and one that required substantial government assistance.

Certain preliminary stages toward the advancement of fuel technology in Japan had been achieved by the middle of the 1930s, due in no small part to advances in ammonia technology. As in Germany, the world leader in synthetic fuels at that time, Japanese scientists involved in synthesis of ammonia were best equipped to make synthetic fuel.[89] The Japanese Navy was particularly interested in a fuel independent of foreign sources and had conducted experiments in

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synthesis for years.[90] Noguchi's coal-tar operations, therefore, caught the eye of Navy men, who urged him to produce fuel using the Navy's methods. But there was no profit to be made from synthetic oil until several years later, at the height of World War II.[91] The only justification for making it was Noguchi's patriotism and large loans from the Bank of Chōsen. Combining research results obtained by Navy and Nitchitsu scientists, Noguchi founded Chōsen Coal Industries (Chōsen Sekitan Kōgyō KK, later renamed Chōsen Artificial Oil [Chōsen Jinzō Sekiyu]) in 1935.

Areas of diversification were metals, acetone, methanol, soybean products, and more than two dozen others. Not all diversification decisions were as dramatic as the decision to invest in synthetic oil, and some were more profitable to the company. The areas of explosives and synthetic oil are, however, typical of the kinds of diversification undertaken by Noguchi on behalf of the Government General in the 1930s.

Technologically, diversification generally followed productive lines. The new chemicals usually modified the technology of products already made by Nitchitsu or its subsidiaries (see Appendix D). Almost all, therefore, used processes dependent on large amounts of electricity. Such great amounts were available to the company because of Noguchi's close interaction with officials able to offer him rights to hydroelectric sources, even after the institution of controls on electricity. Political considerations and personal relationships, then, helped determine the form of diversification. And, conversely, technological requirements drove Noguchi closer to the authorities. But, until controls were imposed on the products themselves during the China War, Noguchi generally determined the specific areas for investment within official guidelines.

CONCLUSION

Noguchi Jun, with his Nitchitsu empire in Japan and Korea—and later throughout China and Southeast Asia as well—was Japan's archetypal scientist-entrepreneur. Starting his career as an aggressive and well trained but cash-poor young industrial visionary, he pioneered in Japan the most sophisticated technology of the prewar era, electrochemicals. He made use of financing from a variety of sources, including loans from banks like Mitsubishi and, most important, pay-

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ments from shareholders, some of the largest of whom were Mitsubishi's owners and top managers. Nitchitsu's Board of Directors reflected the company's debt to Mitsubishi; several Mitsubishi managers also served on Nitchitsu's Board, overseeing their company's investment. Yet Nitchitsu was clearly an independent company, making its own decisions about investment in innovation to further the company's interests. Business strategy was planned independent of Mitsubishi. When Mitsubishi Bank's managers differed with Noguchi on the further expansion of Nitchitsu in Korea, Noguchi did not hesitate to risk loss of Mitsubishi Bank loans in steadfastly promoting the strategic interests of his company.

We should recall that this estrangement was not actually a full-blown divorce, complete with custody battles. There was no struggle over the right to the Changjin River, for example, as is usually asserted. Moreover, Noguchi was allowed to repay the ¥25 million in loans from Mitsubishi Bank in installments over several years rather than being required to pay the entire amount at once. Furthermore, members of Mitsubishi's Iwasaki family, who personally owned shares, did not divest. Nevertheless, the loss of even the borrowed funds required belt-tightening. Why did Noguchi risk the estrangement?

There are several ways to interpret the estrangement between Mitsubishi Bank and Nitchitsu. First, successful innovative companies invest in new technology or in expansion of existing technology because the technology is available; not to invest would mean stagnation and loss of competitiveness. Other conditions for investment must also exist: sufficient capital, adequate resources, skilled workers and managers, a lively market for the product, and an encouraging investment environment, including supportive government officials. As we have seen, these conditions were met in Korea, and Nitchitsu's expansive business strategy demanded investment despite some drawbacks. The imperative to continue investment in technological innovation represented by this scenario parallels the experience of post-World War II technology-intensive companies as well.

Second, the estrangement of Nitchitsu from Mitsubishi may be interpreted in light of Nitchitsu's increasingly intimate relations with government officials who, in some sense, may be said to have taken the place of Mitsubishi as supporters outside the company. The existence of government-sponsored support not only passively eased the

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removal of Mitsubishi aid; in time, it also actively encouraged even more diverse technological innovations as Nitchitsu began manufacturing products for civilian or military officials in the colony. Thus, colonial expansion was necessary for Nitchitsu's survival and was an important result of its business strategy. Subsequently, particularly after 1937, business strategy was itself affected by the company's presence in the colony and its relationship to colonial officials.

Much seemed to change with the end of the war. Japan in defeat lost its colonies, and Nitchitsu, renamed Chisso after the war, came to epitomize at Minamata all that was wrong with rapid development of high technology. Whether to fill government contracts or to follow the technological imperative of expansion and diversification, Minamata's managers planned investment with little concern for the health of the surrounding community. Despite obvious changes in the business environment since the prewar period, Japan's postwar high-technology companies share some interesting characteristics with their prewar predecessors. As Nitchitsu was relatively independent of Mitsubishi, many—though not all—are independent of "groups." Electronics makers Sony, Matsushita, and Sharp, automakers Toyota and Honda, and camera, copier, and watchmakers Canon, Ricoh, and Seiko exemplify this independence.[92] Another characteristic of companies either founded or newly expanded from virtual workshops after the war—the presence of strong founder-executives[93]—replicates Nitchitsu's experience under scientist-entrepreneur Noguchi Jun.

More general but equally instructive comparisons are also evident in pre- and postwar government-business relations. Other scholars, most notably Chalmers Johnson, have made a convincing case that the World War II years bridged the era of weak government involvement in the affairs of businesses and the postwar era of rational planning.[94] Johnson notes that the basis for later cooperation was laid in the decades before World War II, when policy subtly fostered a climate within which private businesses were able to weather the storms of relatively unfettered capitalism. These storms were milder for firms favored by the government. But non-zaibatsu firms like Nitchitsu, rather than the zaibatsu firms cited by Johnson and most other authors, were more likely to take advantage of this benign climate for investment. The tightening of wartime regulations altered these conditions and ushered in the postwar types of government-business relations.

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The broad strokes of Johnson's scenario are well designed. Yet, it is the subtler strokes that add contour and interest to the picture. The types of policies created by the government (the subtle strokes) are as interesting as the degree of rationality of planning (the broad strokes). These types may be categorized as "supply side" and "demand side." Wartime industrial policy typically emphasized the demand side. The government, through its purchase of military supplies from companies like Nitchitsu, permitted and even encouraged private investment in high-technology research and production. After 1937, the government increasingly became Nitchitsu's major market for its otherwise unprofitable non-fertilizer products. Postwar policy was quite different, generally supporting the supply side. The government tended to facilitate investment and production in areas seen as important. The market, whether domestic or international, was supposed to contribute to this effort by absorbing the products of the investment. The government itself created demand only in a few areas, albeit significant ones. For example, the government encouraged research to improve Japan's transistor technology after 1948, starting with research sponsored by universities, by Nippon Telegraph and Telephone, and by the Ministry of International Trade and Industry. MITI also encouraged importation of transistor technology.[95] A few years later, it established research projects, donated subsidies, regulated manufacture, and limited imports to aid the related computer industry. These efforts helped diffuse advanced technology and increased the supply of Japanese computers. This typical supply-side assistance was joined by less common demand-side assistance in 1961 when MITI encouraged the Japanese computer manufacturers to create the Japan Electronics Computer Corporation (JECC) to buy Japanese computers for lease to users. The more usual form of postwar government assistance, the improvement of supply, recalls the prewar government's creation of a benign investment climate, although it differs in its greater degree of rationality and regulation.

Government policies toward high technology businesses in the prewar and postwar eras have one final significant but usually overlooked difference. The postwar policies assumed that supply-side aid was usually sufficient, that the growing domestic market would absorb the products of assisted high-technology companies, and that, whatever the domestic market failed to absorb, the foreign market

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would. This produced unanticipated but now well-known tensions from the resulting export drive. In the prewar period, there were few high-technology exports from Japan to advanced industrial countries, but, as Nitchitsu's case indicates, the most sophisticated Japanese companies were dependent on their manufactures in, and sales to, the colonies. Colonial expansion was integral to the growth of prewar technology-intensive companies like Nitchitsu. Thus, just as the prewar and postwar eras manifest parallels (and some differences) in the diffusion and development of technology, so too do they show technology's evolving challenges to Japan's society, economy, and international position.

APPENDIX A. Nitchitsu Capital and Profits, 1908–1923

Semiannum	*Capital*[a] *(¥1,000,000)*	*Paid-up*[a] *Capital (¥1,000,000)*	*Internal*[b] *Capital (¥1,000)*	*Bonds*[c] *(¥1,000,000)*	*Profits*[d] *(¥1,000)*	*Profit*[e] *Rate %*	*Dividend*[f] *Rate %*	*Dividends/Profits*[g]
1908.1	1.0	0.64						
1908.2	1.0	0.64			25	7.8	10	
1909.1	1.0	0.82			42	10.2	10	
1909.2	1.0	1.0			53	10.4	10	
1910.1	1.0	1.0			74	14.9	10	
1910.2	2.0	1.25			68	10.9	10	
1911.1	2.0	1.5			67	8.9	10	
1911.2	2.0	1.75			79	9.0	8	
1912.1	4.0	2.0			123	12.3	10	
1912.2	4.0	2.0			163	16.4	10	
1913.1	4.0	2.5	65		198	11.7	10	81.3
1913.1	4.0	2.5	49		186	12.5	10	80.2
1914.1	4.0	3.0	-64		94	6.3	8	123.4
1914.2	4.0	3.2	199		370	13.7	10	69.6
1915.1	4.0	3.4	482		704	14.9	12	77.5
1915.2	4.0	3.8	601	1.0	354	18.7	15	75.7
1916.1	4.0	4.0	758		447	22.4	15	65.8
1916.2	10.0	5.5	772		654	23.8	20	79.0
1917.1	10.0	6.4	600	1.0	930	29.1	25	79.3

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APPENDIX A *(Continued)*

1917.2	10.0	7.0	977	1.0	1,150	32.9	25	74.6
1918.1	10.0	7.6	1,116		1,345	35.4	30	81.4
1918.2	10.0	7.6	1,376		1,684	44.3	30	67.7
1919.1	10.0	7.6	1,462		1,758	46.3	30	64.9
1919.2	10.0	7.6	1,707		1,830	48.2	30	62.3
1920.1	10.0	10.0			5,179	103.6	104	73.6
1920.2	22.0	13.0			1,519	23.4	20	82.3
1921.1	22.0	13.0			1,204	18.5	15	81.0
1921.2	22.0	13.0			1,186	18.2	15	82.2
1922.1	22.0	13.0			1,196	18.4	15	81.5
1922.2	22.0	13.0			1,199	18.4	15	81.3
1923.1	22.0	13.0			1,210	18.6	15	80.6
1923.2	22.0	13.0			1,196	18.4	15	81.6

a. Ōshio Takeshi, "Nitchitsu kontsuerun no seiritsu to kigyō kin'yū," *Keizai Kenkyū* 27:61–127 (March 1977), pp. 116–117.

b. Internal capital includes: reserves, balances forwarded, debt amortization; Suzuki Tsuneo, "Daiichiji taisenki Nitchitsu, Denka no tōshi to shikin chōtatsu," *Kurume Daigaku Shōgakubu seiritsu 30 shūnen kinen ronbunshū.* August 1980, p. 147. Data for 1913–1919 only.

c. Ōshio Takeshi, "Nitchitsu kontsuerun," p. 109. These bonds were underwritten by Mitsubishi, Aichi, and Yamaguchi Banks. Interest rates were low: 7% for the first issue, thereafter 6% or lower. Most bonds were issued after 1926.

d. 1908–1913: Shimotani Masahiro, "Nitchitsu kontsuerun," p. 69;
1913–1923: Suzuki Tsuneo, "Daiichiji taisen," p. 142.

e. Profit rates were calculated as a percentage of paid-up capital, adjusted to annual rates, a frequently used method in prewar Japan. Suzuki Tsuneo, p. 142.

f. Percentage of par value paid out as dividends; Suzuki Tsuneo, p. 142.

g. Dividends as percentage of profits; Suzuki Tsuneo, p. 142.

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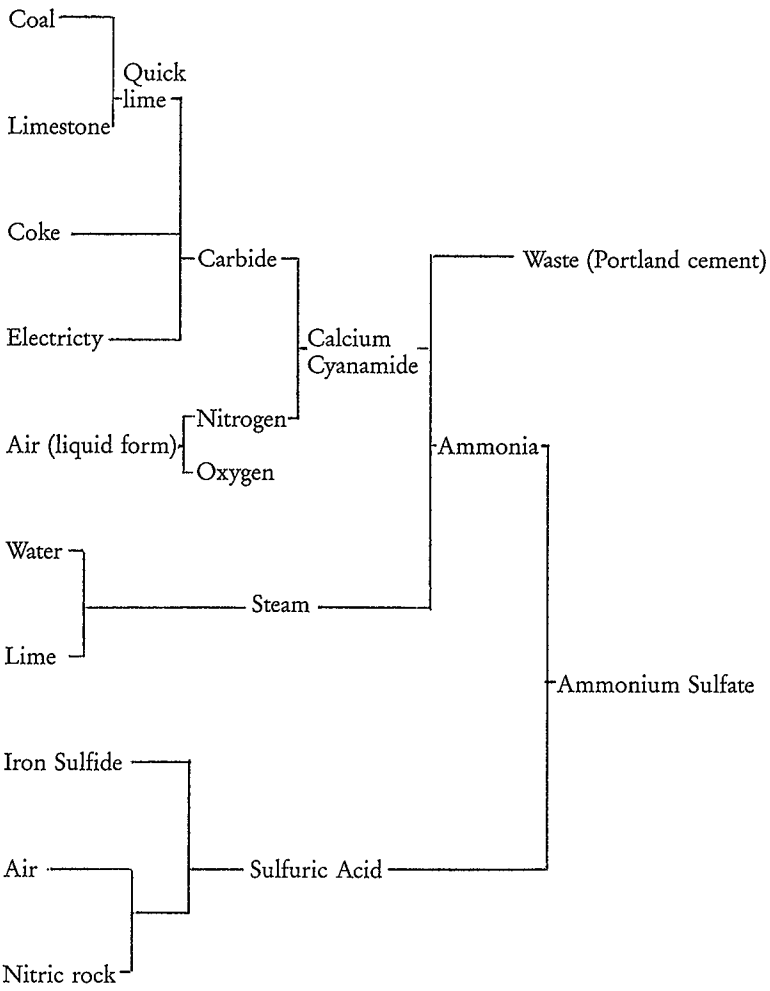
Appendix B. Three-Product Cycle



Source: Yamamoto Tomio, *Nippon Chisso Hiryō jigyō taikan* (Osaka, Nippon Chisso Hiryō, 1937).

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Appendix C. Role of Cooperatives in Fertilizer Distribution (in tons; 1,000 yen)

	All Types of Fertilizer		*Ammonium Sulfate*	
Year	*Amount*	*Value*	*Amount*	*Value*
1923	15,568	1,463	1,497	245
1924	26,610	2,590	3,757	614
1925	31,659	3,166	5,290	794
1926	36,343	3,122	6,234	898
1927	46,399	3,638	6,767	911
1928	64,912	5,358	7,614	924
1929	116,769	8,418	7,423	758
1930	214,432	10,365	24,512	1,667

Source: Hashimoto Jūrō, "1920 nendai no ryūan shijo," *Shakai keizai shigaku* 43.4:62 (1978).

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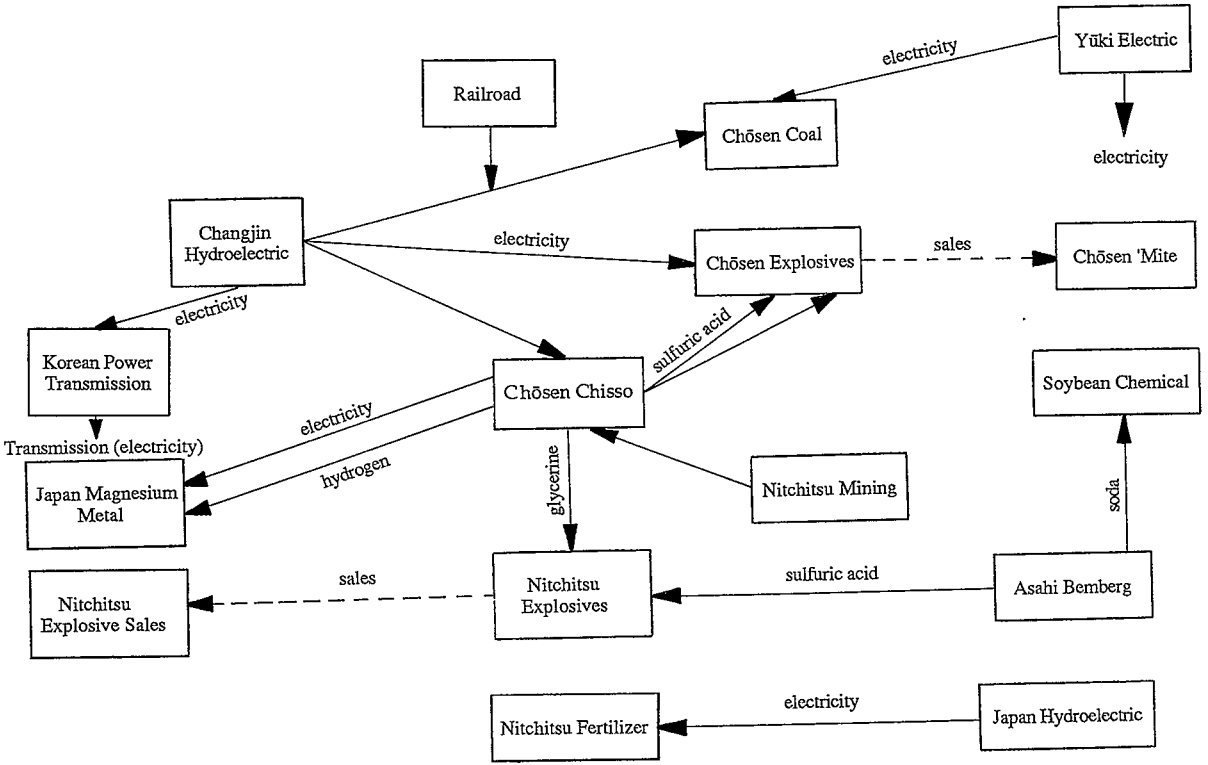
APPENDIX D

PRODUCTIVE RELATIONSHIPS IN CHŌSEN CHISSO - 1935



Source: Shimotani Masahiro, "Nitchitsu kontsuerun to gōsei ryūan kōgyō," Osaka Keidai ronshu 114 (November 1976), p. 61