CHANG CHIH-TUNG AND THE STRUGGLE FOR STRATEGIC INDUSTRIALIZATION: THE ESTABLISHMENT OF THE HANYANG ARSENAL, 1884–1895

THOMAS L. KENNEDY
WASHINGTON STATE UNIVERSITY

IN the spring of 1895, China's Self-Strengthening Movement, which for more than three decades had placed great emphasis on the development of modern military forces and industrial capability, failed a crucial test. A shattering defeat for the Chinese side in the Sino-Japanese War (1894–1895) ushered in a new wave of imperialist intrusions which, within a few short years, threatened the very existence of the empire and its ancient civilization. Why, it was asked, after thirty-five years of self-strengthening, was China still inadequately prepared for this test of arms with Japan—a question which has been analyzed and debated over and over again since shortly after the close of the war.[1] Answers have run the gamut from condemnations of the Empress Dowager[2] to wholesale indictments of

[1] This article is an expanded and revised version of a paper delivered at the annual meeting of the Association of Asian Studies, New York City, March 27–29, 1972, research for which was accomplished during the summers of 1970 and 1971 at the Institute of Modern History, Academia Sinica, Taiwan, under a grant from the Social Science Research Council, Committee on Exchanges with Asian Institutions. Among the many Fellows of the Institute who facilitated my research in one way or another, I am most deeply indebted to Professor Wang Erh-min for his critical advice. Responsibility for factual accuracy and the validity of all conclusions rests solely with the author.

[2] Lo Erh-kang, "Ch'ing hai-chün ching-fei i-chu i-ho-yüan k'ao" (A study of the transfer of Ch'ing naval funds for construction of the Summer Palace), *Tung-nan jih-pao, wen-shih chou-k'an* (Southeast daily, weekly historical and literary supplement), number 103 (Shanghai: Aug. 25, 1948). The same article by a Lo Kang may be found in *Ta-lu tsa-chih* (The Continent Magazine) Vol. 4, No. 10 (Taipei: June 1952). The conclusions of this article, which stress the financial drain on China's military establishent in the years prior to the Sino-Japanese War caused by the preparations for the Empress Dow-

Chinese civilization.[3] Moreover, recent studies have suggested that self-strengthening, though unsuccessful against Japan, contained the intellectual germs of institutional reform which developed after the war and brought China one step further along the road to modernization.[4] In this view, self-strengthening was an integral and essential early stage of China's modernization, the period of gestation in which the concept of reform took hold and began to develop in the minds of China's leaders. This incipient development of the notion of reform is strikingly apparent in the efforts of the Confucian statesman Chang Chih-tung to establish modern ordnance production during the decade prior to the war.

Although Chang cannot be counted among the early advocates of reform who discussed alternatives to the existing institutions of government,[5] his broad-gauged approach to the problem of industrialization represents an advance in self-strengthening strategy and shows an early willingness to initiate broad economic and educational change —a disposition which became prevalent among China's reform leaders only after the Sino-Japanese War. Absorbing lessons from the early years of self-strengthening and applying them creatively to plans for the future, Chang developed a concept of change that was unquestionably among the most progressive of his day. He pursued his goals relentlessly for more than a decade, mobilizing financial support from all over the empire and pulling strings in the government to clear away opposition. Ultimately the arsenal which he founded was one of the largest and most productive machine industries of twentieth-century China—but it had barely begun production in August 1894 when

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ager's sixtieth birthday, though widely accepted in the West, have been called into question by Wu Hsiang-hsiang in "Ch'ing-ch'i yüan-yüan chien-chu yü hai-chün ching-fei" (The rebuilding of the Summer Palace and naval funds in the late Ch'ing dynasty), *Chin-tai shih-shih lun-ts'ung* (Miscellanies on recent Chinese history), 2 vols. (Taipei: Wen-hsing shu-tien, 1964, 1965), I, 151–170.

[3] John Rawlinson, *China's Struggle for Naval Development 1839–95* (Cambridge: Harvard University Press, 1967), pp. 198–204.

[4] Kwang-ching Liu, "Nineteenth Century China" in Ping-ti Ho and Tang Tsou, eds., *China in Crisis*, 2 vols. (Chicago: University of Chicago Press, 1968), I, Book One, 93–178, esp. 138–143.

[5] For a detailed exposition of Chang's political thought see Wang Erh-min, *Wan-Ch'ing cheng-chih ssu-hsiang shih-lun* (Historical essays on late Ch'ing political thought) (Taipei: Chung-yang yen -chiu-yüan chin-tai li-shih so, 1969), pp. 72–100, esp. part 2.

war broke out with Japan. Although the output of Hanyang during its first few years of operation would not have had an important logistical impact on the fighting during the war,[6] the obstacles which delayed its establishment exemplify the magnitude and complexity of the problems which self-strengthening leaders faced in their struggle to establish modern strategic industry. Thus they suggest some of the fundamental reasons for the slow pace of China's early modernization which unquestionably did have a bearing on the outcome of the war. Especially in view of the scope and intensity of Chang's efforts to establish this arsenal and his own imposing stature on the domestic political scene, it is likely that the forces which slowed his progress at Hanyang were also important factors retarding self-strengthening, particularly strategic industrialization, at the national level. In short, the early history of the Hanyang Arsenal provides a glimpse of both the internal dynamism of the Self-Strengthening Movement and some of the major forces which impeded its development.

Chang Chih-tung's New Concept of Self-Strengthening, 1884–1889

Chang Chih-tung's experience during the Sino-French War seems to have had a definite transformational effect upon his strategic think-

[6] During 1896, the first full year of operation at Hanyang, the arsenal produced 1300 rifles and 30 guns. It was anticipated that in several years' time, when the plant was completed and the personnel thoroughly trained, output would increase to 8000 rifles and 100 guns annually. Chang Chih-tung, *Chang Wen-hsiang kung ch'üan-chi* (hereafter *CWHK*) (The complete works of Chang Chih-tung) (Taipei: Wen-hai ch'u-pan-she, 1963), *tien-tu* (telegrams), 32.5–6. It seems likely that these figures were achieved since production totals for the years 1895–1909 reached 130,726 rifles and 1090 guns. *Hu-pei ping-kung kang-yao ch'ang t'iao-shuo piao-tse* (hereafter *HPKC*) (Itemized discussions and charts of the Hupeh Arsenal and the steel and powder works), 13 vols. (Hanyang: Hupeh Arsenal, 1910), held by the Academia Sinica, Institute of History and Philology, Taipei, "Ping-kung-ch'ang Kuang-hsü erh-shih-i-nien chih Hsüan-t'ung i-nien nien-ti tsao-ch'eng chün-huo" (Munitions produced at the arsenal 1895–1909). However, these figures, impressive as they are, must be considered against the enormous needs of the Chinese forces during the war. Chang Chih-tung alone, according to one estimate, purchased 23,000 rifles and 600 guns. Wang Erh-min, *Ch'ing-chi ping-kung-yeh te hsing-ch'i* (The rise of the ordnance industry in the late Ch'ing Dynasty) (Taipei: Chung-yang yen-chiu-yüan chin-tai li-shih so, 1963), p. 133. All of this is quite apart from the fact that decisive aspects of this conflict were determined through naval engagements and operations where rifles and guns produced at Hanyang could have no bearing on the outcome. Rawlinson, *op. cit.*, pp. 167–197.

ing. Before the war, Chang displayed an almost naive confidence in the empire's capacity to stave off pressures from abroad. Deeply concerned with the preservation of traditional civilization and unquestionably loyal to the imperial government, he came to accept the need for certain types of military modernization only after the Ch'ing had ignominiously yielded the Ryukyus to Japan while fending off a Russian thrust in the northwest.[7] Even then, in the late 1870s and early 1880s, while military industrialization projects were the vogue with provincial officials, Chang's sole undertaking was the establishment of a small powder plant in Taiyuan, during his tenure as governor of Shansi, 1882–1884. Established to supply provincial forces recently converted to the use of Western weapons and thereby relieve their logistical dependence on powder from the Tientsin Arsenal of Li Hung-chang, this plant proved to be of little consequence. After Chang was ordered to the governor-generalship of the Liangkwang provinces, in the summer of 1884, it declined in importance and eventually closed.[8]

In Kwangtung, Chang's responsibilities included logistical support of the forces fighting the French in Annam. He found himself at the head of a provincial arsenal system honeycombed with waste and inefficiency. Accusations against arsenal officials made by Vice-President of the Board of War, Admiral P'eng Yü-lin, in 1884,[9] were substantiated by Chang's own investigation. It was no surprise then that the arsenal was unable to step up production of ammunition and ordnance when ordered to do so. Chang had to turn increasingly to Hong Kong and to foreign sources to purchase required supplies of ordnance and ammunition.[10] During this same period Chang was deeply impressed by the efficacy of Western-style weapons in encounters with foreign

[7] Li Kuo-ch'i, *Chang Chih-tung te wai-chiao cheng-tse* (The foreign policy of Chang Chih-tung) (Taipei: Chung-yang yen-chiu-yüan chin-tai li-shih so, 1970), pp. 1–19. William Ayers, *Chang Chih-tung and Educational Reform in China* (Cambridge: Harvard University Press, 1971), pp. 63–136. Daniel H. Bays, "The Nature of Provincial Political Authority in Late Ch'ing Times: Chang Chih-tung in Canton, 1884–1889," *Modern Asian Studies*, Vol. 4, No. 4 (Great Britain, 1970), 325–347.

[8] Yang Chia-lo, ed., *Yang-wu yun-tung wen-hsien hui-pien* (hereafter *YWYT*) (Collected documents on the foreign matters movement), 8 vols. (Taipei: Shih-chieh shu-chü, 1963), IV, 419.

[9] P'eng Yü-lin, *P'eng Kang-chih kung tsou-i* (Memorials of P'eng Yü-lin) (1892), 5.28.

[10] *YWYT*, IV, 379–382.

forces. He witnessed the successes of Kwangsi and Yunnan generals whose troops were equipped with modern firearms and reasoned that Chinese troops equipped with mobile artillery and land mines could exploit their familiarity with the terrain and their superiority of numbers to gain victory over foreign foes.

On August 7, 1885, Chang submitted a long memorial outlining sweeping proposals for the expansion and modernization of military industry in Kwangtung based upon his wartime experiences. He proposed a three-point plan for the development of personnel, production of weapons, and exploitation of natural resources. For the development of personnel he planned a military academy on the order of the naval academies in Peiyang and Foochow staffed by foreign instructors and offering instruction in the science of naval warfare, ground strategy, and scientific and industrial courses related to military industry such as powder making, electricity, and chemistry.[11] His proposals for weapons production were a direct outgrowth of his experience in buying arms. He had learned that foreign ordnance was costly, quality was sometimes uneven, and, during times of crisis, delivery was unreliable. He made recommendations for the production of several types of European field artillery and shipboard guns and his discussion of small arms production included the first advocacy of a standard bore diameter. His plan was to establish production of guns and gun ammunition at the Foochow Shipyard while rifles, rifle ammunition, mines, torpedoes, minelayers, and powder would be produced in Kwangtung.

Chang's plans for the exploitation of natural resources were designed to provide domestic self-sufficiency in the raw materials required for heavy industry. He proposed to employ foreign advisors to locate high-grade deposits of coal, to assist in preparing it for use, and to produce iron and steel from the iron ore deposits of Fukien and Kwangtung. The capital for this venture could be provided by merchants, though the operations would have to be carefully supervised by officials to ensure that the government received what it needed for arms production. Chang stressed that the establishment of this new production should be in Kwangtung. He reasoned that, since for-

[11] For the subsequent establishment and development of this school, see Ayers, pp. 108–113.

eigners always attempted to enter there, if coastal defenses were shored up with newly produced weapons the likelihood of such intrusions would be greatly diminished. Moreover, a large arsenal situated in Kwangtung would be able to supply the border defense forces of Kwangtung and Kwangsi and, if production was sufficient, distribution could be extended to include Hunan and Hupeh. He concluded that, to strengthen southeastern coastal defense and southwestern border defense, Kwangtung was the best possible site to establish an arsenal. But, because the proposed production was so extensive, the responsibility was too great for one province and should be shared with Fukien. To finance these undertakings, he asked for two million taels from recently contracted foreign loans. Although the imperial endorsement on Chang's proposals indicated that they would be set aside for future reference,[12] approval to use the required funds was never given.

Naval development occupied a position of secondary importance in Chang's strategic thinking. This was the result of his commonsense appraisal of the difficulties and expense involved in establishing an ocean-going navy. Nevertheless, in a separate memorial, he laid out plans for the immediate employment of local resources to establish a shallow-water defense fleet and the gradual development of domestic shipbuilding potential.[13] Pending the establishment of an ocean-going defense fleet, he felt that primary emphasis should be placed on the production of arms and ammunition for onshore coastal defense installations and ground forces.

Though Chang's plans for large-scale arsenal development in Kwangtung were temporarily blocked by lack of funds, during the war he had learned important lessons in logistics and ordnance, and he had witnessed the failures of the small inefficient arsenals in Kwangtung. Drawing on this experience, he formulated a plan for the production of modern arms and ammunition based on the development of domestic self-sufficiency in technical personnel and raw materials. During the next ten years he gradually succeeded in raising the funds to carry out the arms production embodied in this plan and, eventually, he brought it to fruition with the establishment of the Hanyang Arsenal.

[12] *CWHK*, *tsou-i* (memorials), 11.16–24.

[13] *CWHK*, memorials, 11.29–32.

Initially, however, he was obliged to content himself with a locally financed program of consolidation and modernization of rifle ammunition production, a small shipyard, and a military officers' training school.[14]

Since these fell far short of fulfilling the need which he saw for military industrial development in Kwangtung, by 1889 he had worked out a plan for arms production financed by local contributions[15] as well as plans for the extraction of iron and coal and the refining of iron and steel financed by provincial funds.[16] In July 1888, he began contacting German ordnance machinery firms through the Chinese minister in Berlin, Hung Chun. By late November, he had decided upon equipment from the Berlin firm of Ludwig Loewe: a one-hundred-and-twenty horsepower plant; rifle machinery capable of turning out fifty ten-shot Mauser repeating rifles per day; and gun machinery to produce fifty Krupp mountain guns of 7.5 to 12 centimeter caliber per year. The cost was over 300,000 taels. Approval of the Navy Yamen, required for purchase of foreign machinery, was obtained in May 1889 and the order was made final. Ludwig Loewe began work on the machinery. Completion was forecast for late April or early May 1890.[17] However, on August 8, 1889, while preparations for the establishment of the new Kwangtung Arsenal were just getting underway, Chang was transferred from his post in the Liangkwang provinces to the governor-generalship of the Hukwang provinces (Hupeh and Hunan) to be in charge of the construction of the Lu-Han Railroad.

Chang found the development of strategic industry in the Hukwang provinces at a complete standstill.[18] National attention had first been directed to Hupeh, the northernmost of the two provinces, as a possible site for military industry in late 1884, after the French fleet de-

[14] *CWHK*, memorials, 17.18–20; 21.1–2; 25.27–28; *kung-tu* (official documents), 9.35–36; telegrams, 3.13b; 4.15a. *YWYT*, IV, 381. Ting Jen-chang, ed., *Fan-yu hsien hsu-chih* (Gazetteer of Fan-yu district), (1931) 4.6. Kuo Ting-yee *et al.* eds., *Hai-fang tang* (Maritime defense archives), 5 vols. (Taipei: Chung-yang yen-chiu-yüan, chin-tai li-shih so), III, 195–196.

[15] *CWHK*, official documents, 9.35–36; memorials 25.28–30.

[16] *CWHK*, memorials, 27.1–4.

[17] *CWHK*, telegrams, 10.9–10; 10.16a; 11.9-10.

[18] Limited machine production of arms and ammunition began in 1884 under acting Hukwang governor-general Pien Pao-ti. Pien Pao-ti, *Pien Chih-chun tsou-i* (Memorials of Pien Pao-ti) (1894), 5.71.

stroyed the Foochow Shipyard. Though the vulnerability of coastal arsenals had long been of serious concern to farsighted officials such as Li Hung-chang, it was only after this disaster that the fundamental importance of arsenal location was widely acknowledged. A memorial of Han-lin compiler Chu I-hsin called for the establishment of new arsenals at protected inland sites on navigable waterways in Hupeh and Kiangsi. Chu's recommendations also included a precedent-shattering suggestion that capital for the expansion of military industry be provided by the formation of privately owned stock companies on the European model.[19] As a result, Hupeh Governor Pien Pao-ti briefly entertained the notion of a privately financed arsenal in his province until dissuaded by Commissioner of Southern Ports Tseng Kuo-ch'üan. Tseng's arguments reiterated the time-honored rationale behind the government monopoly of arms production: private production would very likely result in arms reaching the hands of dissident elements; the greed of merchants would sacrifice quality for profit; and, in time of emergency, supply to the government could be unreliable. After the idea of private finance was dropped, planning for arsenal development financed by gentry contributions was begun by Pien.[20] But the following year the project was abandoned by the newly appointed Governor Yu-lu who calculated that the funds required to establish military production were more than he could hope to raise.[21] This was the situation as Chang found it in 1889.

Though very little progress had been made in developing strategic industry either in Kwangtung or Hupeh in the years from 1884 to 1889, the concept of self-strengthening through military industry had evolved in several important ways. First, Chang had spoken out for balanced and planned industrialization. He stressed the establishment of the ironworks and the training of technical personnel to provide a base for economic development. From his plans, it is unmistakably clear that the critical importance of military production did not obscure in his mind the need for orderly and diversified economic development. In this respect, Chang had progressed beyond the concept of industrialization which motivated earlier self-strengthening projects such as the arsenals of Li Hung-chang. Li, perhaps because of

[19] Chu I-hsin, *Pei-hsien chai wen-tsun* (1896), *shou.*14.

[20] Pien Pao-ti, *op. cit.*, 6.51–53, 56–59.

[21] *Hai-fang tang*, IV, 1241.

his military background and the greater urgency of the military threats which China faced in the 1860s, had made military production the central element in his plans and entered production as quickly as possible, employing imported materials and foreign technicians as required. Technical schools were first proposed after production had begun and plans for the extractive and refining industries came up even later. In the 1870s Li began promoting mining and transportation projects that were of economic as well as strategic potential; however, his own heavy defense responsibilities seem to have led him to attach greater importance to the latter aspect.[22]

Chang knew of the materiel and personnel problems which limited the effectiveness of Li's plants and called for a simultaneous attack on the problems of economic development and the development of military industry. In this respect, he learned important lessons from Li's experience and carried forward some of his proposals for economic development while formulating a more systematic and comprehensive development plan. Even in matters of purely military industrial significance, Chang showed a heightened awareness of important practical problems—for example, in his advocacy of a standard bore diameter for small arms.

Although Chang's ideas for balanced industrial development were not rejected, the imperial government failed to give its support in the critical area of capital investment. These two problem areas, imperial leadership and investment capital, would haunt the further development of the arsenal. Furthermore, the problem of finding capital in Hupeh gave rise to a revolutionary proposal for private financing. Even though stifled by the dead weight of tradition, this proposal, like Chang's concept of industrialization, is indicative of the innovative

[22] The best treatment of Li's self-strengthening policies in the 1870s may be found in Kwang-ching Liu, "Li Hung-chang in Chihli" in Feuerwerker, Murphey, and Wright, eds., *Approaches to Modern Chinese History* (Berkeley: University of California Press, 1967), pp. 68-104, in which the author shows that, from 1870 on, Li made the buildup of arms production his primary objective but placed increasing emphasis on personnel development and augmenting state income. Li Kuo-ch'i, *Chang Chih-tung te wai-chiao cheng-ts'e*, pp. 9–18, compares Chang's approach to modernization with Li's and finds that Chang stressed general development while Li emphasized military-related modernization. See also Stanley Spector *Li Hung-chang and the Huai Army* (Seattle: University of Washington Press, 1964), pp. 152–194.

thinking that was prompted by the problems confronted in building strategic industry.

Finally the matter of arsenal location was raised with great urgency by the destruction of the Foochow Shipyard in 1884. Objective criteria of defensibility and access to domestic rather than imported raw materials were acknowledged as the most important considerations in selecting sites for strategic industry. No longer would Chinese leaders build their arsenals at coastal sites under the muzzles of foreign naval guns.

The Move to Hupeh, 1889–1890

The decision to move the Kwangtung Arsenal project to Chang's new post in Hupeh was reached after a prolonged controversy involving several of the leading governors-general and the Navy Yamen —a controversy which provides an insight into political alignments and ambitions as they pertained to the initiation of this major self-strengthening project. Li Han-chang, the older brother of Li Hung-chang, succeeded Chang Chih-tung in the governor-generalship of the Liangkwang provinces. His assessment of the situation in Kwangtung was entirely different from that of his predecessor; within several months he recommended delay or abandonment of the military and industrial projects which Chang had vigorously promoted. His first and most compelling argument against establishment of the iron and steel works in Kwangtung was the scarcity of iron ore. Contrary to Chang's expectations, output of the two known producing areas in Kwangtung was not great. Furthermore, finance for the variety of new projects which Chang favored, in Li's view, was beyond the capability of Kwangtung. The situation on the border was calm at the time, and he felt that the ordnance then held by Kwangtung was adequate. The critical need, as he saw it, was railroad development; therefore he recommended that the iron and steel works be relocated where it could better serve the construction of the Lu-Han Railroad from Chihli to Hupeh.[23]

The specific question of arsenal location was raised by Li Han-chang's request that the Board of Revenue allocate the second half of the price of the ordnance machinery which Chang had ordered for

[23] *Hai-fang tang*, III, 177–178.

Kwangtung. The contribution program arranged by Chang would not provide an adequate sum by the date the payment was due, and, according to Li, Kwangtung was unable to advance the necessary amount.[24] At this point the Navy Yamen stepped into the discussion. On January 12, 1890, Prince Ch'un of that yamen wired Chang that Li Han-chang had declined to carry through with the establishment of the ironworks and he inquired of Chang as to the suitability of moving it to Hupeh. Chang replied on January 15, 1890, that iron and coal deposits were close by and that, in Hupeh, the ironworks would be well situated to provide rails to the Lu-Han line. He suggested that the funds be provided from the Ministry of Revenue's appropriation for railroad building. On January 24, the Navy Yamen replied that it had memorialized and gained approval for relocating the ironworks in Hupeh with finance provided by the railroad funds.[25]

In the same telegram Prince Ch'un advised Chang that Li Han-chang did not want the arsenal in Kwangtung and had suggested that it be relocated in the north, in the bailiwick of his brother Li Hung-chang, Commissioner of Northern Ports and Governor-General of Chihli, but that the matter was presently unsettled and would be determined after there had been some success in iron and steel production. Three days later, on January 27, 1890, Li Hung-chang, who was also an official of the Navy Yamen, addressed a request to that yamen that the arsenal be relocated near his headquarters in Tientsin, where coal could be brought by rail from the T'ang-shan mines and iron and steel refined in Hupeh could be shipped in by steamer. He advised against delaying the opening of the arsenal until production of iron and steel had begun since this might be a very long time and storage of the machinery would result in depreciation. Estimating that plant construction would cost considerably more than the several tens of thousands which Chang had forecast and that there would be shipping and insurance charges of more than 100,000 taels payable on delivery, Li asked that the latter amount be supplied from the new provincial contributions for maritime defense and that the Navy Yamen

[24] *Li Wen-chung Kung ch'üan-chi* (hereafter *LWCK*) (The complete works of Li Hung-chang) (Taipei: Wen-hai shu-tien, 1965), *tien-kao* (draft telegrams), 11.59.

[25] *CWHK*, telegrams, 12.39–41.

arrange for the payment of the last half of the price of the machinery and the cost of building the arsenal.[26]

On January 27, also, Chang wired Li Hung-chang of the Navy Yamen at Tientsin and made his bid for the arsenal. Since the arsenal must be served by iron, he argued, the best way to do this would be to move it together with the ironworks to Hupeh. He reported that good deposits of coal and iron had been discovered in Hunan and that there was considerable iron in Hupeh and Yunnan. All were situated conveniently for transport. The central location in Hupeh would facilitate distribution of weapons to Szechwan, Shensi, Honan, Anhui, Kiangsu, and Hunan. Taken by river steamer to Shanghai, they could be transhipped to anywhere on the coast.[27] On January 29, 1890, in another wire to Li Hung-chang in Tientsin, Chang attempted to strengthen his case for moving the arsenal to Hupeh. He employed some remarkable logic in view of his earlier plans to establish it in Kwangtung. The machinery on order, reasoned Chang, could produce only repeating rifles and field artillery, weapons which would be of enormous help to the provinces of West China; therefore it would be best to situate the arsenal inland along the river. It could not produce the large ship and fort guns which should logically constitute the ordnance output of a coastal arsenal.[28]

The following day Prince Ch'un of the Navy Yamen wired Li that he thought it better that the arsenal be moved close to the source of iron and that it be kept in the hands of its founder, Chang Chih-tung. He planned to inform Chang if Li agreed. Reluctantly, Li wired his agreement cautioning that Hupeh would probably be unable to raise

[26] *LWCK*, *hai-chun han-kao* (letters to the Navy Yamen), 4.1–2. A spirit of personal competition between Li and Chang prevailed during this period apparently inherited from the years prior to the Sino-French War when Chang was associated with the Ch'ing-liu tang (Pure Group) which sought strict adherence to Confucian principles in domestic matters and the threat, or actual use, of force to check foreign intrusions. Li was foremost among the opponents of the Ch'ing-liu tang; they regarded his early self-strengthening innovations as departures from Confucian principle and his realistic foreign policy as appeasement. By this time Chang had adopted a reform position in domestic affairs which was perhaps more innovative than Li's. Nevertheless, the antagonism between the two is reported to have persisted through the turn of the century. Ayers, *op. cit.*, pp. 65–69, esp. n. 18.

[27] *CWHK*, telegrams, 13.1a.

[28] *CWHK*, telegrams, 13.1, 3b–4a.

the last half of the machinery price, the plant building expenses, or the shipping and insurance charges and Kwangtung had already said that it could not.[29]

Once the possibility of moving the proposed arsenal from Kwangtung had been raised by Li Han-chang's suggestion that it be established in the north and once it had been decided that the ironworks would be removed to Hupeh, Chang had sound economic reasons for advocating that the arsenal should also be in Hupeh. Furthermore Hupeh's protected inland position and its central location made it strategically superior to Tientsin. All of this should have sufficed to outweigh the arguments which Li Hung-chang advanced for removal to Tientsin—particularly since Chang had a powerful ally in the imperial government, Prince Ch'un, who also favored Hupeh. But Chang's additional argument that the machinery was not suited to produce the ordnance which should be the proper output of a coastal arsenal calls into question his original reasoning for ordering the machinery for Kwangtung. As a matter of fact, if this machinery was suitable for arsenal production in Kwangtung, it would probably also be suitable for use in Tientsin, since the situation in both places with respect to military industry was quite similar. Neither produced the rifles and guns which the machinery on order would turn out. Nor did either produce the naval and fort guns which Chang argued were the proper product of a coastal arsenal. The projected output of this arsenal

[29] *LWCK*, telegrams, 12.3b. Prince Ch'un, the husband of the younger sister of the Empress Dowager and father of the Emperor Kwang-hsü, was a particular favorite of the Empress Dowager. *Eminent Chinese of the Ch'ing Period*, ed. Arthur W. Hummel (Washington, D.C., 1943–1944), p. 384. In the period before the Sino-French War, both she and Prince Ch'un supported the conservative Ch'ing-liu tang. Chang Chih-tung was also associated with this group which sought to restrict the influence of both Li Hung-chang and Prince Kung whom they regarded as excessively pragmatic in domestic matters and inclined toward appeasement in dealing with foreign powers. Ayers, *op. cit.*, pp. 68–69. After Prince Kung was stripped of his power in 1884, Prince Ch'un's influence in government rose sharply. The next year he was appointed controller of the newly established Navy Yamen where he found himself a colleague of his erstwhile antagonist, Li Hung-chang, who was named associate controller. Prince Ch'un remained extremely close to the Empress Dowager until his death in 1891. Hummel, *op. cit.*, pp. 384–385. This relationship may have influenced his sympathetic response to Chang Chih-tung's appeal for control of the arsenal since, during this period, Chang also maintained close ties with the Empress Dowager, apparently a carryover from the days in the Ch'ing-liu tang. Bays, *op. cit.*, pp. 342–347.

would have been a distinct asset to either of these provinces as well as Hupeh. Chang facilely overlooked these facts as he sought to strengthen his own arguments for control of the arsenal against those advanced by Li Hung-chang.

On February 1, 1890, when the Navy Yamen notified Chang of the decision that the arsenal would be in Hupeh, it also suggested that the funds for establishment could be taken from the annual appropriation of 2,000,000 taels for railroad building, which had been earmarked for the establishment of the ironworks.[30] It appears that Li Hung-chang was behind this suggestion, which in effect would shrink the financial base from which Chang's self-strengthening projects could draw, for, on February 5, Chang replied to Li in the Navy Yamen that he thought this would be overtaxing the railroad appropriation. He recommended instead that the last half of the cost of the ordnance machinery, 190,000 taels, plus 150,000 taels required for plant building, be provided through the contributions which he had arranged in Kwangtung before his departure. He noted that he had anticipated the need for additional funds and extended the contribution program for a period of six months. The total received would be in excess of 800,000 taels and, allowing for certain other expenses which had to be provided from this, he felt the sum should be more than adequate to pay for the last half of the machinery and defray plant building expenses. It was only a question of providing the money ahead of time, i.e., before the contributions were actually received. Chang said that he could find a way to make such a temporary advance and that he intended to discuss it with Li Han-chang.[31]

On February 22, the Navy Yamen wired Chang that Li Han-chang had taken into account the inadequacy of the ministry's railroad appropriation and agreed to advance the last half of the price of the machinery from Kwangtung. But Li asked that Hupeh provide the 150,000 taels needed for plant building. Anticipating that Hupeh would be unable to do this, the Navy Yamen said that this sum could be advanced from the Board of Revenue's railroad appropriation and

[30] *Ch'ao-pen Chang Chih-tung tien-kao* (hereafter *CCT*), Kuang Hsü 16/1/12, in Sun Yu-tang et al., eds., *Chung-kuo chin-tai kung-yeh-shih tzu-liao* (hereafter *CCKT*) (Materials on China's modern industrial history), 4 vols. (Peking: San-lien shu-tien, 1957), 1, 545.

[31] *CWHK*, telegrams, 13.5–7.

later be repaid by Kwangtung contributions. On March 16, Chang replied agreeing that the Board of Revenue advance the building funds from the railroad appropriation and also that he would be responsible for the provision of regular operating funds.[32] On March 19, the Navy Yamen and the Board of Revenue submitted a plan for movement of the proposed arsenal and provision of establishment costs to the throne. It was stipulated that the arsenal would move to Hupeh and that the balance due on the machinery would be provided from the Kwangtung contributions,[33] but the 150,000 taels for plant building was to be temporarily advanced from the railroad appropriation and repaid later by Kwangtung. However, on March 22, the Navy Yamen wired Chang advising him that the funds for the arsenal must be clearly distinguished from the railroad appropriation. Transfers could not be made from the railroad appropriation lest railroad building be retarded.[34]

The situation with respect to the availability of the railroad appropriation for support of industrial development in Hupeh was changing rapidly in the spring of 1890. The strategic importance of Manchuria had loomed paramount as a result of crisis in Korea and Russia's plans for building a trans-Siberian railroad. On March 31, 1890, the Tsungli Yamen, based on the opinions of Li Hung-chang, memorialized on Korean policy advocating that construction of the Lu-Han trunk line, which was primarily of economic importance, be delayed in favor of immediate development of strategic railways in Manchuria. Prince Ch'un, Li, and the Tsungli Yamen were directed to come up with a plan. On April 1, 1890, these parties decided that the 2,000,000 taels appropriated annually for railroad construction should be completely devoted to building railroads in Manchuria excluding only the 2,000,000 taels for 1890 which had been designated for the ironworks in Hupeh.[35] This decision left the ironworks in a difficult financial predicament. Estimated establishment costs were over 2,400,000 taels,

[32] *CWHK*, telegrams, 13.14b–15a.

[33] *Ch'ao-pen tu-ch'u kung-tu*, Kuang-hsü 16/2/29, in *CCKT*, I, 525.

[34] *CWHK*, telegrams, 13.16b.

[35] *YWYT*, VI, 298. *CWHK*, telegrams, 13.24b–25. Li Kuo-ch'i, *Chung-kuo ts'ao-ch'i te t'ieh-lu ching-ying* (Early railroad enterprise in China) (Taipei: Chung-yang yen-chiu-yüan chin-tai li-shih so, 1961), pp. 85, 88, 214.

and actual income from the railroad appropriation received during 1890 amounted to only 1,000,000 taels.[36]

Nevertheless, on April 13, when Chang ordered surveying of the arsenal plant site to begin, he was still proceeding on the assumption that building funds for the arsenal would be advanced from the railroad appropriation. However, three days later he wired the Navy Yamen that he agreed with the position they had taken in their March 22 wire to him, i.e., that funds for the arsenal and the railroad appropriation would have to be clearly separated. He went on to ask the Navy Yamen to forward to him then the advance of 150,000 taels which would be needed for plant building, but suggested that the funds be taken from the new maritime defense contributions rather than the railway appropriation.[37] The Navy Yamen replied that these funds were already designated for northern maritime defense to repay foreign loans. There, they would be at the disposal of Li Hung-chang. On April 22, Chang wired Li requesting that he make these funds available. The following day he received a wholly unsympathetic reply. Li, who had formerly suggested that maritime defense funds be used for the arsenal when he thought it would be under his own control, now advised that plant construction be delayed until the Kwangtung contributions materialized.[38]

Subsequently, on April 28, Chang addressed another request to the Navy Yamen. This time he asked that the 150,000 taels needed for building be advanced to him from the resources of the Navy Yamen or through a separate loan from the Board of Revenue.[39] During August Chang heard that the Board of Revenue had no funds from which such a loan could be made. On August 27, he reported to the Navy Yamen that equipment had begun arriving. Further delay was impossible. To provide the necessary funds he asked that the Navy Yamen memorialize for permission for him to borrow 150,000 taels from the Hupeh Grain Intendants Treasury to be repaid by Kwangtung in 1892.[40] The Navy Yamen consulted the Board of Revenue and the request became bogged down there. Finally after Chang had gained Li Hung-chang's

[36] *CWHK*, official documents, 12.1–11. *CCKT*, 1, 885, 888–889.
[37] *CWHK*, telegrams, 13.21b–22; official documents, 11.16–18.
[38] *CWHK*, telegrams, 13.23b–24, 25b–26a.
[39] *CWHK*, telegrams, 13.27a–28b.
[40] *CWHK*, telegrams, 14.12–13.

support in this matter, he was notified, on October 2, by the Board of Revenue that they would join with the Navy Yamen and memorialize recommending this loan.[41] The memorial was not submitted until January 8, 1891. Chang was notified of approval on January 14, and the funds were sent to the arsenal office on February 4. These funds were repaid by Kwangtung by the end of 1892.[42]

Meanwhile, by January 1891, Chang had raised the remaining funds required to complete establishment and begin operations. Former Hupeh Commander in Chief Liu Wei-chen pledged 200,000 taels. Shipping and insurance charges to bring the machinery all the way into Hupeh would consume 60,000 to 70,000 taels of this. Another 80,000 to 90,000 taels would be needed to purchase rifle and gun ammunition machinery which had not been included in the original order since Kwangtung already had this type of equipment. Anything that remained was to go to the first year's operating expenses.[43]

Throughout this entire affair, Chang was anxious to bring the arsenal to Hupeh, but he wanted the machinery and establishment costs to be borne by the contribution fund which he had established in Kwangtung rather than by the railroad appropriation which had been designated for support of the ironworks. Prince Ch'un was successful in helping Chang overcome Li Han-chang's objection to paying the balance due on the price of the machinery and the arsenal building expenses from the Kwangtung contributions. However, when the Navy Yamen denied Chang access to the railroad appropriation as a source for temporary advance of 150,000 taels needed to build the arsenal, finding these funds proved to be a troublesome affair which consumed most of 1890 and the first quarter of 1891. It seemed that Li Hung-chang had prior claim to, or influence over, the alternate sources of funds which Chang sought to tap—and Li was slow to give his assent.

Chang rationalized this large-scale employment of the financial resources of Kwangtung for the establishment of an arsenal in Hupeh by nominally elevating the Hupeh Arsenal from a provincial to an imperial institution and requesting the throne to give recognition and

[41] *LWCK*, telegrams, 12.36b. *CWHK*, telegrams, 14.17b.
[42] *YWYT*, IV, 455, 461–463.
[43] *YWYT*, IV, 453–455.

awards to contributors from Kwangtung.[44] However, there are no subsequent indications that anyone in the imperial government, or in fact anyone other than Chang himself, had an important voice in the arsenal's affairs. Furthermore, the logical corollary and foreseeable consequence of Chang's advocacy that Kwangtung's resources be used for the Hupeh Arsenal was that military industrial development in Kwangtung would be deprived of capital and retarded. This, in fact, was what happened.[45] Although Li Han-chang's negative attitude was an important factor here also, as Chang struggled to raise the funds for the new arsenal in Hupeh he showed little concern for the future of strategic industry in Kwangtung, a cause for which he had argued so urgently in 1885.

Establishment at Hanyang, 1891–1895

By September 1890, a site for the arsenal was selected in Hanyang at the foot of Ta-pieh Shan adjacent to the ironworks and just across the Hsiang River from the capital city, Wu-ch'ang.[46] During 1891 and 1892, Chang set to work on the problem of providing regular annual income. In April 1891, he estimated that operation at one-half of the production capacity of the machinery would require 400,000 taels each year. Subsequently, with imperial authorization, he allocated 360,000 taels annually from Hupeh provincial salt and opium revenues for the regular operating funds of the arsenal. Since a large portion of these funds had been designated for northern maritime defense, Chang had to guarantee that no shortages in the provincial maritime defense contributions would occur.[47]

[44] *CWHK*, telegrams, 13.5–7.

[45] For the development of military industry in Kwangtung through 1895 cf. Wang Erh-min, *Ch'ing-chi ping-kung-yeh te hsing-ch'i*, pp. 112–113. *CCKT*, I, 465–473. *YWYT*, IV, 387–389.

[46] *CWHK*, telegrams, 14.13–14.

[47] *CWHK*, memorials, 30.1–6. *Ch'ao-pen tu-ch'u kung-tu*, Kuang-hsü 17/5/15, in *CCKT*, I, 553–555. *YWYT*, IV, 461–462.

TABLE I[48]

INCOME OF THE HANYANG ARSENAL

Year	*Total*	*Hankow and Ichang Salt Bureaus*	*Ichang Native Opium Excise Bureau*	*Loans, Contributions, Special appropriations*
1890	555,840			555,840
1891	370,088		209,556	160,532
1892	371,088	91,513	239,703	39,854
1893	543,546	250,381	253,725	39,440
1894	539,955	150,345	234,814	154,796
1895	577,663	174,633	199,147	203,883

(unit: *ch'ang-p'ing* taels)

This income supported the completion of production facilities at the Hanyang Arsenal through 1895. There were five types of equipment for production of rifles, guns, rifle ammunition, gun ammunition, and gun carriages. Rifles became the best known product of the Hanyang Arsenal. The order which Chang had made final with the Ludwig Loewe Company in 1889 was for machinery to produce the 11 mm. caliber Mauser single-shot rifle model 1871–1884.[49] On March 28, 1891, while this equipment was still incomplete, he wired Hsü Ching-ch'eng, the new minister in Germany, telling him that the model 1871–1884 was already obsolescent and directing him to contact Ludwig Loewe about changing the order to machinery to produce the 7.9 mm. caliber Mauser model 1888. The order was placed on August 16.[50] Though the 7.9 caliber Mauser was clearly a superior weapon, the delay in deciding upon the change is inexplicable. It was adopted by the German Army Commission in 1888 and was produced in large quantities by Ludwig Loewe.[51] But the sources indicate it was

[48] *HPKC*, "Hu-pei ping-kung kang-yao ch'ang tzu k'ai-pan ch'i chih hsüan-t'ung yüan-nien chih shou-chih ke-k'uan szu-chu ch'ing-tze" (Tables on the income and expenditure of the Hupeh Arsenal and the steel and powder works from its establishment until 1909).

[49] *HPKC*, "Ke-hsiang hsiang-hsi ch'ing-hsing" (Various matters in detail), §1, 6b, mistakenly states model 1876; see W. H. B. Smith, *Mauser Rifles and Pistols* (Harrisburg, Pa.: Telegraph Press, 1954), pp. 56–66.

[50] *CWHK*, telegrams, 14.21b–22a. *CCT*, Kuang-hsü 17/7/12 in *CCKT*, 1, 529.

[51] Smith, *op. cit.*, pp. 77–83.

Chang, not the minister in Germany, who first suggested the changeover and that it was not until 1891.[52] There seems to have been a serious information or communications lag regarding this major development in the German ordnance industry.

Meanwhile, in April 1890, for reasons which he did not specify in correspondence, Chang advised Hsü not to order the iron which the German plans called for to build the rifle plant. Instead, he decided to build with wood.[53] Construction was begun in 1892. The machinery arrived during 1893. But the plant was not complete and ready to commence production until late spring or early summer 1894.[54] Production had not yet begun in mid-July when a fire of unexplained origin gutted the plant, doing about 300,000 taels worth of damage.[55] Rebuilt under wartime pressure to begin production, the new building was constructed with iron from the Hupeh Ironworks but not a single rifle was turned out before the conclusion of hostilities in April 1895. In October of that year, when the restored rifle plant began production, only one-half of the machinery was operational and these machines were producing below their rated capacity due to permanent damage sustained during the fire.[56]

The original order for machinery had also included equipment for production of Krupp breech-loading guns of 7.5 to 12 cm. caliber. Though Chang saw drawings of quick-firing guns, for the first time, in February 1892, he decided against conversion to this model because of the expense. Construction of the gun plant was begun in

[52] In addition to Chang's works, the following sources have been searched: *Chu-te shih-kuan tang-an-ch'ao* (Archives of Chinese embassies in Germany) (Taipei: Hsüeh-sheng shu-chu). Hsu T'ung-hsin, *Hsu Wen-su kung i-chi* (Collected works of Hsu Ching-ch'eng) in Shen Yun-lung, ed., *Chin-tai Chung-kuo shih-liao tsung-k'an*, Ti-shih-chiu-chi (Collected materials on modern Chinese history, 19th series) (Taipei: Wen-hai ch'u-pan-she).

[53] *CCT*, Kuang-hsü 16/ intercalary 2/18, intercalary 2/27, in *CCKT*, 1, 527.

[54] *CWHK*, telegrams, 17.7b. *HPKC*, "Ke-hsiang hsiang-hsi ch'ing-hsing," §1, states that rifle and gun plant buildings were completed during 1893 but notes that machinery was not completely installed until later.

[55] *HPKC*, "Ke-hsiang hsiang-hsi ching-hsing," §6. *North China Herald and Supreme Court Gazetteer* (Shanghai: 1872–1941), July 20, 1894.

[56] *CWHK*, *tien-tsou* (telegraphic memorials), 5.12a; memorials, 39.20b. *CCT*, Kuang-hsü 21/2/9; 21/2/11; 21/ intercalary 5/26, in *CCKT*, 1, 538–541.

1892. The machinery arrived the following year. Everything was complete and ready to enter production in May 1894. But the first two Krupp 8.7 cm. breech-loading steel guns were not completed until May 1895.[57] Meanwhile, by September 1894, in an abrupt reversal of policy, Chang decided to convert to the production of quick-firing guns and ammunition. After an extended telegraphic exchange dealing with the cost and specifications of equipment, in June of 1895, orders were confirmed for machinery to produce 5.3 and 7.5 cm. quick-firing guns from Ludwig Loewe. In the meantime, equipment already at the arsenal had been modified to produce 3.7 cm. quick-firing guns and two were being turned out each month.[58]

During 1891, in the course of explaining his financial maneuvers to the court, Chang disclosed his intention to produce rifle and gun ammunition and gun carriages at Hanyang. During the spring and summer of 1892, he ordered machinery to produce one hundred gun carriages per year, one hundred rounds of gun ammunition per day, 25,000 rounds of rifle ammunition per day, and other related equipment, all from Ludwig Loewe. Total cost including transport and insurance was 308,000 taels. It was October 1894 when this equipment began arriving. The plants were completed and the equipment operational in the summer of 1895. By this time Chang had incurred additional expense for construction materials for the various plants, production materials and conversion to quick-firing guns. Although he borrowed and made some payments to his German suppliers, the end of 1895 found the Hanyang Arsenal deep in the red.[59]

[57] *CWHK*, telegrams, 16.7b–8a. *HPKC*, "Ke-hsiang hsiang-hsi ch'ing-hsing," §1. *CWHK*, memorials, 39.21a. *CCT*, Kuang-hsü 21/5/1, in *CCKT*, I, 539.

[58] *CWHK*, telegrams, 17.31b; 25.17b–18a. *CCT*, Kuang-hsü 21/ intercalary 5/24, in *CCKT*, I, 540.

[59] *CWHK*, memorials, 35.15–19; 39.12b–13. *HPKC*, "Ke-hsiang hsiang-hsi ch'ing-hsing," §1, "Li-nien shou-chieh ke-k'uan ch'ing tse."

TABLE II[60]

EXPENDITURE OF THE HANYANG ARSENAL

Year	*Total*	*Equipment*	*Material*	*Wages & Salaries*	*Admin. & Misc.*	*Land & Construction*	*Loans to Ironworks*
1890	399,242	396,022		3,208	12		
1891	52,022	45,087	37	6,632	166	100	
1892	785,839	173,239	1,040	8,032	1,553	46,168	555,809
1893	580,474	1,212	286	10,175	1,700	75,700	491,387
1894	535,432	30,071	6,259	27,186	6,044	95,206	370,666
1895	465,878	125,580	27,632	79,746	8,270	142,737	81,913

(unit: *ch'ang-p'ing* taels)

Indebtedness accumulated primarily because of the diversion of arsenal income to support the ironworks. Table II shows that, from 1890 to 1895, the total amount lent to the ironworks, 1,499,775 taels, was actually greater than the amount spent on the establishment of production. To explain this, it is necessary to recall the relationship which Chang tried to foster between the ironworks and the arsenal. He regarded the ironworks as antecedent to the arsenal. The arsenal would employ its steel in the production of modern weapons. This stress on domestic self-sufficiency in raw materials had been the cornerstone of Chang's plans for strategic industrial development from the time of his earliest proposals in 1885. Since he placed foremost importance on the early establishment of the ironworks, it is not surprising that he was willing to employ the annual income of the arsenal to supplement its irregular and inadequate income. Large-scale transfers which depleted the arsenal's establishment capital became necessary when establishment costs for the ironworks exceeded the 2,000,000 taels' allocation from the railroad appropriation by almost 800,000 taels and subsequently because the ironworks had no regularly appropriated income of its own.[61] By December 1894, Chang reported that the ironworks was completely dependent on the regular annual income of the arsenal.[62]

Aside from the chronic shortages of funds caused by loans to the

[60] *HPKC*, "Shou-chih ke-k'uan ssu-chu ch'ing-tse."

[61] *CWHK*, official documents, 12.1–11, 14.5–8; memorials, 31.25–30.

[62] *CWHK*, telegraphic memorials, 4.27b.

ironworks, the establishment of the arsenal was beset by other serious problems. Frantic efforts to mobilize the domestic building supply industry proved futile and plant construction was seriously delayed by bottlenecks in the supply of bricks.[63] Technical personnel presented another grave problem area. Chang's plans for the development of technical and scientific education had fallen by the wayside in the struggle to find the funds necessary to begin production. Though he had established a technical school, the Self-Strengthening Academy at Wu-chang in 1893, insufficient language training retarded the students' progress in technical subjects. The academy's personnel contribution to the arsenal, if any, was negligible. As the date for beginning production finally drew near, a personnel crisis arose. On June 18, 1895, Chang wired the director that he had heard that the arsenal was so short of qualified personnel that positions could not be filled and work was being delayed. According to the reports, officials were receiving high salaries but they were unwilling to hire capable artisans who could do the actual production work. Chang directed that the recruiting of skilled artisans from Hong Kong and Shanghai begin immediately. However, in late August the arsenal had only two hundred fifty of the five hundred ninety artisans of the grade of foreman or below that were needed for operation of the machinery. Emergency recruiting was still going on.[64]

From November 1894 until February 1896, Chang served as acting governor-general of the Liangkiang provinces while continuing to hold authority over the arsenal, the ironworks, and the other industries which he had established in Hupeh. In the Liangkiang provinces, he attempted to find new sources of funds with which to relieve the accumulated indebtedness of the Hanyang Arsenal. On August 19, 1895, in a long memorial on postwar reconstruction, he placed an important part of the blame for China's recent defeat on faulty and outdated weapons. The limitations of domestic production had once again necessitated purchasing from abroad and all the evils that went with it. He recommended the establishment of new provincial arsenals and development of existing ones at protected inland sites on waterways that would facilitate wide distribution. He stressed the impor-

[63] *CWHK*, memorials, 39.9a–b.

[64] Ayers, pp. 124–130. *CWHK*, telegrams, 25.16. *CCT*, Kuang-hsü 21/6/1, in *CCKT*, I, 542.

tance of producing the most modern weapons, i.e., magazine rifles and quick-firing guns. After presenting this description of where an arsenal should be and what it should produce so that it fit exactly the Hanyang Arsenal, Chang announced his intention to raise funds in the Liangkiang provinces to alleviate the financial predicament of the Hanyang Arsenal.[65]

On the same day, in a separate memorial, he dismissed the possibility of further modernization or expansion of either of the two major arsenals in the Liangkiang provinces: Nanking or Kiangnan. Nanking, because of its urban setting, did not have the space available for required expansion and Kiangnan was extremely vulnerable to foreign naval blockade. Instead he proposed to use one million taels of Liangkiang foreign loan funds to provide part of the financing for a general expansion of production facilities in the five plants of the Hanyang Arsenal and the establishment of additional plants for the production of black, brown, and smokeless powder. He also proposed to employ southern maritime defense funds for the immediate provision of operating capital to the ironworks, which had been without funds since the spring of the year, and to pay the balance due on the production facilities already installed at the arsenal. This request was denied after a memorial by the Board of Revenue pointed out that Chang had not itemized his requirements and that an unlimited transfer of funds might result. The edict also approved the Board's recommendation that Chang raise the required amounts for the arsenal without making transfers from funds already appropriated to a specific use.[66]

After briefly considering a proposal to employ private German capital for arsenal development,[67] on September 27, 1895, Chang submitted another scheme to mobilize the wealth of the Liangkiang provinces to relieve the financial problems of the Hanyang Arsenal. This time he tailored his proposals to avoid the objections which the Board of Revenue had to his earlier plan. He itemized the equipment and materials which he had purchased to complete the five plants and begin production on which payment to foreign firms was still due. Total indebtedness was over 600,000 taels. He explained that the

[65] *CWHK*, telegrams, 19.11b–12a; memorials, 37.26–28.

[66] *CWHK*, memorials, 38.4–6, 11; 39.20.

[67] Chu Shou-peng, ed., *Kuang-hsü ch'ao tung-hua hsü-lu* (1908), 128.11. *CCT*, Kuang-hsü 21/6/15, 21/7/9, 21/7/15, 21/7/16, in *CCKT*, II, 416–418.

arsenal did not have the funds to meet these bills because its regularly allocated income, with imperial approval, had been consumed by the expenses of the ironworks. Since the Board of Revenue had directed him to raise the funds necessary to complete the plant and begin production without transferring funds already appropriated to other uses, he suggested to the Board that they allocate 600,000 taels from their foreign loan funds, or, if they were unwilling to do this, that they authorize him to use 600,000 taels from the foreign loan funds for southern maritime defense. In this case, he proposed to make repayment by supplying 150,000 taels worth of weapons from the Hupeh Arsenal to southern maritime defense during each of the next four years.

At the time Chang had already begun negotiating for commercial capital for the ironworks. It was his intention, he reported, to separate the finances of the arsenal and the ironworks beginning in 1896. The expenses of the arsenal, prior to that time, he regarded as establishment costs. From 1896 on, expenses would be for production. Based upon regularly allocated income he predicted certain minimum annual production figures. Unless he was provided with the funds to clear the bills from the establishment period, production would have to be halted in order that 1896 income could be used to pay these bills.[68] This logic prevailed. In 1896, the Hanyang Arsenal received 626,000 taels from southern maritime defense foreign loan funds. No repayment was ever made either through distribution of products or transfer of funds.[69] In the simplest terms Chang's financial manipulations during the past five years amounted to this: he had used the regular income of the Hanyang Arsenal to finance establishment of the ironworks while drawing on contributions from Kwangtung and southern maritime defense funds to pay for the establishment of the arsenal.

[68] *CCT*, Kuang-hsü, 21/7/16, 21/10/18, in *CCKT*, 1, 818, 819. *CWHK*, memorials, 39.20–24.

[69] *HPKC*, "Li-nien shou-chieh ke-k'uan ch'ing-tze" and "Li-nien chi Hsüan-t'ung yüan-nien tsao-ch'eng po-chieh shih-tsun ke-hsiang shun-huo piao-tse" (charts of munitions produced, distributed, and stored through 1909).

Conclusions

Despite Chang Chih-tung's sustained and herculean efforts, the establishment of the Hanyang Arsenal dragged on for more than a decade from the time that he first conceived of such a plant for Kwangtung until production began in Hanyang. Although not crucial from a logistical standpoint, it must have been a bitter disappointment to Chang that Hanyang was not ready to supply the Chinese forces fighting Japan in 1894–1895. In this sense, Chang failed. In 1885, he had seen the need for strategic industrial strengthening to prepare for the next imperialist thrust. But the thrust came before he completed the task of preparation which he had set for himself. The obstacles and frustrations which Chang encountered during the establishment of the Hanyang Arsenal not only explain why it was not complete and ready to enter production in 1894, they also suggest some of the broader factors which retarded self-strengthening, specifically strategic industrialization, in the decade prior to 1895.

But first it should be emphasized that Chang's plans for Hanyang were a rational and comprehensive approach to strategic industrial development, a clear advance in self-strengthening strategy. They aimed at overcoming problems of dependence on foreign material and manpower, nonstandardized production, and strategic vulnerability, problems which had undermined earlier self-strengthening projects such as the Kiangnan Arsenal. However, the realization of these plans proved to be a tortuous and time-consuming process beset by difficulties, the magnitude and complexity of which suggest the real dimensions of the problem of establishing modern strategic industry in late nineteenth-century China. Changes for the sake of product modernization, diversion of financial resources to the ironworks, difficulties in the domestic building supply industry, a major fire, and personnel shortages and shortcomings all combined to retard the establishment of the Hanyang Arsenal.

Delays due to changes in plans for the sake of product modernization were great, rifle production being the best case in point. Inexplicably, Chang did not move promptly in response to important model changes in the German ordnance industry. Machinery orders were changed to equipment to produce the 1888 Mauser only in August 1891, occasioning a delay of one to two years more in getting the rifle

machinery to China. Although Chang was capable of formulating a balanced and comprehensive plan for self-sufficient industrial development, either he or the minister in Germany (or both) failed to understand the reaction speed necessary for China to stay abreast of the competition in an international arms race with the imperialist powers and Japan.

Even more time was lost because of delays in plant building. From March 1890, when Chang was first given imperial approval to expend the contribution funds from Kwangtung to build the arsenal in Hupeh, more than four years elapsed until the rifle and gun plants were complete and ready to begin production. Funds were used sparingly and progress was slow. The first year was spent in a frantic quest to have funds advanced. During the period from 1891, when funds for construction were first available, until 1894, when the Sino-Japanese War began, only eleven percent of all funds used were devoted to building whereas seventy-three percent were loaned to the ironworks. Nevertheless, two of the arsenal's five plants were complete on the eve of the war. However, one was destroyed by fire just a few weeks after completion. Judging from the fact that this plant was rebuilt under wartime pressure in less than one year, there is no doubt that the original construction time of all the plants could have been shortened considerably had there not been the massive diversion of financial resources to the ironworks. Another consideration bearing on the construction of plant buildings during these years was the inability of the building supply industry to maintain a steady flow of materials to the construction sites at Hanyang.

The fire which gutted the rifle plant in the summer of 1894 was a crippling blow delivered at a most inopportune moment. Coming as it did, on the eve of the war, it held up production for more than one year at a critical juncture. Although it is impossible to pinpoint responsibility for this calamity, Chang's own decision to cut corners and build with wood rather than iron as prescribed in the plans is certainly a pertinent consideration. However, the sheer destructive impact and dramatic timing of this fire should not obscure the fact that, at this late date, it made very little difference to the Chinese side in the war whether Hanyang began production of rifles or not. During 1896, the first full year of normal operations, the rifle plant produced only 1300 Mausers, hardly enough to have had any important logistical impact. Even if this output were doubled (which

theoretically it might have been had production machinery not been adversely affected by the heat of the blaze), the first year's production from the Hanyang rifle plant would have meant little to China's wartime ordnance requirements which ran to tens of thousands of rifles. The fire was simply one more in the frustrating sequence of obstacles which delayed the completion of Hanyang.

Financially strapped and beset by this multitude of problems, Chang failed to develop the technical and scientific training programs essential to balanced industrial growth. As a result, untrained managers and shortages of skilled artisans caused additional last-minute delays in 1895. Although this reflected an important weakness in Chang's industrialization scheme which, in the long run, would have to be remedied, it was not crucial in preventing Hanyang from entering production at this time. Like the fire, last-minute personnel shortages merely prolonged the extended delays in establishment already occasioned by the changes in machinery orders and the diversion of funds from arsenal establishment to the ironworks.

The struggle to establish strategic industry in Hupeh also suggests several more fundamental obstacles to industrialization in late nineteenth-century China. First, a self-defeating interprovincial competition developed between Chang and Li as a result of a leadership failure in Peking—a failure to give national purpose and national direction to the establishment of national defense industry. The initiative for the establishment of the arsenal and the ironworks was all Chang's. Until 1889, the imperial government did little more than veto several key requests for funds. Then Prince Ch'un came to Chang's assistance just when the project seemed about to slip into the hands of Li Hung-chang. Though Chang gained control of the arsenal, Li retaliated by blocking his access to an advance of establishment capital. As a result, it was Li, not the imperial government, whom Chang saw as obstructing his efforts to develop military industrial power. This feuding contributed substantially to the delay in beginning construction from the spring of 1890 to the spring of 1891.

Another basic factor was the weight of officially sanctioned tradition —tradition such as the government monopoly on arms production— which closed the door on innovative suggestions for commercial financing and management of arsenal industry made, in 1884, at a time when a new approach was sorely needed.

Finally, the international environment in which the Ch'ing Dy-

nasty found itself had a pervasive influence on the establishment of Hanyang. What Chang had in mind was balanced, self-sufficient, strategic industrialization to broaden the initial narrow emphasis on arms and ammunition production which had prevailed during the early years of self-strengthening. What the international situation demanded of China was rapid development of modern military power. The foreign pressures which had originally motivated China's Self-Strengthening Movement in the 1860s were intensifying. Near neighbors, Russia and Japan, had patent territorial ambitions on the northeast Asian mainland. It seemed that the deadline had arrived; the ancient sprawling empire would have no longer to mobilize its resources for a systematic assault on the problem of strategic industrialization. Modern military industrial power had to be realized immediately.

As Chang struggled toward the twin goals of strategic industrialization and modern military production, his efforts were undermined by the multiple factors already discussed—but it is clear that diversion of capital resources, resulting from foreign pressures from Russia and Japan, had the most serious retarding effect on the establishment of the arsenal. Capital was drawn from the Hanyang Ironworks with the result that financial resources at Chang's disposal were no longer adequate for the simultaneous establishment of the ironworks and the arsenal, the two central elements in his industrialization scheme. Instead of proceeding with both projects, Chang was forced to make a choice whether to give first priority in the allocation of capital to the ironworks which was of greater importance for general development, or to the arsenal which was of greater military significance. True to his belief in balanced industrialization for self-strengthening, he chose the ironworks. The Hanyang Ironworks, which would become the hub of China's iron and steel industry during the first half of the twentieth century (and itself the object of new foreign pressures), was born. But the immediate result was the diversion of arsenal income to the ironworks, a slowdown in the establishment of the arsenal, and extensive delay in the beginning of military production.