THE INTRODUCTION OF WESTERN INDUSTRY TO JAPAN DURING THE LAST YEARS OF THE TOKUGAWA PERIOD

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The modern period of Japanese history is generally dated from 1868, the year of the Meiji Restoration. Like most dates used in defining historical periods, this one gives the illusion of a sharp break in historical development that did not occur in fact, for many distinctive characteristics of modern Japan may be clearly traced at least as far back as the Tokugawa period. Even so recent a feature as industrialization began in the closing years of the “feudal” period with the introduction of Western technology and methods in several branches of industry. It will be the purpose of this paper to describe the conditions under which this movement began, the scope and character of the process, and to attempt to estimate its significance for the industrial history of the Meiji period.

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It is a fact of capital significance in the history of the Far East that industrialization began earlier and progressed more rapidly in Japan than elsewhere. An important reason for this was the relatively advanced state that Western studies, and particularly the applied sciences, had reached in Japan by the initial phases of industrialization.

It will be recalled that the Tokugawa Shōgun had cut Japan off from all intercourse with Europe, save for a restricted commerce permitted the Dutch at Nagasaki, just on the eve of those great scientific achievements of the seventeenth century that were to lead indirectly to machine industry and the conquest of much of the Far East by European nations. Despite the enormous handicaps that isolation imposed, Japanese scholars tediously expanded their knowledge of Western science, geography, and armaments throughout the eighteenth century by the study and
translation of Dutch books. The movement, heretofore dependent upon the efforts of individual scholars, was given powerful official support shortly after the turn of the century. In 1808, the Bakufu幕府, which had been translating Western works on the calendar for several years, obtained the services of Baba Sajūrō 馬場佐十郎 (1787-1822), an illustrious rangakusha 萌學者, or "Dutch scholar," and commenced the translation of Western geographical works. The work of Baba Sajūrō marked the beginnings of an official translation bureau, at which some of the most celebrated rangakusha of the time were employed. The activity of this bureau, together with the work of similar enterprises undertaken by individual daimyō 大名, resulted in the translation and collection of Dutch works on such a variety of subjects as medicine, chemistry, shipbuilding, mechanics, mining, mathematics, physics, and pyrotechnics and the translation of an encyclopedia, which ran to seventy volumes and required twenty-eight years to complete.

The appearance of Perry's squadron in Edo Bay gave the movement a new urgency. "The necessity of defense against the barbarians," a Mito水戸 official commented in 1854, "requires that we know them and know ourselves; there is no other way to know them than through Dutch learning." It was for this purpose that the Bakufu established a school for Western studies

1 C. R. Boxer, Jan Companie in Japan, 1600-1817, An essay on the cultural, artistic, and scientific influence exercised by Hollanders in Japan from the seventeenth to the nineteenth centuries (The Hague, 1936), Chaps. 3, 4.
2 Bakufu literally means "tent government," hence military government or shogunate.
3 The term daimyō denotes the hereditary head of a territorial government, of which there were over two hundred in the Tokugawa period, and in which the daimyō enjoyed a high degree of independence despite definite obligations and limitations on his power imposed by the Shōgun.
4 Numata Jirō 浅田次郎, "Bansho-shirabesho ni tsuite" 藩書調所に就いて ("Regarding the Bansho-shirabesho"), Rekishi chiri 歴史地理 (History and Geography) 71 (May, 1938).18-19. To expedite work on the encyclopedia, which was begun in 1811 and not completed until 1839, only items of practical utility were included. The pragmatic character of the selections may be seen from the Japanese title given the work, Kösei shimpen 厚生新編 (New Book for the Welfare of the People).
5 Tokugawa kōshaku ke 公爵家 ed.. Mito han shiryō 水戸藩史料 (Historical Materials on the Mito Han) (Tōkyō, 1916) 1.919.
called the *Bansho-shirabesho* 藩書調所 in 1855.* Language study was necessarily the most important part of the program, and its development is a rough index of the progress of the school. Instruction was at first offered only in the Dutch language, but English and French were added in 1860, German in 1861, and Russian in 1864.* Facilities for specialized study in the several branches of “Western learning” (yōgaku 洋學) were also developed, as foreign books and translations were accumulated and the general “Dutch scholar” on the faculty with a smattering of knowledge on many subjects tended to become a specialist in one of them. Government regulations in 1864 fixed the curriculum to include astronomy, geography, mathematics, physics, refining (seirengaku 精煉學), and painting, and there were four instructors in chemistry at the school in 1866.*

Although samurai 士 were admitted to the *Bansho-shirabesho* without distinction as to the han 畿 from which they came, most of the han also undertook independent programs to promote a knowledge of Western languages and “Western learning” among their samurai. Rangaku, or “Dutch learning,” was introduced as a subject of study into many han schools. Chōshū 長州 sent young samurai to Nagasaki to study Dutch,* giving them official

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* The school was successively known as the *Bansho-shirabesho*, the *Yōsho-shirabesho* 洋書, the *Kaiseisho* 開成所, and Tōkyō Imperial University. Honjō Eijirō 東山 恵治郎, ed., *Meiji ishin keizai shi kenkyū 明治維新経済史研究 (Studies in the Economic History of the Meiji Restoration)* (Tōkyō, 1990) 5.

* NUMATA, “Bansho-shirabesho,” 29-31. In 1866 the school had 17 instructors in Dutch, 10 in English, 6 in German, 4 in French; no instructors in Russian are listed for 1866.

* Ibid. 31-32. For a list of the subjects in which lectures were given at the school in 1866, see Ōkurashō 大蔵省 ed., *Nihon zaishi keizai shiryō 日本財政経済史料 (Historical Materials on the Finances and the Economy of Japan)* (Tōkyō, 1922-25) 10,960.

* The territory under the jurisdiction of a daimyō 東 was known as a han 畿. The term han is usually translated as “fief,” but the strong European connotations of this word are not appropriate to Tokugawa Japan, and the Japanese terminology has therefore been used.


preferment upon their return, and after 1864, the han employed several Englishmen as language instructors. Tosa 佐佐 sent samurai to Nagasaki and Edo for the study of European artillery as early as 1843; lectures on "Western learning" were afterwards introduced into the routine of the han school, and instruction in English and French was commenced in 1866. Mito began instruction in Dutch in 1832; the program was permitted to lapse after the loss of the instructor to the Edo police authorities but was revived in 1855 and continued until the Restoration. But it was in Satsuma 藩 and Saga 佐賀 that Western studies were most highly developed, and it is interesting to note that these han were also leaders in introducing Western industry.

Satsuma possessed an exceptionally favorable location for the development of Western studies. Her territories lay close by Nagasaki and the Ryūkyū Islands, which until 1854 were the sole means of direct access to Europeans. Equally important was the character of the Lord of Satsuma in the years immediately before and after Perry. SHIMAZU Nariakira 島津齊彬 (1809-1858) was himself a student of Dutch and an enthusiastic patron of "Western learning." Before becoming daimyō in 1851, he had

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12 A case in point is NAKAJIMA Jihei 中島治平, who came from a family of low rank and rose to a high position in the Chōshū bureaucracy through a knowledge of Dutch and English. HORIE Yasuzō, “Nakajima Jihei to Yamaguchi han no yōshiki kōgyō” (“Nakajima Jihei and Western-style Industry in the Yamaguchi Han”), Keizai ronsō 40 (May, 1935).135-37.

13 HORIE, “Yamaguchi han,” 156.


15 Mito han shiryō 1.916, 919, 921. There was an interesting element of conservatism associated with the program begun in 1855. All persons were forbidden to study Dutch save those specially designated by the han government because "Western studies have become increasingly fashionable of late, a fact which may in the future give rise to serious evils." Ibid. 922.

16 Satsuma carried on a large-scale, illicit commerce with Chinese junks that touched at the islands, which had been a dependency of the han since their conquest in 1609. It has also been established that Satsuma was in contact with French and Dutch traders in the Ryūkyūs before the first commercial treaty in 1858. TSUCHITA Takao 土屋恒雄, Hōken shakai hōkai katei no kenkyū 封建社會崩壊過程の研究 (A Study of the Disintegration of Feudal Society) (Tōkyō, 1927) 527-29.
commissioned the translation of numerous Dutch books, among them an important work on steamships, and had been active in the collection of scientific works, particularly in the field of chemistry in which he had a special interest.\textsuperscript{17}

In the year he became \textit{daimyō}, Nariakira established the \textit{Seirenjo} 製煉所 as a laboratory for the study of the practical applications of Western science. Here experiments based on Dutch works were made on such problems as the plating of metals, the bleaching of silk and cotton cloth, and the manufacture of acids, alcohol, and glass. A model reverberatory furnace was built and experiments conducted on the smelting of iron ore.\textsuperscript{18} The activities of the \textit{Seirenjo} were continued after the death of Nariakira in 1858, and in 1865 the policy of promoting “Western learning,” with which his name is inseparably associated, was carried to its logical conclusion by the dispatch of fifteen young samurai to Europe as students.\textsuperscript{19}

Saga, like Satsuma, was favored by geography. Nagasaki was located in the province of Hizen 肥前, a large part of which was Saga territory, and responsibility for the defense of the port in alternate years provided exceptional opportunities for direct, if clandestine, relations with the Dutch. As early as 1804 Saga was sending students to Nagasaki to study “Dutch medicine” (\textit{ran’i-gaku} 薬醫學),\textsuperscript{20} and a medical school (\textit{Igakkan} 醫學館), based on the accumulated body of “Dutch” medical knowledge, was opened by the \textit{han} in 1834.\textsuperscript{21} In 1851, the \textit{Rangakuryō} 藩學寮, or

\textsuperscript{17} \textit{Ibid.} 490.
\textsuperscript{18} \textit{Ibid.} 489, 491.
\textsuperscript{19} Three Satsuma officials accompanied the students abroad to study European industry. \textit{Ibid.} 512-13.
\textsuperscript{20} The first student seems to have been \textit{Shimamoto Yoshimasa} 島本良順, who was sent to Nagasaki sometime before the Bunka era (1804-1818). \textit{Erō} Tsunekaru, “Takashima tankō ni okeru kyūhan makki no Nichiei kyōdō kigyō” 高島炭坑に於ける舊藩末期の日英共同企業 (“The Joint Anglo-Japanese Undertaking in the Final Period of the Old \textit{Han} at the Takashima Coal Mine”), \textit{Keizai shi kenkyū} 13 (Feb., 1935). 42.
\textsuperscript{21} \textit{Ibid.} 43. The interest of Saga in Western medicine was not exceptional. It was the first branch of “Western learning” to attract interest in other \textit{han}; study of the subject had progressed so far by 1859 that an American physician could report that: “Already are our systems of medicine and surgery in practice to a large extent throughout the Empire.” \textit{The Nautical Magazine and Naval Chronicle} (Nov. 1859) 569.
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Bureau of Dutch Studies, was established. Although instruction was confined to the Dutch language and Western military science, a number of the graduates of the school were sent to Nagasaki to study shipbuilding, mechanics, and electricity under Dutch instructors.22

In 1852, Saga established a Seirenjo 精炼所 of the kind opened by Satsuma the previous year.23 Like the Kagoshima 鹿児島 institution, study was based on Dutch books and focused on the applied sciences. The Saga Seirenjo studied photography, telegraphy, spinning, and sugar refining among other subjects and by 1855 had built models of the telegraph and steamship for experimental purposes.24 The extraordinary interest of Saga in technology is indicated by the fact that the two representatives chosen by the han to accompany a Bakufu mission to the United States in 1860 were selected from among members of the Seirenjo.25 The observations of these emissaries in the United States resulted in the final educational undertaking of the han before the Meiji Restoration. Instruction in Dutch, which was reported to be an unduly circuitous approach to Western science, was dropped, and an English language school (eigakuryō 英学寮) was founded at Nagasaki in 1865.26

The most striking feature of the early history of “Western learning” in Japan is the exceptional interest shown in the applied sciences. The reason for this is obvious. The period in which these studies were coming to maturity coincided with the most serious crisis in Japan’s foreign relations since the Mongol invasions. The material superiority of the West had been clearly demonstrated by the Opium War (1839-1842), and the increas-

22 Erō, “Takashima tankō,” 43.
23 Ibid. 51. It is interesting to note that several of the principal technicians and scientists employed at the Seirenjo were brought in from outside the Saga han, a measure that constituted a departure from the traditional policy of the han. Ishiguro Tadanori 石黒直寛 was a scientist from the Tamba han 但馬藩; Nakamura Yorisuke 中村吉輔 was a Kyōto chemist; Tanaka Chikae 田中近江 was from Kurume.
24 Ibid. 53.
25 The two representatives were Ishiguro Tadanori and Fukutani Keiko 福谷啓古. Ibid. 53.
26 Ibid. 43.
ingly frequent appearance of European ships in Japanese waters suggested the probability that Japan would soon be put to a test that China had already failed. It is not strange, then, that the Japanese showed a clear partiality for those branches of “Western learning” which, it was believed, gave the Westerners their margin of superiority. “It is a most amazing fact,” SAKUMA Shōzan 佐久間象山 (1811-1864) commented, “that, with the invention of the steamship, the magnet, and the telegraph, they now appear to control the laws of nature.”

Once the military potentialities of Western technology had been grasped, it was but a short step to the attempt to develop the industries necessary for their realization. The fact that the Shogunate and the leading han, upon whom the principal burden of national defense fell, were acting under the compulsion of what they not unreasonably regarded as military necessity affected the early history of Western industry in Japan in two important respects. First, the earliest and most important of the Western industries developed during the Tokugawa period, such as iron, armaments, and shipbuilding, were of a military character. Consumer industries based on Western technology, such as cotton spinning, did not appear until the very end of the period. Second, the urgency of the new industries and the absence of a capitalist class with traditions and experience in industrial undertakings precluded the possibility of their development being left to private interests, and, consequently, the Western industries of the Tokugawa period were all owned and developed as government enterprises.

The significance of some measure of previous familiarity with Western science and technology, the directness of the connection between the crisis in Japan’s foreign relations and the introduction of Western industry, and the characteristic features of

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27 TABOHASHI Kiyoshi 田保橋潔, Kinsei gaikoku kankei shi 近世外國關係史 (A History of Japanese Foreign Relations in the Tokugawa Period), (Tōkyō, 1940), Chaps. 6, 10, 12.

Western industry in the Tokugawa period may be seen in the history of specific industries in this period.

Saga was the first han to introduce Western methods of smelting iron ore, a fact closely related to the defensive assignments of the han and the advanced state of Western studies in her territories. Since the seventeenth century Saga had been charged with responsibility for the defense of Nagasaki in alternate years with the Fukuoka han. The inadequacy of defensive arrangements for the port had become apparent early in the nineteenth century, and in 1850 Saga drew up a plan for strengthening these defenses by emplacing a total of fifty-three guns, varying in size from twelve to one hundred and fifty pounds, on the islands lying immediately off the coast. At that time copper was almost exclusively used in casting weapons, for the traditional methods of smelting iron ore did not yield high-quality iron in sufficient quantities for the purpose. As guns were cast in increasing numbers in the first half of the century, copper became prohibitively expensive and difficult to procure in quantity. Confronted with the necessity of using iron to carry out such an extensive program of casting as its plans involved and of finding a more efficient means of smelting the ore, Saga, in 1850, built the first successful reverberatory furnace in Japan, using a Dutch book as guide.

The capacity of this furnace soon proved inadequate, and three additional furnaces were built in quick succession. The success of the entire undertaking was verified in 1853 when an iron gun was satisfactorily cast from one of the new furnaces. Sugitani Yasusuke, the translator of the book upon which con-

29 Erō, "Takashima tankō," 37.
30 Ibid. 38-39. The estimated cost of casting and emplacing these weapons was 208,145 ryō, of which 50,000 ryō were borrowed from the Bakufu. (For ryō, see note 49.)
32 Ibid. 16; Horie, "Yamaguchi han," 153. A detailed construction sketch of the type of reverberatory furnace used in the Tokugawa period is to be found in Mito han shiryō 1.352 ff.
struction of the furnaces had been based, expressed his satisfaction with the results in his diary. "Even though this gun is not yet the equal of Western guns," he wrote, "still the difference is not appreciable." The daimyō of Saga must have shared SUGITANI's opinion, for it is certain that Saga cast guns from iron on a considerable scale after 1853. No summary figures can be given, but an average of one hundred workers were employed in casting during the first three years of the enterprise, and Saga filled an order from the Bakufu for two hundred of the new guns before 1857.

Other han, as well as the Edo government, watched the progress of the Saga experiment with keen interest, for they were likewise compelled by the increasing pressure of foreign powers to expand their armaments despite the shortage of copper. Satsuma, Mito, and the Bakufu quickly followed the example of Saga, and by 1858 all three had succeeded in building one or more reverberatory furnaces. Chōshū began a furnace but failed to complete it, and Tosa, Jōshū 上州, Tottori 島取, and Kuroda 黒田 never progressed beyond the planning stage. The reasons that these plans were left unfulfilled are not entirely clear, and they no doubt varied with individual han. But the case of Tosa, which found the project beyond its means, suggests that other han may have encountered similar financial difficulties.

Even before the success of the Saga furnace had been demonstrated, Satsuma built a model of the furnace at the Seirenjo using SUGITANI's translation. Experiments in the smelting of ore were made with the model, and in 1853 the han built a full-sized

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34 The date of the entry is January 26, 1853. Quoted in ŌYAMA, "Yōshiki seitetsu jigyō," 16.
35 Erō, "Takashima tankō," 49; ŌYAMA, "Yōshiki seitetsu jigyō," 16-17. One hundred of the guns cast for the Bakufu were thirty-eight pounders, and one hundred were eighty pounders.
36 See below.
37 Chōshū began construction of its furnace from sketches of the Saga furnace made by a Chōshū official. Work on the furnace was abandoned in November 1856, owing to the expense of the undertaking and the fact that Chōshū regarded the guns cast by Saga as unsatisfactory. HORIE, "Yamaguchi han," 161.
38 Ōyama, "Yōshiki seitetsu jigyō," 23.
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reverberatory furnace and a blast furnace (yōkōro 熔鍊爐) the following year. Two additional furnaces of the reverberatory type were built in 1865. In the same year Satsuma built a sankaidai 鐵開台, an apparatus powered by a water wheel for boring the solid iron gun barrels cast from the furnaces, from sketches of the device in a Dutch book.40

The iron produced with these furnaces was used chiefly for casting weapons, and a lively armaments industry developed at Kagoshima.41 SHIMAZU Nariakira, the energetic daimyō of Satsuma, also established a number of small workshops to turn out a variety of iron products such as carpentry tools and agricultural implements both for direct use by the han and for sale on the commercial market. The iron and armaments industry, together with these workshops and a number of others for sugar refining and for the manufacture of leather articles and paper, were collectively known as the Shūseikan 鑒成館.42 Although there are no satisfactory data on the output of iron by Satsuma in this period, some suggestion of the size and importance of the industry is contained in the fact that twelve hundred workers were being employed at the Shūseikan in 1858.43

The origin of the iron industry in Mito followed the same pattern as it had in Saga and Satsuma: the necessity for casting guns from iron led to the construction of Western-style furnaces for smelting ore.44 There are, however, a number of details of the Mito industry which are of special interest. They indicate a surprising degree of co-operation among specific han and throw some light on the financial problems involved in the introduction of the new industry.

Co-operation with other han antedated the actual introduction of Western industry by Mito. In this early period TOKUGAWA Nariaki 徳川齊昭 (1800-1860), the Lord of Mito, had exchanged Dutch books with other daimyō including SHIMAZU Narioki 齊興

40 TSUCHIYA, Hōken shakai hōkai 401-94.
42 TSUCHIYA, op. cit. 491.
43 Ibid. 498.
44 Mito han shiryō 1.345.
(1791-1859) of Satsuma, and in 1851, Mito was permitted to send a representative to Satsuma and Saga to inspect the work being done by these han on the reverberatory furnace. Two years later, when Satsuma had at last succeeded in smelting iron ore, Shimazu Nariakira reported the event to the Lord of Mito in detail. By this time the latter was already embarked on a similar project and needed no instruction on the merits of the new furnace. He had obtained the services of Ōshima Takatō, a samurai of the Nambu han who had been studying the reverberatory furnace through Dutch books, and Takeshita Norimichi, a Satsuma samurai who had worked on the furnace at Kagoshima. By 1853 these outsiders had produced a model furnace for Mito and the construction of a full-sized furnace had been ordered.

The construction of a reverberatory furnace involved a substantial investment. Mito was unable to finance the project entirely from its own treasury and was obliged to solicit a loan of 10,000 ryō from the Bakufu. In April of 1854 the Edo government granted the loan and acceded to the proposed condition that the loan be repaid in weapons cast after the completion of the furnace. Construction was begun four months later under the technical direction of Ōshima and Takeshita, and the furnace was completed in December of 1855, after a little more than twelve months of work. A second furnace was begun several months later and finished in June of 1856. A sankaidai, necessary equipment in manufacturing iron guns, had been built in 1855 in conjunction with the first furnace, and a blast furnace was built in 1858, marking the completion of the Mito iron industry.
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Despite the fact that the Bakufu bore the primary responsibility for national defense, it was not until 1858 that it built a reverberatory furnace. Even so, the initiative came from a Tokugawa provincial official, EGAWA Tarōzaemon (1801-1855), who had built a small but unsuccessful furnace as early as 1842 at Nirayama in Izu province. Stimulated by the success of the Saga furnace, for the study of which he had dispatched a subordinate to Saga, EGAWA requested permission from Edo to build a furnace in his district. Permission for the project was granted, and after several years’ labor and the death of EGAWA, the furnace was completed at Nirayama, and the casting of guns was begun in 1858.

After 1858 the Bakufu developed the iron industry in connection with shipbuilding. The two industries are so intimately related in the materials for their study, as well as in fact, that it will be convenient at this point to consider them together.

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Since the year 1635, the Tokugawa had prohibited the construction of seagoing vessels, as part of a program of eliminating those factors of growth and change that might disturb their dominance. It was not until 1853, when the arrival of Perry’s “black ships” had given unmistakable evidence of the danger to the nation from foreign powers, that the prohibition was lifted to make the building of a navy possible. There is no doubt of the motivation of this abandonment of a time-honored policy. It was to national defense (kokubō 国防) that the Lord of Mito had appealed in

54 Ibid. 14. EGAWA was daikan 代官, a local administrative official in the domain governed directly by the Tokugawa, of the Kamo 賀茂 District in Izu Province. He was one of the most progressive men of his time: he was a student of Dutch, advocated the use of commoners as soldiers, and had studied European artillery, mathematics, and surveying with TAKASHIMA Shūhan 秋帆 (1798-1866), a student of Western military systems and a leading exponent of intercourse with foreign countries. Nihon keizai shi kenkyūjo ed., Nihon keizai shi jiten 辞典 (A Dictionary of Japanese Economic History) (Tōkyō, 1940) 2.1845.

55 The furnace was begun at Shimoda, a small port in Izu at which foreign ships were permitted to refuel after 1854. The work was removed from Shimoda for security reasons and completed at Nirayama, which was less accessible to foreigners. Nihon zaisei keizai shiryō 1.1000; ŌYAMA, “Yōshiki seitetsu jigyō,” 15.
petitioning for a reversal of policy in the less strenuous days of the Tempō era (1830-1844), and the language of the decree announcing the new policy permitted the construction of large ships (taisen 船) “because in the present state of affairs, they are a necessity. . . .” A supplementary decree spoke of ships as “necessary items for maritime defense.” Thus, the immediate stimulus for the introduction of modern shipbuilding, which dates from this measure, came as clearly from strategic considerations induced by the menace of foreign aggression as it did in the case of the iron industry.

The iron and shipbuilding industries of the Bakufu mark the appearance of an important new feature in the early history of Western industry in Japan. Unlike the han, the Edo government from the first, if exception be made for a few early ships and Egawa’s furnace, relied heavily upon foreign engineers and machinery in the development of these industries. Later this dependence upon outside aid was broadened to include the use of foreign capital. Both Saga and Satsuma followed the example of the Bakufu in varying degrees, but this was almost a full decade later and concerns other fields of industry.

The Bakufu built its first Western-style ship, a barkentine, at Uraga 浦賀 in 1855. Several small two-masted schooners were built near Shimoda 下田 in the same and the following year, and

56 Mito han shiryō 1.97-98.
57 Nihon zaisei keizai shiryō 4.1111.
58 Ibid. 1111.
59 Properly qualified, this statement would make allowance for the purchase by Saga of Dutch machinery for the manufacture of rifles in 1859 and the employment of a Dutch engineer in ship construction, an episode that will be mentioned later. Eto, “Takakima tankō,” 51.
60 The construction of the Hōō maru 鳳凰丸, as the vessel was named, was based upon Dutch books and the imitation of an English ship in Edo Bay at the time. Takimoto Seiichi 瀧本誠一 and Mukai Shikamatsu 向井鹿松 eds., Nihon sangyō shiryō taikei 産業史料大系 (An Outline of Historical Materials on Japanese Industry) (Tōkyō, 1926-28) 5.642. A contemporary print of the Hōō maru is the frontispiece of Tōkyō teikoku daigaku 東京帝國大學 ed., Dainihon komonjo; bakumatsu gaiikoku kankei monjo furoku 大日本古文書: 幕末外國關係文書附錄 (Old Documents of Japan; Supplement of Documents on Foreign Relations in the Bakumatsu Period) (Tōkyō, 1901-26) 99.
61 After having been shipwrecked near Shimoda, Count Putiatin, a Russian envoy to Japan, had built a small schooner in 1854 to return to Russia, using the villagers
the first Japanese-built steamer was completed at Nagasaki in 1857. The construction of these ships seems to have been without the benefit of direct foreign aid. If so, they constituted the only wholly independent undertakings of the Bakufu in this field, for, by 1857, a program of naval training under Dutch instructors was sufficiently well advanced to contribute substantially to the knowledge of shipbuilding, and work had begun on the Nagasaki Iron Foundry.

The policy of utilizing foreign aid, inaugurated with the naval training program of 1855, was first applied to industry in the establishment of the Nagasaki Iron Foundry. The equipment for the foundry was ordered from Holland, and upon its arrival in 1857, Dutch engineers and workmen were employed to supervise its installation. After 1861, when the plant was completed, Dutch employees were retained to provide technical guidance in its operation.

The facilities at Nagasaki included a shipyard, and although a steamer was built there sometime after 1857, the yard was used chiefly for repair work. The principal function of the foundry,

of Heta-mura 戸田村 in its construction. The Bakufu employed these same villagers to build six vessels of the same type, which was known to the Japanese as the kimizōgata from the name of the district in which the village was located. These ships were seventy-seven and one-half feet long and three hundred koku 石 burden. 1 koku is equivalent to 4.96 bushels. Nihon keizai shi jiten 1.399.

Ibid. 2.1450. An account of 1859 by an American described the construction of what must have been this steamer as follows: "The greatest curiosity at Nagasaki . . . is a small steamer built entirely, the native engineer says, from drawings he met with in an old Dutch work. Dutch engineers are correcting some slight defects of the engine . . . I think that the ingenious mechanic must have seen the 'Mississippi' or 'Susquehanna.'" Nautical Magazine (Nov. 1859) 569.

The Bakufu acquired a Dutch steamer as a gift in 1855. Fourteen Dutch seamen were employed aboard the ship as instructors and a group of forty-three officers and men from the Dutch navy were procured as instructors at Nagasaki. Instruction included such subjects as navigation, mathematics, naval architecture, and mechanics. Hōrīe, "Bakumatsu no gunji kōgyō," 6; Nautical Magazine 568.

Ōyama, "Yōshiki seitetsu jigyō," 2-4; Hōrīe, "Bakumatsu no gunji kōgyō," 6. The former gives a complete list of the machinery ordered from the Dutch.

as its name suggests, was the smelting of iron ore.\textsuperscript{66} Although there are no data on its capacity or actual production, the fact that the foundry proper occupied an area of over 16,000 square yards may serve as an indication of the importance of this enterprise at the time.\textsuperscript{67} An American physician gave the following description of the activities at the Nagasaki Iron Foundry in 1859: \textsuperscript{68}

Dutch engineers are erecting a large machine shop for a steam hammer, and all the appliances needed for keeping the steam navy in repair. A steam engine is already at work moving lathes, at which apprentices, sons of men of rank, are turning, whilst others are molding, forging, or filing.

The repair facilities at Nagasaki soon proved inadequate. The number of Western-style ships was rapidly increased after 1858 by construction and the purchase of foreign-built ships, and it was found necessary to send the larger of these to Shanghai for repair.\textsuperscript{69} Plans were made for additional repair facilities using the equipment purchased from Holland by Saga, which had been given to the Bakufu in 1859;\textsuperscript{70} but after consultation in 1864 with the French minister, who emphasized the importance of large-scale construction facilities as a basis for naval expansion and offered to provide the necessary capital and engineering skill, the Bakufu decided upon a much more extensive program.\textsuperscript{71} Closely related iron foundries were to be built at Yokohama and Yokosuka, and the latter was to include important shipbuilding facilities.

In 1865 the Saga equipment was installed at Yokohama by a French engineer.\textsuperscript{72} The new foundry included "factories" (kōba工場) for producing wrought iron, machine models, steam boilers, sails, ship fittings, and for casting iron. The machinery used in the shops was powered by steam.\textsuperscript{73} It was intended that at least

\textsuperscript{66} ŌTAMA, "Yōshiki seitetsu jigyō," 3.
\textsuperscript{67} HONJO Eijirō, "Bakumatsu no kakushinteki shisō to seisaku" 幕末の革新的 思想と政策 ("Reform Thought and Policy in the Bakumatsu Period"), \textit{Keizai shi kenkyū} 12 (Aug. 1939).70.
\textsuperscript{68} \textit{Nautical Magazine} (Nov. 1859) 567-68.
\textsuperscript{69} HONJŌ, "Reon Rosshu," 15.
\textsuperscript{70} See below. ETÔ, "Takashima tankō," 56.
\textsuperscript{71} ŌTAMA, "Yōshiki seitetsu jigyō," 7, 11.
\textsuperscript{72} \textit{Ibid.} 9-10; HONJŌ, "Reon Rosshu," 16-17.
\textsuperscript{73} ŌTAMA, "Yōshiki seitetsu jigyō," 7.
a part of the equipment required by the larger Yokosuka foundry would be produced at Yokohama and that such farm implements and household articles as could be made from iron would be manufactured for commercial sale.  

The Yokosuka foundry was planned on a much larger scale. In addition to the iron foundry (seitetsu-sho 製鉄所), there were to be three ways (sendai 船台) for ship construction, two docks for repair work, and an arsenal; construction was to be spread over a four-year period at a cost of 600,000 Mexican dollars a year. A French loan was arranged with the foundries serving as security, and a Bakufu official was stationed in Paris to buy machinery and hire technicians. Actual construction was begun at the end of 1865 under Francis L. Verny, an engineer of the French navy, and two assistant engineers, also of French nationality; in addition, thirty-seven French mechanics were employed on the project. Construction proceeded as scheduled despite the disturbed political conditions of these years, and the work was half finished at the time of the Restoration.

An important feature of the new foundries, and one that provided a precedent for the industrial policy of the Meiji government, was the program of language and technical training established in conjunction with them. The objective of the program was clearly stated in the Draft Plan for the Yokosuka Shipyard (Yokosuka zosenjo gen’an 橫須賀造船所原案):

In order that the Japanese government may in future years replace the Frenchmen in charge of shipbuilding with Japanese, a school will be established at the shipyard to train persons of talent as engineers and technicians.

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74 Ibid. 7, 9.
75 Honjō, “Reon Rosshu,” 16-17. The Mexican dollar (yōgin 洋銀) was the standard monetary unit used in foreign trade; it weighed 27.075 grams and was ninety per cent silver. Nihon keizai shi jiten 2.1600.
78 Honjō, “Reon Rosshu,” 17.
The training program at Yokosuka was conducted on two levels. **Samurai** were selected for training as “engineers” (山士技士) and were instructed in the French language by the chief interpreter and in technical subjects by the various department heads. Young workers at the foundry were selected by the French engineers for training as technicians (技手); they were given practical instruction in their respective jobs in the morning and attended school in the afternoon for instruction in “drafting and other essential studies.” The instruction at Yokohama was on a lower level: one hundred Japanese artisans, who were skilled in traditional industrial arts, were trained in Western industrial techniques by French instructors. In addition, a language school was opened at Yokohama in April 1865, with fifty-seven students and five French instructors, to provide interpreters for the foundries, and six of the students were shortly afterwards sent to France for study.

Shipbuilding activity was widespread among the han and was comparable to that of the Bakufu. Satsuma, Mito, and Saga held no such monopoly in the field as they did in the processing of iron; by the time of the Restoration, no less than fourteen han had either repair or building facilities, the chief of which were located at Ishikawajima 石川島, Kagoshima, Himeji 姫路, Tsu 津, Sabusawa 寒風澤, Hagi 萩, Tomonotsu 順津, Saga, Aomori 青森, Shingū 新宮, and Nanao 七尾. Tosa completed a schooner in 1859 and is said to have built other Western-style ships after that date. Before abandoning shipbuilding in favor of the purchase of foreign steamers, Chōshū built two schooners for her navy in 1859 and 1860. Sendai 仙台, Awa 阿波, Tsu, Akita 秋田, Matsuyama 松山, Himeji, Shōnai 荘内, Tsugaru 津軽, Fukuyama 福山, and Ōno 大野 all built at least one ship of either the schooner

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80 Ibid. 9-10.
81 ŌYAMA, “Yōshiki seitetsu jigyō,” 8.
83 Nihon sangyō shiryō taikei 5.732.
84 Tosa sent a number of representatives to the Mito shipyard at Ishikawajima for study; these persons were later used by Tosa in ship construction. Erō, “Kōchi han no shinseisaku,” 9.
85 The Tsu vessel was named the Kamikaze maru 神風丸.
INTRODUCTION OF WESTERN INDUSTRY TO JAPAN

At the end of the Tokugawa period all the han together possessed a total of ninety-four Western-style ships, as compared to forty-four for the Bakufu. The combined figure indicates the rapidity with which knowledge of Western ships was being accumulated in the fifteen years after 1853 and represents a substantial beginning in the creation of a merchant marine.

Despite the remarkable spread of activity in shipbuilding among the han, the leadership of Satsuma, Mito, and Saga was conspicuous. They were the only han to build steamers, and Satsuma and Mito built Western-style sailing vessels earlier and in greater numbers than other han. The efforts of Satsuma and Mito in this field, as in the iron industries of all three han, were distinguished from those of the Bakufu by an absence of direct foreign aid and a very nearly complete reliance upon the study of Western books to master the necessary industrial arts; Saga also differed from the Bakufu in this respect but to a lesser degree.

Satsuma was the first han to build a Western-style ship. It had a particular interest in developing a navy by reason of its exposed position on the southern approaches to Japan and an important maritime trade with the Ryūkyū Islands. This interest was evinced as early as 1848 by the translation of a Dutch work on steamships, and by 1852 Satsuma had built three model steamships based in part on this translation. With the change in the Edo government’s regulations on shipbuilding in 1853, Satsuma drew up a program for the construction of twelve sailing ships and three steamers. The first of these, a sailing vessel, was completed the following year. In 1855, three docks were built at Sakurajima with a capacity of two ships each, and three sailing vessels and a small steamer were completed there in the

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86 Nihon keizai shi jiten 2.1553-56.
87 Nihon sangyō shiryō taikei 5.644.
88 The translation, which was done by an Edo “Dutch scholar” was partially supported by the Lord of Mito; the Japanese title of this important work was Suijōsen setsuryaku 水蒸船說略 (An Abridged Treatise on the Steamship). HORIE, “Bakumatsu no gunji kōgyō,” 7.
89 TSUCHIYA, Hōken shakai hōkai 502.
90 Ibid. 508.
92 The largest of these ships was 140.28 feet in length; the smallest, 119.40 feet.
course of the year.\(^93\) The extraordinary activity of this year is an indication of the energy with which the building program was being pushed and of its potentialities had it been continued. However, shipbuilding ceased entirely after 1855, and during the remainder of the Tokugawa period, Satsuma sought to develop a navy by the purchase of foreign ships.\(^94\)

Mito was but a few years behind Satsuma in shipbuilding. It had been among the first of the han to recognize the need for a navy and had been studying ship construction from Dutch works at least as early as the Satsuma translation of 1848.\(^95\) In the year following the removal of restrictions upon shipbuilding, a measure Mito was instrumental in securing, the han began work on a shipyard at Ishikawajima which was to retain importance into the Meiji period.\(^96\) The first Western-style ship, the “Rising Sun” \((Kyokujitsu maru 酷日丸)\), a sailing vessel, was completed at the new yard in August, 1856.\(^97\) Five additional ships were built there before the Restoration. Four of these were \(kimizōgata\) two-masted schooners of the type built by the \(Bakufu\) near Shimoda.\(^98\) The final vessel was a steamer finished in 1866 after four years’ work. Its description may serve as an index to the relatively advanced state of shipbuilding at Ishikawajima: the ship was equipped with a screw propeller instead of the usual paddle wheel, was ninety-seven feet long, displaced one hundred and thirty-eight tons, and was driven by a sixty-horsepower engine.\(^99\)

Unlike Satsuma and Mito, Saga made a limited use of direct foreign aid in shipbuilding. Early study of the steamship was

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\(^93\) Construction of the steamer was based upon the translation of 1848. Horie, “Bakumatsu no gunji kōgyō,” 7.

\(^94\) Tsuchiya, \(op. cit.\) 503-04.

\(^95\) Mito built a model of a Western-style ship from a Dutch book in the Tempō era (1830-1844) and another in 1853. Mito \(han shiryō\) 1.97, 115.

\(^96\) Ibid. 118. Suzuki Hambei 魚半兵衛, who had received instruction in Dutch under the Mito language program of 1833, was placed in charge of shipbuilding at Ishikawajima. Ibid. 121.

\(^97\) Ibid. 118. The vessel was 121.39 feet long and of wooden construction. A print depicting the “Rising Sun” is reproduced opposite p. 130.

\(^98\) Nihon keizai shi jiten 1.41.

\(^99\) Ibid. 41.
based upon a model purchased through a Dutch merchant at Nagasaki in 1853, and three years later Saga ordered a complete set of equipment from Holland for steamer construction.\textsuperscript{100} The expense of installation was too great and the equipment was given to the Bakufu in 1859 to be used eventually at Yokohama, but its purchase illustrates a feature of Saga policy which was unique among the han until the last few years of the Tokugawa period. While delivery of the equipment was being awaited, Saga acquired the services of a Dutch mechanic, and a fifty-ton cutter was built under his supervision.\textsuperscript{101} In 1861 a steam boiler was built as a replacement part for a steamer that had been purchased three years earlier.\textsuperscript{102} The boiler proved satisfactory and a number of others, including three ordered by the Bakufu, were built in the next two years.\textsuperscript{103} Encouraged by success with the boilers, Saga undertook the construction of a small steamer which was completed in 1865,\textsuperscript{104} shortly before the Restoration terminated shipbuilding by the han.

The Western industries of the Tokugawa period were predominantly in iron, armaments, and shipbuilding, but they were not confined to these. Both Satsuma and Saga developed Western industries in this period which were non-military in character and produced primarily, if not exclusively, for the commercial market. Even so, the introduction of these industries was indirectly related to the crisis in Japan’s foreign relations. The exceptional financial strain of developing the new military industries and increasing armaments made the discovery of new sources of revenue imperative. Certain han had long engaged in commercial operations to supplement their revenues,\textsuperscript{105} and it was natural that the most

\textsuperscript{100} Erō, "Takashima tankō," 54-55.

\textsuperscript{101} Ibid. 55.

\textsuperscript{102} The vessel was purchased from the Dutch in 1855; in its enthusiasm for Western applied science, Saga gave the ship the extraordinary name of the "Electric Current" (Denryū maru 電流丸). Ibid. 56.

\textsuperscript{103} Ibid. 56.

\textsuperscript{104} The steamer was sixty feet long, eleven feet wide at midships, equipped with an external paddle wheel, and was driven by a ten-horsepower engine. Ibid. 57.

\textsuperscript{105} Most of the han governments monopolized the sale of certain important items, such as sugar and indigo, within their territories; they also monopolized the sale of the chief products of their territories, shipping these to the Edo and Osaka markets, where they were disposed of through merchants, who acted as agents for the
progressive of them should have applied the practice of state enterprise to Western industry for profits as well as guns.

Direct foreign aid was a conspicuous feature of these enterprises, and, indeed, it was a condition of their success. In 1868, the year of the Meiji Restoration, one hundred looms and spinning machinery, with a total of 2,640 spindles, were purchased by Satsuma from the Pratt Company of Manchester. The machinery was installed at Kagoshima by seven English technicians and production was begun the same year under their supervision. The new spinning and weaving mill, which marked the beginning of the modern textile industry in Japan, was "large scale" for a system of production in which the factory system was as yet unknown: the machinery was powered by steam, and two hundred workmen were employed at the mill, which had a capacity of nearly four hundred pounds of yarn a day.

In this same year, Saga entered into a contract with the Garaburu Company of England for the joint exploitation of the coal deposits at Takashima. The technical and commercial experience of the English company was an outstanding advantage of the union, but it was the inability of Saga to finance the project independently that made the joint enterprise necessary.

daimyō. Satsuma provides an excellent example of this practice. Certain areas were designated in which all suitable fields had to be planted with sugar cane. In these areas the entire produce, after the payment of taxes in kind, were sold to the han government at fixed prices, which were one-sixth of the Osaka market price in 1830 and one-fourth in 1853. The han then shipped the sugar to Osaka, where it was sold to the highest bidder among wholesale merchants. TAKAHASHI Kamekichi 高橋亀吉, Tokugawa hōken keizai no kenkyū (A Study of the Tokugawa Feudal Economy) (Tōkyō, 1932) 57-59, 436-42.

106 TSUCHIYA Takao and OKAZAKI Saburō 関崎三郎 Nihon shihonshugi hattatsushi gaisetsu 資本主義発達史概説 (An Outline of the Development of Japanese Capitalism) (Tōkyō, 1937) 267. The purchase price of the machinery was reported to have been "about 80,000 dollars, and the erection about 50,000 more." Commercial Reports by Her Majesty's Consuls in Japan: 1875 (London, 1876) 101.

107 TSUCHIYA, Hōken shakai hōkai 507-08.

108 It is impossible to divine the correct name of the English company from the phonetic rendering in Japanese, which is used here.

109 To support a large-scale enterprise such as was planned, a larger market than domestic consumption as yet afforded was necessary; Saga recognized the disadvantages of commercial inexperience and the invaluable aid that the English company would provide in disposing of the coal in Shanghai and to foreign ships in Japan. But it was financial considerations that were decisive. The state of the han treasury at the time
The English company was to provide the necessary capital for developing the mine, and one half of this investment was to be a first charge against profits, which were thereafter to be shared equally. Under this arrangement a shaft was sunk by English engineers during the course of the year; the first coal was lifted in 1869, and a second shaft was sunk in 1871. The new enterprise was characterized by the use of a number of Western mining techniques: the coal was moved in the shafts by a steam-powered winch; steam-powered pumps were used to raise water from the sub-surface; and the shafts were lighted by “Western lamps” (yōto 洋燈). The scale of operations may be inferred from the fact that three hundred miners were involved in a wage dispute at Takashima in 1870 and that the interests of the English company were brought for $400,000 in 1874, when the Meiji government took over the mines.

The last years of the Tokugawa period, as the preceding survey has indicated, were marked by successful efforts to introduce specific Western industries. That the movement had begun before the “opening” of Japan by Perry, an event that undoubtedly imparted a new impetus to it, was an early demonstration of that precocity in mastering the arts and sciences of the West which was to raise Japan to a pre-eminent position among the nations of the Orient by the end of the century and to enable her to humble one of the greatest powers of the Occident in the first years of the next. No doubt the tradition of learning from China provided a favorable psychological background for learning from the “Western barbarians” as well. Other contributing factors may be found in the peculiarities of the Japanese political and social structure, but a more immediate factor was the long apprenticeship in “Dutch learning” which prepared the Japanese both to recognize and exploit the potentialities of Western technology.

the mining contract was signed may be surmised from the fact that Saga was obliged to borrow 43,750 ryō from the English company to pay for a recently purchased warship. Erō, “Takashima tankō,” 6-8.

The menace to Japan's independence implicit in the aggrandizement of the Western Powers in China and elsewhere in the Far East provided the immediate stimulus for its introduction. Consequently the first and most important Western industries of the period were of a military character and were, at least partly for that reason, undertaken as government enterprises. At the very end of the period two important non-military industries were begun by Satsuma and Saga as government enterprises, indicating that the absence of a class of industrial capitalists contributed to the monopoly of government in the field of commercial as well as military industries.

In the development of these industries the Bakufu and han anticipated several important features of the industrial policy of the Meiji government. Government ownership and management of industry was a salient feature of the early Meiji period and was in part the result of the inheritance by the new government of the industries developed by its predecessors; in extending the principle to new industries, the Meiji government was following their example. In the operation of these industries, the Meiji government made use of foreign engineers and technicians, a policy which had already been applied in the Tokugawa period on a lesser scale; and it was likewise following a precedent of the earlier period in supporting training programs both in Japan and abroad to provide qualified personnel to take over technical positions of responsibility from foreigners.

In an even more direct way the Meiji government owed much to the Bakufu and the han governments. It was not obliged to begin the process of industrialization from scratch. When the new government was launched, it was already the prospective heir to several iron foundries and numerous scattered furnaces for smelting iron ore, a mechanized spinning mill, a modern coal mine, assorted facilities for shipbuilding and repair, and a modest but significant merchant marine. Not the least benefit of its inheritance was a group of persons who had acquired invaluable technical experience in starting these industries and upon whom it could draw for administrators. Thus by the end of the Tokugawa period the first and in some ways the most difficult step in industrialization, that of overcoming inertia and initial technical difficulties and making a start, had already been taken.