

# **THE ESTABLISHMENT OF MODERN MILITARY INDUSTRY IN CHINA 1860-1868\***

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## **INTRODUCTION**

The year 1860 marks a fundamental turning point in the history of modern China. Forces which had been at work in the ancient civilization for decades—in some cases centuries—reached maturity and converged creating a powerful influence for change in some of the most basic features of the state and society. During the next eight years certain of China's leaders, responding to this influence, established three large steam-powered machine plants for the production of Western-style models of ordnance and munitions, the first of their kind in China. Although the introduction of steam-powered machinery for the production of modern arms and ammunition was only one aspect of the reforms introduced after 1860, it was an important one for it related directly to the dynasty's capability to ward off domestic and foreign foes. It is not surprising, then, that Western as well as Chinese historians have had a good deal to say about

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the early arsenals.<sup>(1)</sup> Nevertheless, the motives which prompted establishment and the role which the founders foresaw for these plants remain obscure. This is due not only to the incomplete nature of the data available to some researchers<sup>(2)</sup> but also to the ideologically-inspired opinions which, in some cases, have colored conclusions.<sup>(3)</sup> It is the purpose of this essay to set forth the facts concerning the establishment of China's first modern machine industries as they are revealed in the currently-available source material and, beyond this, to draw those inferences which the record warrants regarding the motives for establish-

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- (1) Some of the more important studies dealing with the early period include: Wang Erh-min, *Ch'ing-chi ping-kung-yeh te hsing-ch'i* (The rise of military industry in the late Ch'ing Dynasty), Nankang: Institute of Modern History, 1963. Wang Erh-min, *Huai-chün chih* (The annals of the Huai Army), Nankang: Institute of Modern History, 1967, especially chapter 6. Ch'üan Han-sheng "Ch'ing-chi te Chiang-nan chih-tso-chü" (The Kiangnan Arsenal of the Ch'ing Dynasty), *Li-shih yü-yen yen-chiu-so chi-k'an* (Bulletin of the Institute of History and Philology), Academia Sinica, XXIII, 1951, pp. 145-159. Yoshiro Hatano, *Chūgoku kindai kōgyōshi no kenkyū* (Studies on the early industrialization in China), Kyoto: Tōyōshi kenkyū-kai, 1961, especially pp. 193-200. Wu Chieh ed., *Chung-kuo chin-tai kuo-min ching-ch'i-shih* (Recent history of the Chinese peoples economy) Peking: Jen-min ch'u pan-she, 1958. Sun Yü-t'ang ed., *Chung-kuo chin-tai kung-yeh-shih tzu-liao* (Materials on the history of modern Chinese industry), Vol. I 1840-1895, Peking: K'o-hsueh ch'u-pan-she, 1957, pp. 1-66. Mo An-shih, *Yang-wu yun-tung* (Foreign-matters movement), Shanghai: Jen-min ch'u-pan-she, 1961, pp. 62-86. John L. Rawlinson, *China's Struggle for Naval Development 1839-1895*, Cambridge: Harvard University Press, 1967. Mary C. Wright, *The Last Stand of Chinese Conservatism The T'ung-Chih Restoration 1862-1874*, New York: Atheneum 1966. Stanley Spector, *Li Hung-chang and the Huai Army*, Seattle: University of Washington, 1964. Thomas L. Kennedy, *The Establishment and Development of the Kiangnan Arsenal 1860-1895*, Ph. D. dissertation, Columbia University, 1968. Lü Shih-ch'iang, *Ting Jih-ch'ang yü tzu-ch'iang yun-tung* (Ting Jih-ch'ang and China's self-strengthening), Nankang: Institute of Modern History 1972.
- (2) For example: Ch'üan Han-sheng *Op. cit.* and Wang Erh-min's *Ch'ing-chi ping-kung-yeh te hsing-chi* were completed before many of the materials which constitute the basis for this study became available.
- (3) For example: Wu Chieh *Op. cit.*, Sun Yü-T'ang *Op. cit.* and Mo An-shih *Op. cit.*. Other works listed in foot note 1 treat the arsenals from the point of view of some larger question or they treat only one arsenal or one aspect of the arsenals. This study will deal comprehensively and exclusively with the early development of the arsenals.

ment, the vision of the founders and the influences which affected these plants. These inferences, it is hoped, will deepen our understanding of the beginning of modernization in China and the mentality of the leaders who guided the ancient empire along the first few steps on the path of self-strengthening.

For more than half a century prior to 1860, the empire had been plagued with rebellions. However, the uprising of the Taipings (1851-1865) which controlled much of the lower Yangtze Valley in the late 1850's and early 1860's was a disturbance of unprecedented extent and duration, classified by some as a genuine revolution. It signaled a deep discontent among the Chinese people and posed a grave military threat to the Dynasty. In 1856, the Kiangnan headquarters of the Imperial Pacification Forces east of Nanking, which blocked the rebel entry into the rich Yangtze Delta region, suffered a shattering defeat and was saved from total destruction only when dissension struck among the Taiping leaders. Although the imperial forces were gradually rebuilt and, by 1860, again laid siege to Nanking, in the interim, a new and vigorous Taiping leadership emerged. The most able of the new leaders was Li Hsiu-ch'eng, the Loyal Prince, whose forces handed the imperial armies a decisive defeat at the battle of Tan-yang in mid-May 1860. This time the imperial headquarters collapsed completely and, within two months, the Taiping menace had almost engulfed the Yangtze Delta. The cities on the shore of Lake T'ai fell during the summer and, by mid-August 1860, Li Hsiu-ch'eng's forces were nearing Shanghai.<sup>(4)</sup>

The Dynasty responded in early August by naming Tseng Kuo-fan, who had been leading an army raised in his home province of Hunan

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(4) Wang Erh-min, *Huai-chün Chih*, pp. 1-4.

against the Taipings, as Governor-General of the Liangkiang Provinces and Imperial Commissioner in charge of all imperial forces in the lower Yangtze region,<sup>(5)</sup> an unprecedented grant of military and administrative authority to a provincial official. Meanwhile British and French fears had been raised by the likelihood of a Taiping takeover of Shanghai where their commercial interests were great. As early as May 1860, a joint declaration of the foreign consuls in Shanghai proclaimed the city an international port where Chinese and foreign interests were inextricably intertwined. It was no surprise then that, when Li's troops finally reached Shanghai on August 19, they were expelled by British and French defenders.<sup>(6)</sup>

Concurrent with the escalation of Taiping military pressures on the Dynasty was the intensification of foreign aggression. The Second Opium War, or the Arrow War as it is sometimes called, which pitted France and Britain against China began in 1856. Although the two Western powers found *casus belli* in their relations with China, the real issue was their demand for revision of existing treaties to grant greater commercial, diplomatic and evangelical privileges to British and French representatives in China. It was to coerce the ratification of revised treaties that an Anglo-French force of 18,000 men occupied Tientsin on August 21, 1860, and pressed on to Peking, occupying that city on October 13. There, on October 24, new treaties which vastly expanded the scope of British and French commercial activities were ratified by the Chinese.

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(5) Kuo T'ing-yee ed., *Chin-tai Chung-kuo shih-shih jih-chih* (A day by day history of modern China), 2 Vols., Nankang: Institute of Modern History 1963, Vol. I, p. 337.

(6) Wang Erh-min, "China's Use of Foreign Military Assistance in the Lower Yangtze Valley", *Chung-yang yen-chiu-yuan chin-tai-shih yen-chiu-so chi-k'an* (Bulletin of the Institute of Modern History, Academia Sinica), Vol. II, pp. 558-559.

Specifically, the new treaties opened to foreign commerce ports on the Yangtze in areas then controlled by the Taipings. China's humiliation far exceeded that of the defeat in the first Opium War (1839-1842). The Emperor had been forced to flee and the terms of the treaties had, for all practical purposes, been dictated by foreigners occupying the capital of the empire. The government was in the hands of the Emperor's brother, Prince Kung, who had supervised negotiation of the treaties and who seemed determined to make the best of a bad situation by complying strictly with their terms.<sup>(7)</sup>

One curious aspect of this escalation of foreign and domestic pressures on the Dynasty was the apparent inconsistency of the Anglo-French position. On August 21, British and French forces fought to defend Shanghai from the Taipings only two days after troops of the same two nations had forcibly occupied Tientsin. The seeming contradiction disappears if one recalls that both steps were taken to safeguard or improve the two powers' commercial position in China. Furthermore, once an improved status had been promised by the ratification of new treaties in the fall of 1860, Britain and France gradually shifted from neutrality to support for the imperial side in their struggle with the Taipings in the Yangtze Valley.<sup>(8)</sup>

By late 1860, both foreign and domestic military pressures had become serious considerations in the minds of China's leaders as they contemplated a future course for the empire. Moreover, the intellectual ambience in

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(7) Immanuel C. Y. Hsü, *China's Entrance into the Family of Nations*, Cambridge: Harvard University Press, 1960, pp. 21-31, 98-105. Mary C. Wright, *Op. cit.*, pp. 15-20. Arthur Hummel ed., *Eminent Chinese of the Ch'ing Period*, Washington D. C.: U. S. Government Printing Office, 1943-44, pp. 379-381.

(8) Wang Erh-min, "China's Use of Foreign Military Assistance in the Lower Yangtze Valley", pp. 560, 580.

which such considerations were made had changed drastically. A reform impulse was moving among China's leaders inspired partly by the recent military emergencies but also by indigenous intellectual developments which had been centuries in the making. The preoccupation with empirical research which had characterized the Confucian schools of the seventeenth and eighteenth centuries was given a new focus by the problems which pervaded China's state and society after 1800. Scholars of the Confucian School of Statecraft (ching-shih) addressed themselves increasingly to the adjustment of institutions and the improvement of administration for the purpose of bolstering the wealth and power of the faltering imperial regime.<sup>(9)</sup> At the same time the emergence of the New Text School of Confucianism seemed to bless the School of Statecraft's tendency toward reform by advancing notions of historical evolution which were understood by many scholars to mean that Confucianism advocated reliance on the past only when it could be of assistance in solving the problems of the present.<sup>(10)</sup>

The convergence of these ideas is perhaps best exemplified by the New Text scholar Wei Yuan whose writing showed a definite concern with the improvement of state administration even before China's first disastrous encounter with the West in the first Opium War. However, it was in 1842 that Wei Yuan enunciated his two famous principles for the guidance of state policy. One was the age old dictum that China should employ barbarians to control barbarians. But the other was a

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(9) Hao Chang, *Liang Ch'i-ch'ao and Intellectual Transition in China*, Cambridge: Harvard University Press, 1971, pp. 26-27. Benjamin Schwartz, *In Search of Wealth and Power: Yen Fu and the West*, New York: Harper and Row, 1969, pp. 5-8.

(10) Frederic Wakeman, "The Huang-ch'ao Ching-shih Wen-pien" *Ch'ing-shih Wen-t'i*, Vol. 1, No. 10, February 1969, p. 10.

new idea, "learn the superior techniques of the barbarians in order to control them." These techniques, he observed, fell into three categories: warships, firearms and the maintenance and training of troops. He made specific recommendations for the establishment of arsenals and shipyards and the translation of Western works on technology. However in the two decades which followed the Opium War, Wei Yuan's suggestions were, for the most part, ignored as the court settled back into the false security of a temporary peace.<sup>(11)</sup>

During these years, scholars of the School of Statecraft and the New Text School remained active and, when the multiple crises of 1860 struck, reform notions which had been germinating during the past several decades were formulated into a coherent program by the far sighted Confucian scholar of the School of Statecraft, Feng Kuei-fen. Feng's writings were read by Tseng Kuo-fan and his leading protege Li Hung-chang who a few years hence would be the founders of China's first modern machine industries; they provide an important part of the intellectual backdrop against which the decisions to establish these industries were made.

Feng's reform proposals struck with thorough-going practicality at the very basis of the imperial system. For example, his suggestions for the appointment of official personnel involved the principle of popular elections at the lowest levels and peer-group selection at higher levels. In discussions of how to deal with foreign pressures, he emphasized the need for China to make a reasoned approach to foreign governments and to improve methods of communication. Rejecting Wei Yuan's concept of playing one foreign power off against another as unsuitable for the

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(11) Ssu-yu Teng and John K. Fairbank, *China's Response to the West A Documentary Survey 1839-1923*, New York: Atheneum, 1963, pp. 30-35, 46.

present, Feng stressed the principle of learning the foreigner's techniques in order to control them. Although he never hesitated to recommend reform in any area in which he observed the need for it, it was in the field of munitions production that he saw the greatest deficiencies and most urgently called for reform based on Western models. He proposed to establish an arsenal and a shipyard in each treaty port and employ foreign technicians and instructors to staff them. Addressing himself to a more fundamental aspect of the problem, he called for the establishment of foreign language schools and institutions where Chinese could thoroughly penetrate the mysteries of Western sciences. A reform of the civil service examinations which he suggested would have directed half of China's intellectuals to the study of foreign subjects. It is clear that Feng's reform proposals were inspired by the hope of strengthening China and ridding the empire of the oppressive foreign presence and that they reflected the objectivity and practicality which were the hallmark of the Confucian School of Statecraft. He argued with great cogency for fundamental reforms involving the political system, the educational system and, with the utmost urgency, for the introduction of Western methods in strategic industry.<sup>(12)</sup>

Although the Taiping forces under Li Hsiu-ch'eng had been repulsed at Shanghai in August 1860 by foreign intervention, they remained active in Kiangsu and Chekiang during 1861 occupying one city after another. Finally in December of that year Hangchow, the capital of Chekiang, fell to the highly effective army under Li's command. As Taiping military

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(12) Teng and Fairbank, *Op. cit.*, pp. 50-55. Lü Shih-ch'iang, "Feng Kuei-fen te cheng-chih szu-hsiang" (The political thought of Feng Kuei-fen), *Chung-hua wen-hua fu-hsing yueh-k'an* (Chinese cultural renaissance monthly), Vol. 4, No. 2, pp. 1-8.



pressure mounted in the lower Yangtze Valley, responsible Chinese officials echoing the logic of Feng Kuei-fen's reform proposals began to call for military modernization based on Western models to meet the Taiping menace. And now in the changed international climate resulting from the signing of the new treaties, the Western powers were more than willing to assist with arms and arms technology.

Early in 1861 Tseng Kuo-fan, the new leader of the anti-Taiping struggle counseled the imperial government to decline direct military aid and instead to concentrate on establishing domestic production of Western style ordnance and warships.<sup>(13)</sup> In supporting Tseng's advice before the throne, Prince Kung of the Tsungli Yamen reported that France had already expressed its willingness to sell arms to China and to provide technicians to instruct in arms production. This idea was again referred to Tseng Kuo-fan along with other proposals to sell steamships to China which had been advanced by Robert Hart, later the British Inspector General of the Imperial Maritime Customs Service. Tseng's reply was written in mid 1861 shortly after Tso Tsung-t'ang's Hsiang Army relieved his headquarters at Ch'i-men in Southern Anhwei where he had been bottled up by the Taipings. It reflected a deepening determination to take immediate steps toward military industrial self-strengthening. The purchase of foreign guns and ships, he observed, was China's most urgent need at the moment. He felt they would be of great immediate use in checking the advance of the rebels but stressed that, in time, possession of these arms and skill in their employment would equalize China's power relationship with Western nations. Moreover, he advocated that Chinese

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(13) Wang Erh-min, "China's Use of Foreign Military Assistance in the Lower Yangtze Valley, 1860-1864", p. 556.

scholars and artisans become adept with foreign ships and guns and learn how to make them themselves. Optimistically, he forecast that, within several years, the steamer would become a common phenomenon on the Chinese scene.<sup>(14)</sup> This advocacy led directly to the introduction of machine production of Western-style arms in China.

### ANKING ARSENAL

Although the suggestion to employ French technicians in ordnance production did not materialize, nevertheless, it was not long before Tseng Kuo-fan was in the position to attempt production himself. After the recapture of Anking, a Yangtze port in southwestern Anhwei, by Tseng's brother Tseng Kuo-ch'uan, in early September 1861, Tseng moved his headquarters to that city. In December he ordered the establishment of a powder plant, an ammunition plant and a domestic arsenal (*nei chün-hsieh-so*), which was to produce foreign style ordnance.<sup>(15)</sup> This arsenal was staffed by some of the most distinguished Chinese engineers and scientists of the day reflecting the great importance which Tseng placed upon having the right man in the right job. Included were: Hsü Shou, a renowned engineer whose son went on to play an important role in the development of Chinese strategic industry; Hua Heng-fang, an accomplished mathematician; Kung Chih-t'ang, son of Kung Chen-lin, one of the pioneers of strategic industrial development at the time of

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(14) Ch'ou-pan i-wu shih-mo (Management of foreign barbarians), Taipei: Kuo-feng ch'u-pan-she, 1963, Hsien-feng, 72:11A-12, (hereafter *IWSM*). Tseng Kuo-fan, *Tseng Wen-cheng kung ch'üan-chi* (The complete works of Tseng Kuo-fan.), Taipei: Shih-chieh shu-chü, 1965 ed., tsou-kao (memorials), pp. 416-418, (hereafter *TWCKTK*).

(15) Sun Yü-t'ang ed., *Chung-kuo chin-tai kung-yeh-shih tzu-liao* (Materials on modern Chinese industrial history), Vol. 1, 1840-1895, Peking: K'o-hsüeh ch'u-pan-she, 1957, p. 249, (hereafter *CCKT*).

the Opium War who had perfected the iron mold for casting ordnance and conducted experiments aimed at construction of a steam engine; and Wu Chia-lien, another engineer. In 1863 Li Shan-lan, the distinguished mathematician and translator of Euclid's *Elements* Books 7-15, also joined this group.<sup>(16)</sup>

Meanwhile in 1862 a team headed by Hua Heng-fang completed work on a steam engine and in 1863 a small steamer, the Huang-ku, about twenty-eight feet in length, was completed and tested under the direction of Tseng's aid, Ts'ai Kuo-hsiang. The arsenal at Anking also turned out ordnance items, including explosive shells, air bursting shells and large guns up to thirteen thousand catties in weight. Tseng summarized his attitude toward the production at Anking in the summer of 1862: "The way to self-strengthening" he wrote, "is urgently to put governmental affairs in order; to seek out men of talent and to take the learning of ordnance production and shipbuilding as our initial tasks."<sup>(17)</sup> Although far more cautious than the bold steps proposed by Feng Kuei-fen, in the critical matter of the emphasis which they placed on strategic industrialization, Tseng's views bore the clear imprint of Feng's ideas.

Tseng was initially quite enthusiastic about the ability of his engineers at Anking to master Western techniques of production but, as time wore on, he took a more realistic view. In January 1863, he anticipated

(16) CCKT, pp. 251-252. Hummel, *Op. cit.*, pp. 479, 540. Gideon Chen, *Tseng Kuo-fan, Pioneer Promoter of the Steamship in China*, Peking: Yu Lien Press, 1935, pp. 82-92.

(17) CCKT, pp. 249-250. Chen, *Op. cit.*, pp. 40-41. Ch'ing-shih pien-tsuai wei-yuan-wei yü Chung-kuo wen-hua yen-chiu-so ho-tso (Ch'ing history editorial committee with the Institute of Chinese Culture) ed., *Ch'ing-shih* (History of the Ch'ing Dynasty), 8 Vols., Taipei: Kuo-fang yen-chiu-yuan, 1961, VII, p. 5469. Tseng Kuo-fan, *Tseng Wen-cheng Kung shou-shu jih-chih* (The handwritten diary of Tseng Kuo-fan), 40 Vols., 1909, T'ung-chih 1/5/7.

expanding production to include foreign style percussion caps; however, he felt uncertain as to whether or not his artisans could be successful at this. In 1868, he stated in a memorial that the staff at Anking had been entirely Chinese and, though they had built one steamer, it was slow and they had not grasped the techniques involved very well.<sup>(18)</sup> Experience at the Anking Arsenal seems to have convinced him that the successful production of Western arms and ships would require a certain amount of foreign technical assistance and the employment of foreign machinery.

#### THE YUNG WING MISSION

It was in this connection that Tseng, on the advice of several of his engineers, summoned Yung Wing, a Yale educated Chinese businessman, to his headquarters. Yung Wing arrived at Anking in September 1863. When asked by Tseng what type of machinery would be best for China to acquire, Yung Wing's reply indicated clearly that he felt machine production should not be confined to the narrow military limits which Tseng had in mind.

I would say that a machine shop in the present state of China should be of a general and fundamental character and not one for specific purposes...a machine shop that would be able to create or reproduce other machine shops of the same character as itself; each and all of these should be able to turn out specific machinery for the manufacture of specific things...A machine shop consisting of lathes of different kinds and sizes, planers and drills would be able to turn out machinery for making guns, engines, agricultural implements, clocks etc. In a large country

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(18) *TWCKTK*, pp. 549-550, 839-840.

like China...they would need many primary or fundamental machines shops but after they had one...they could make it the mother shop for reproducing others.<sup>(19)</sup>

After hearing this proposal, Tseng felt that a judgment on its correctness was beyond his competence. However, he gave implied approval by empowering Yung Wing "to go abroad and make purchases of such machinery as in the opinion of a professional engineer would be the best and the right machinery for China to adopt."<sup>(20)</sup> Tseng's concurrence with Yung Wing's views on the type of machinery that China should acquire is further substantiated by a statement made in a letter to his lieutenant, Li Hung-chang, December 5, 1863: "We are planning to establish a machine shop and employ machinery making machinery. It must be bought from the West."<sup>(21)</sup>

Tseng arranged funds for the purchase of the machinery.<sup>(22)</sup> Yung arrived in the United States in early 1864 and placed the order. The machinery was completed in the early spring of 1865 and shipped directly to Shanghai, arriving in November or December 1865. Between one and two hundred pieces of equipment were included.<sup>(23)</sup> There is little likelihood that Tseng kuo-fan grasped the far reaching potential of his decision

(19) Yung Wing, *My Life in China and America*, New York: Henry Holt, 1909, pp. 149-151.

(20) *Ibid.* 151-153.

(21) Chiang Shih-jung ed., *Tseng Kuo-fan wei-k'an hsin-kao* (Unpublished drafts of Tseng Kuo-fan's correspondence), Shanghai: Chung-hua shu-chü, 1959, p. 188.

(22) Yung Wing, *Op. cit.*, p. 154, states that the sum was 68,000 taels half of which was to be provided by the Shanghai Taotai and half by the Provincial Treasurer of Kwangtung, c. f. *Tseng kuo-fan wei k'an hsin-kao*, p. 188, which states that Tseng directed Li Hung-chang in Shanghai to provide 10,000 taels and Governor-General of the Liangkwang Provinces to provide 20,000.

(23) Yung Wing, *Op. cit.*, pp. 156, 160, 164. The specifications were drawn up by an American engineer John Haskins. The order was filled by the Putnam Machine Company, Fitchburg Massachusetts.

to introduce capital equipment to the Chinese economy. Nevertheless, when presented with the option of establishing machine production broader than the purely military production so important at that moment, Tseng, for reasons which he did not commit to writing, chose to do so. Had he perhaps sensed the desirability, at least in the long run, of a basic change in the mode of production?

### EARLY ARSENALS IN THE SHANGHAI-SOOCHOW AREA

There is no doubt that such ideas were beginning to take shape in the mind of Tseng's lieutenant, Li Hung-chang. After the recapture of Anking in September 1861, Tseng adopted a new anti-Taiping strategy which provided the opportunity to employ Li in the position of great responsibility for which he had been grooming him. Tseng evolved a three pronged attack plan in which forces under Tseng Kuo-ch'uan would press down river toward the Taiping capital at Nanking from Anking in the west. Armies under Tso Tsung-t'ang would move up from the south. And the crucial task of stemming the Taiping onslaught in the east, where it was again threatening Shanghai, was entrusted to Li who, on Tseng's recommendation, was named acting Governor of Kiangsu.<sup>(24)</sup> The decision to send Li to Kiangsu was actually triggered in November of 1861 when Tseng received an urgent appeal from gentry leaders to rescue the beleaguered city of Shanghai from the Taiping menace. Unable to spare a sufficient number of troops from his Hunan Army for a relief expedition, Tseng dispatched Li to his native area in northern Anhwei to recruit a new force which he was to bring back to Anking for training. Tseng augmented the three thousand five hundred troops which Li

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(24) Hummel, *Op. cit.*, PP. 464-465.

recruited with two thousand from his own forces and together these troops comprised the original nucleus of the Huai Army. In March of 1862 this force was transported from Anking down the Yangtze through the Taiping lines to Shanghai on seven British steamers rented for this purpose by the gentry of Shanghai. In early April 1862, Li reached Shanghai with the first contingent of the Huai Army.<sup>(25)</sup>

Practically from the moment that he arrived in Shanghai, Li was enormously impressed by the effectiveness of the foreign ordnance which he encountered there and by the woeful inadequacy of Chinese efforts at ordnance production. At the time, in addition to some three thousand British, British-Indian and French troops defending the city, there were also about three thousand Chinese troops of the Ever Victorious Army officered by Western volunteers under the command of Fredrick Townsend Ward, an American. All were equipped with foreign ordnance. Unlike the Chinese commanders who had preceded him in Shanghai, who had urged the foreigners to assume even greater responsibilities for defense of the city, Li was quick to recognize the long range threat which the foreigners and their superior weapons posed to China. He held to the general policy lines laid down earlier by Tseng Kuo-fan attempting to minimize the actual intervention and influence of the foreigners while, at the same time, seeking to obtain and to reproduce the superior ordnance which they held. In both respects he was notably successful. The Ever Victorious Army was brought under effective Chinese control and strategic direction and, by early October 1862, Li had gained the agreement of Ward to act for China in hiring foreign technicians to produce ammunition

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(25) Kwang-Ching Liu, "The Confucian as Patriot and Pragmatist: Li Hung-chang's Formative Years 1823-1860", *Harvard Journal of Asiatic Studies*, Vol. 30, 1970, pp. 12-13.

and in purchasing small arms.<sup>(26)</sup>

Subsequent to an edict received at Li's headquarters in November 1862 directing commanders to appoint Chinese to study the production of foreign munitions, Li engaged British and French military personnel experienced with ordnance to duplicate their production. He ordered Colonel Han Tien-chia and a party of Chinese artisans to study with them and requested the transfer of Ting Jih-ch'ang, an official with some experience in the production of domestic ordnance, to be in charge of production in Shanghai. However, diminution of local government customs income in Shanghai subsequent to the opening of a customs house in Hankow, coupled with the high cost of production in Shanghai and the high cost of imported raw materials, delayed the beginning of production and forced prolonged reliance on foreign supply of ammunition. Nevertheless, continued contact with the foreign forces deepened Li's respect for the effectiveness of their arms and strengthened his determination to produce them. In early 1863, when he established in Shanghai an institute for the study of foreign languages (*kuang-fang yen-kuan*) he observed that this would enable Chinese to understand fully the techniques involved in the production of fire arms and steamships. On February 2, he wrote to Tseng that he had visited British and French vessels and that he was deeply impressed with the excellence of their arms and ammunition. He urged his officers to study Western techniques and felt that the blame would be great should this opportunity to learn slip by. Less than a month later, Li estimated his requirements for munitions production at 20,000 taels each month. By May 1863 he was purchasing

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(26) Liu, *Op. cit.*, pp. 14-16. Li Hung-chang, *Li Wen-chung kung ch'üan-chi* (The complete works of Li Hung-chang), Taipei: Wen-hai ch'u-pan-she, 1965, p'eng-liao han-kao (letters to colleagues), 1:116, 1:54a. (hereafter *LWCKCC*).



foreign arms, recruiting foreign technicians and buying arms production equipment in Hong Kong. In October his efforts began to bear fruit; the artisans under Han Tien-chia were producing shells and fuses. He later reported that he had employed funds saved from military requirements in order to begin this production.<sup>(27)</sup>

Meanwhile Li was receiving encouragement and assistance from another source. In the spring of 1863, Dr. Halliday Macartney, M.D., had left the British forces in China and joined Li's staff as an adviser. He urged Li to produce his own ammunition because of the excessive cost of foreign purchase. Once Macartney had demonstrated that he could successfully produce gun shells with Chinese labor, he had Li's support. Li authorized him to hire fifty workers and begin production in a temple in the Sungkiang area of Shanghai. This arsenal was part of the arms depot of the forces which Macartney commanded for Li. His equipment was crude; the iron smelting furnace was built with earth. After Li's forces captured the provincial capital, Soochow, on December 4, 1863, he shifted his headquarters to that city and directed Macartney to follow with his small arsenal. While the move was in progress, in January 1864, Macartney persuaded Li to purchase a batch of arsenal machinery which had been brought to China with the gunboats of the ill-fated Lay-Osborn Flotilla. By April 1864, this machinery, the first steam-powered production equipment employed in China, was installed in a former Taiping temple in Soochow.<sup>(28)</sup> The Soochow Arsenal entered production under the direction of Macartney and a Chinese, Liu Tso-yu.

(27) *IWSM*, T'ung-chih, 20:13b. *LWCKCC*, tsou-kao (memorials), 3:11-13, 26:13a, p'eng-liao han-kao, 2:45b, 46b, 3:2a, 16b.

(28) Demetrius Boulger, *The Life of Sir Halliday Macartney*, London: John Lane, 1908, pp. 79, 123-32.

It was manned by a Chinese staff and four or five foreign technicians, who drew salaries of one to three hundred yuan each month. Although steam-powered machinery was employed, production was limited to explosive shells. About four thousand of varying sizes were produced each month.

By this time two other arsenals were operating in the Shanghai area: one under the direction of Ting Jih-ch'ang who had served with Tseng Kuo-fan in southern Anhwei and subsequently engaged in ordnance production in Kwangtung before coming to Li's staff in 1863, and the other under Han Tien-chia. The work force in these arsenals was entirely Chinese and numbered over three hundred persons. Here, foremen received a modest twenty to thirty yuan each month and other workers five to ten. Native style furnaces were used for casting shells. Monthly output was six or seven thousand explosive shells and six or seven small guns. Percussion caps and fuses were also produced, but quality was not up to that of foreign products. Coal, iron, sulphates, and nitrates required for production all had to be brought from abroad. None of the three plants could produce gun powder of the quality required for employment with foreign ordnance. Since the price of high quality foreign powder was reasonable and the investment required for domestic production was great — more than 20,000 taels — there were no plans for the initiation of powder production.<sup>(29)</sup>

At this time the troops which Li headed, the Huai Army, consisted of about 50,000 personnel. Among this number 30,000 to 40,000 were equipped with foreign small arms or cannon which fired explosive shells.

(29) *IWSM*, Tung-chih, 25:4-8. Kuo T'ing-yee ed., *Hai-fang Tang* (Maritime defense archives), 5 Vols., Nankang: Institute of Modern History, 1957, Vol. III, pp. 3-4, (hereafter *HFT*).

In addition to this, there were pacification units headed by P'an Ting-hsin, Liu Ping-chang, Lo Jung-kuang, and Liu Yü-lung all of which were equipped with foreign style artillery. The cannon and shells employed by these forces originally were purchased from abroad, but eventually the three arsenals took over the complete responsibility for supply. Shells from these arsenals were employed successfully when Li's forces retook Soochow, Ch'ang-chou, Chia-hsing, and Hu-chou. Li was well pleased with the functioning of the three plants; in late 1864 he memorialized that shells made under Macartney's supervision had been instrumental in retaking Soochow. On the basis of Li's recommendation, Macartney was awarded the cap button of the third grade of imperial officials.<sup>(30)</sup>

In the spring of 1864 the Tsungli Yamen asked Li for a report of the progress that had been made in the arsenals under his supervision. Li's reply outlined the facilities, production, personnel, and costs of his arsenals and went on to state that the most important shortcoming was the inability to produce long foreign-style cannon. The production of arms, he said, should be expanded through the acquisition of machinery capable of producing other types of machinery and the skills involved should be disseminated:

I consider that if China wishes to make herself strong, then there is nothing more important than study and practice with the excellent weapons of the foreign nations. To learn about these foreign weapons, there is no better way than to seek the machines which make machines and learn their way [of making them] but not employ their personnel. If we wish to seek

(30) Chou Shih-ch'eng, *Huai-chün ping-nien chi* (Record of the pacification of the Nien by the Huai Army), 1877, 12:2. *CKKT*, pp. 254-255. Yang Chia-lo ed., *Yang-wu yun-tung wen-hsien hui-pien* (Collected Documents on movements relating to foreign matters), 8 Vols., Taipei: Shih-chieh shu-chü, 1963. Vol. IV p. 2. (hereafter *YWYT*).

machinery for making machinery and the personnel to make machinery then we should establish a special course and select scholars. The scholars for the rest of their life should have a goal through which they will become rich and famous, then, this undertaking can be successful, the skill can be perfected and the talent [necessary to do it] also can be assembled.<sup>(31)</sup>

The suggestion was clearly that there should be an avenue for social ascent for scientific and engineering personnel aside from that offered by the civil service examination system; and that there should be material rewards for their accomplishment not merely the incentive of bureaucratic position. As a first step, he proposed that troops from the Artillery and Musketry Division at Peking be trained in the production of Western arms.<sup>(32)</sup>

The study and production of arms was already underway at Peking but there, as at Anking, there were neither foreign technicians nor foreign machinery. Interest in the production of Western style weapons in the north dates from 1859 after the forces of Seng-ko-lin-ch'in, the Mongol commander of the Ch'ing armies, turned back the British forces in their initial attempt to reach Peking and coerce ratification of the Tientsin Treaties. Impressed by the excellence of the weapons which had been captured, Seng-ko-lin-ch'in ordered the Artillery and Musketry Division to study and reproduce them. By the autumn of 1862, troops under the superintendence of Ch'ung-hou, Commissioner of Northern Ports, were continuing this effort. They were training with Russian rifles and had cast and successfully test fired at least ten cannon and produced six gun vehicles of Western design.<sup>(33)</sup>

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(31) *IWSM*, T'ung-chih, 25:8-10.

(32) *Ibid.*

(33) *CKKT*, pp. 343-344. *IWSM*, T'ung-chih, 25:1-3.

In the spring of 1864, after receiving Li's report on the arsenals in Kiangsu, Prince Kung of the Tsungli Yamen presented it to the throne with a preface that incorporated his own suggestions for the development of arms production. He commended the achievements which had been made in Li's arsenals and stated that the purchase of machinery to produce other types of machinery was in accord with his own views. He went on to state that the troops from the Artillery and Musketry Division at Peking had not progressed because they lacked proper technical instruction. To remedy this situation, he proposed to dispatch eight officers and forty men from this division to Li's arsenals to study the production of foreign munitions and machinery-making machinery. He anticipated that they could later be dispersed to the banners to serve as instructors. These personnel arrived in Shanghai on July 23, 1864, and were sent on to the three arsenals for training. In December 1865, Li reported favorably on their accomplishment in mastering the production of explosive shells. In 1867, some of these officers and men were assigned as part of the initial personnel complement of the first modern arsenal established in north China, at Tientsin.<sup>(34)</sup>

By 1864, there was a growing recognition among self-strengthening leaders of the need for foreign technical assistance in the production of modern ordnance and the necessity for incorporating technical and scientific training in China's educational system; but the way that these problems would be resolved was far from settled. The training of personnel from the Artillery and Musketry Division was an important first step but still fell far short of the large scale educational adaption which Feng Kuei-fen had called for. During the spring of 1865, Prince Kung proposed a

(34) *IWSM*, T'ung-chih, 25:1-3. *LWCK* tsou-kaio, 7:17, 9:65-66. *YWYT*, IV, pp. 235-236.

different approach for China to learn the production of Western arms. The Tsungli Yamen addressed a confidential letter to Li soliciting his views on the advisability of sending bannermen abroad to study arms production. Li felt that there was nothing to fear in such a mission but the results could not be foreseen. He recommended instead that a bureau be established in China equipped with foreign machinery and staffed with foreign and Chinese instructors. Once students had shown some progress they could possibly be sent on for further study. This way, he reasoned, the undertaking could be more closely supervised, the results would be quicker and more certain and the cost would be about the same.

He dismissed Prince Kung's fears that China might not get the really capable technicians or the first rate equipment. If good salaries and high positions were offered, Li argued, the good men would come and they would bring with them the first rate machinery. Even if those that came were not highly skilled, he felt that there was much that Chinese personnel could learn from them. He urged that China take this opportunity of temporary peace with the West to establish her maritime defense. To undertake, right now, to send students to the foreign centers of technology would be a complicated and time-consuming task. The temporary opportunity for defensive strengthening could be lost. It would be wiser, he reasoned, to learn what could be learned from the technicians which China could get and proceed on that basis.<sup>(35)</sup> There is a pragmatic ring to this reply. Li discouraged Prince Kung's grandiose suggestion for transforming the ordnance industry through overseas education of bannermen in favor of a step by step approach which he foresaw would bring more rapid, if more limited, results in improving ordnance production

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(35) *HFT*, III, pp. 13-26.

for the immediate task of pacification while laying the foundations for long range strengthening against the West.

The general guidelines which Li favored for the employment of foreign technical assistance and the development of technical personnel for the production of ordnance were becoming clear by early 1865. By this time, also, Chinese contacts with the West were broadening and the urgency of reform in the critical area of ordnance production was becoming even more apparent. A forceful statement of such views from the pen of Wang T'ao, a maverick Chinese scholar residing in Hong Kong, was addressed to one of Li's arsenal directors, Su-sung-t'ai Taotai Ting Jih-ch'ang, during 1864. Wang T'ao's observations were included in the preface which he wrote to a volume on ordnance production entitled *Huo-ch'i shuo-lueh*, compiled and translated by Wang and a friend, who had traveled in the United States, for presentation to Ting. The book itself contains materials dealing with smelting iron, making molds, installing furnaces, boring guns, making powder, surveying, small arms, and the first discussion in Chinese of the principle of wind resistance. In his preface to this work Wang pointed out that firearms techniques were one special aspect of Western affairs which China would do well to master promptly before relations with the West went from bad to worse. He observed that good weapons were essential for pacification of the rebels. To continue to rely on foreign supply was an insecure policy. And to continue to conduct military examinations in archery and rock hurling, as was being done, revealed a grave shortcoming in the system. He saw the production at the small arsenals in Shanghai as a ray of hope in understanding Western methods and called for further development of the production of Western style ordnance and the training

of personnel to employ it as a means to put down the Taiping Rebellion. He even went so far as to set forth a proposed plan for a combined artillery and naval bombardment of Nanking. But Wang also reminded his readers that arms were not exclusively for rebellion suppression. They had the additional value of intimidating potential rebels, and making China less vulnerable to foreign intrusion. Firearms, he observed, should be an instrument to effect just rule in the hands of a wise ruler and not an aid to oppression. "Therefore" he concluded, "I say that firearms are one aspect of planning for pacification at present and intimidating potential enemies in the future. Can we fail to make urgent efforts?"<sup>(36)</sup> Ting Jih ch'ang's views on self-strengthening, expressed in 1864, reflect the same sense of urgency and unqualified commitment to military modernization.<sup>(37)</sup>

Meanwhile, in early 1864 a similar expression of the importance of ordnance production originating from a high bureaucratic source reached Li. A memorial of Court Historian Ch'en T'ing-ching calling for the establishment of arsenals at Canton and Shanghai and the employment of foreign technicians was forwarded to Li's headquarters and to that of Tseng Kuo-fan for comment. In the wake of these expressions of the importance of modern ordnance production during 1864, Li stepped up his efforts. From August 1864 to July 1865 production of modern ordnance in the three arsenals under Li's direction was the most important form of military production carried on by his forces. A total of 110,658 taels,

(36) Wang T'ao *T'ao-yuan wen-lu wai-pien* (Collected writings of Wang T'ao), Hong Kong, 1882, 8:8-10.

(37) *HFT*, III, pp. 4-5, a confidential report from Ting Jih-ch'ang to Li Hung-chang written in 1864. Ting's commitment to ordnance production is also clear from his efforts to establish the Kiangnan Arsenal in Shanghai in 1864-1865 (to be discussed below).



about one-sixth of total military expenditures during this period, was devoted to support production in the three arsenals whereas only 69,311 taels were used for the production of traditional style weapons.<sup>(38)</sup>

### THE KIANGNAN ARSENAL

Though Li was pleased with the production in the three arsenals, he felt the need for larger guns which these plants could not produce. As early as the spring of 1864 he made up his mind to purchase the foreign machinery required for such production.<sup>(39)</sup> His initial contacts with foreign ordnance machinery supply firms were made through Dr. Halliday Macartney who arranged for Colonel Gordon, the new commander of the Ever Victorious Army, who was then about to return to Great Britain, to purchase machinery to produce one thousand rifles per month from a British firm. Li was prepared to make payment when apprised of the total cost. However, when Macartney subsequently determined through direct correspondence with the firms that the price for such equipment would run between £50,000 and £100,000, Li was shocked and directions were issued through Macartney for Gordon to hold off on the purchase.

Li was, no doubt, wary of entrusting such a sum to a foreign purchasing agent in view of the recent bitter experience which he and other Chinese officials had suffered as a result of this practice. Over 150,000 taels had been advanced to Frederick Ward's brother to purchase ships in America; of this sum only 20,000 was acknowledged by Ward's executors, the rest having been lost through poor management and currency exchange. Moreover, several years had elapsed since Li had given 10,000

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(38) *YWYT*, I, pp. 11-14. *CCKT*, pp. 262-263.

(39) *IWSM*, T'ung-chih, 25:8.

taels to a French agent for the purchase of machinery and to date nothing had been received. These disappointments were quite apart from the disastrous Lay-Osborn Flotilla affair, the ill-fated plan to purchase British gunboats which miscarried during 1863 because of disagreement over how the British-manned vessels were to be controlled; the net loss to China was over 700,000 taels. While this bitter experience induced a judicious caution in Li, others in the government were soured on dealing with foreign firms and actively opposed Li's plan to purchase machinery.<sup>(40)</sup>

Accordingly, he adopted an approach designed to eliminate the unwarranted expense and the unreliability of overseas purchase through foreign purchasing agents and rebuff official objections to this scheme. He directed Ting Jih-ch'ang, Taotai of the Su-Sung-T'ai Circuit which included Shanghai, to investigate the availability of machinery already in China where on-the-spot bargaining could be conducted. However, by the spring of 1865 Ting still had not located suitable machinery. And by this time, he had presumably read Wang T'ao's *Huo-ch'i Shuo-lueh* which no doubt deepened his understanding of the complexities of ordnance production. Li's understanding of the problems involved in establishing machine production of modern ordnance was also sharpened during the intervening months. In the spring of 1865 he wrote to Prince Kung that the requirements for ordnance production would be great; greater, for example, than those for shipbuilding. He felt the 30,000 taels which Yung Wing had at his disposal would be inadequate to buy all that was

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(40) British Public Record Office, General Correspondence, Series: Foreign Office 17, item: 425, no. 81, letter from Halliday Macartney in Soochow to Harry Parkes, dated March 24, 1865. On the Lay-Osborne Flotilla see Lü Shih-ch'iang, *Chung-kuo tsao-ch'i-te lun-ch'uan ching-ying* (The early development of steamships in China), Nankang: Institute of Modern History, 1962, pp. 101-112.

needed. Nor did he have the funds in Kiangsu to purchase a complete set of the required equipment from abroad. In any case, he was more convinced than ever that this would be an impractical and imprudent course. He was continuing the search for the right equipment at the right price among the foreign firms in Shanghai.<sup>(41)</sup>

In the spring of 1865 Li's prolonged search for production machinery among the foreign firms in the treaty ports finally met with success. Ting Jih-ch'ang reported that he had reached agreement with the foreign owners for the purchase of machinery in a site later known as Hunts Wharf in the Hung-k'ou section of Shanghai. Forty thousand taels of the total price of 60,000 taels was supplied by the donations of three cashiered officials who sought to regain their positions. The remaining 20,000 taels for the purchase of initial material was raised by Ting himself. The purchase was concluded sometime in the spring of 1865 and in late May or June of that year the plant began operating under Chinese management. Li changed its name to the Kiangnan General Manufacturing Bureau (Chiang-nan chih-tsao tsung-chü) but, from that time on, it has been known to foreigners as the Kiangnan Arsenal.<sup>(42)</sup>

Although it is perhaps impossible to catch the exact connotation which Li attached to the employment of the Chinese terminology "general manufacturing bureau," a term which subsequently became one of the synonyms for arsenal, he used these words, he said in his report to the throne, "to rectify the name and distinguish the thing" (cheng-ming pien-wu), a clear allusion to the Confucian philosophical tenet that things should be given names which denote their reality and distinguish them

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(41) *LWCK*, tsou-kao, 9:31-35. *HFT*, III, pp. 13-26.

(42) *LWCK*, tsou-kao, 9:31-35.

from other things.<sup>(43)</sup> One reason for changing to this name was, as Li explained, to make clear that the machine shop was no longer foreign owned. However, his rationale seems to have gone beyond this. It most probably related to the broad mission which he foresaw for the new machine shop and the catalytic role which he believed machine production would play in China's economic development. He reflected on these considerations also in his report to the throne:

....what we have is machinery-producing machinery; no matter what type of machinery it can be reproduced step by step following the (right) method; then, it can be employed to make that type of product; there are no limits to what can be produced; all things can be mastered. At present we are unable to do everything at once; it is most important that we still produce iron ordnance to meet our military needs....foreign machinery can produce machinery for plowing, weaving, printing, ceramics and tile making which will benefit the daily needs of the people; originally it was not just for munitions....I predict that in several decades there certainly will be wealthy Chinese farmers and great traders who will imitate foreign machine manufacturing for their own profit. The laws of the land have no way to deal with this; but they can establish restrictions on coins and firearms in accordance with previous precedent and those in official service should at all times devise ways to keep control of those who are skilled at ordnance production.<sup>(44)</sup>

The two smaller arsenals headed by Ting and Han Tien-chia were merged with the new arsenal. The personnel from the Artillery and Musketry Division from Peking who were stationed at these two plants were transferred to Kiangnan to continue their training. Ting was

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(43) Fung Yu-lan, *History of Chinese Philosophy*, trans. Derk Bodde, 2 Vols., Princeton: Princeton University Press, 1952, Vol. I, pp. 305-306.

(44) *LWCK*, tsou-kaio, 9:31-35.

placed in charge of planning and supervision while Han, Feng Chunkuang, Wang Te-chun and Shen Pao-ching were appointed managers. Operating funds were initially provided by Li from his military budget. The machinery which Yung Wing purchased in the United States arrived in China in late 1865 and was subsequently installed in the Kiangnan Arsenal.<sup>(45)</sup>

### THE NANKING ARSENAL

The equipment which Li and Ting purchased had previously been devoted primarily to the construction and repair of steamships, but developments in the Nien Rebellion during 1865 dictated that the newly acquired facilities be quickly converted to the production of arms and ammunition. In the spring of 1865, the imperial forces campaigning against the Nien in Shantung were badly defeated at Ts'ao-chou. The commander, Prince Seng-ko-lin-ch'in, lost his life. Gravely alarmed, the government in Peking moved to revitalize its forces in North China. In late May 1865, Liangkiang Governor General Tseng Kuo-fan, who had recently concluded the campaign which crushed the Taiping Rebels in the Yangtze Valley, was transferred to the command position left vacant by the death of Seng-ko-lin-ch'in, and Li Hung-chang was named acting Governor General of the Liangkiang Provinces. Li was ordered to provide troops armed with modern weapons to bolster the forces in the north and to send ordnance and munitions from the arsenals of Kiangsu. Over 10,000 explosive shells were shipped immediately, and Li reported that there was still a large number on hand at the Shanghai and Soo-

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(45) *LWCK*, tsou-kaio, 9:31-35. Yung Wing, *Op. cit.*, pp. 160-164.

chow arsenals which could be supplied as required.<sup>(46)</sup>

This turn of events proved to be of enormous consequence for the establishment of additional facilities for the production of modern ordnance in China. In the first place Li had founded his first modern arsenals in Shanghai and Soochow where they were conveniently located to supply the Huai Army forces which he commanded against the Taipings in that area. Now that the Nien had replaced the Taiping Rebellion as the foremost domestic threat, North China also replaced the Yangtze Delta area as the most critical theatre of military operations. This meant that the Kiangnan Arsenal was hardly established before its location proved less than ideal for supplying the government units under Tseng Kuo-fan battling the Nien in North China, a large number of which were detached from the Huai Army. Furthermore, in his new headquarters at the administrative capital of the Liangkiang Provinces, Nanking, Li found himself far removed from the Shanghai-Soochow logistical base which he had worked to establish during the past several years.

Responding to these difficulties, Li moved to insure his control over supply of modern arms and ammunition to Huai Army units in North China: he directed Macartney to remove the Soochow Arsenal, which by now had begun production of small guns, to Nanking. There, under Li's watchful eye, it was reestablished as the Nanking Arsenal (Chinling chih-tsao-chü) outside the southern gate of Nanking. Its initial operating funds were supplied from the budget of the Huai Army. Beginning in 1867, this was augmented by an annual allocation of

(46) Stanley Spector, *Li Hung-chang and the Huai Army*, Seattle: University of Washington Press, 1964, p. 117. *LWCK*, tsou-kaio, 8:52-54.

funds from the income of the Kiangnan Arsenal for the purchase of foreign materials needed for production. By 1870 facilities had been expanded to include an iron smelting furnace, a boiler house, a brick kiln, and a branch arsenal at Shen-mu-an outside the Tung-chi Gate for the production of rockets. Early production also included guns of various calibers, gun mounts, gun ammunition, gingals, small arms, small arms ammunition, percussion caps and fuses.<sup>(47)</sup>

### THE TIENTSIN ARSENAL

Although the production of the Nanking Arsenal eventually made an effective contribution to the pacification of the Nien, the reestablishment at Nanking was not completed until June 1866. In the meantime responsibility for logistical support of the forces battling the Nien fell squarely on the newly established Kiangnan Arsenal. Kiangnan, with its new plant of foreign machinery, could hardly be removed from the Shanghai area where the foreign advice essential for its operations was available. Consequently, no sooner had the Shanghai plant opened its doors than it received appeals to help establish a comparable facility in North China. The same edict which directed Li to send troops, arms and ammunition to North China also called upon him to assist in the establishment of another arsenal to facilitate supply in that region. The Court asked that, if Ting Jih-ch'ang could be spared, Li send him north with the troops to establish production in Tientsin. Li replied that Ting could not be spared from the arsenal in Shanghai but he

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(47) Boulger, *Op. cit.*, pp. 145-72. British Public Record Office, General Correspondence, Series: Foreign Office 17, item: 425, no. 81, letter from Halliday Macartney in Soochow to Harry Parkes dated March 24, 1865. *YWYT*, IV, pp. 32, 39, 44, 46, 185. *CCKT*, pp. 328-329.

instructed P'an Ting-hsin, the commander of the relief forces which he sent to Tientsin, to assess the situation. If P'an felt an arsenal could be established, Li said that he would send Ting, but Ting was never sent.<sup>(48)</sup>

However, the Tsungli Yamen was determined that Li should assemble a set of machinery such as that held by Kiangnan and send it on to Tientsin where Ch'ung-hou, the Commissioner of Northern Ports, would use it for the establishment of a second arsenal. Li showed little enthusiasm for this venture. In January 1866, in response to an inquiry from Ch'ung-hou, he stated that the machinery from the Kiangnan Arsenal could not be delivered to Tientsin until the spring of the following year. He explained that technical and personnel difficulties being experienced in the initial operation of the Kiangnan Arsenal made it impossible to fulfill this requirement any earlier. Furthermore Li suggested that Ch'ung-hou recruit his own foreign technicians and Chinese artisans so that personnel would not have to be sent from Shanghai.<sup>(49)</sup>

As it became clear in North China that Li was carefully husbanding his meager production resources in Kiangsu, in the spring of 1866 the Tsungli Yamen commissioned Sir Robert Hart to purchase machinery in Great Britain. Thirty-three crates of munitions machinery purchased by Hart arrived in Shanghai in September 1866. The Tsungli Yamen directed that these be sent on to Ch'ung-hou and that he await instructions as to further disposition of this equipment.<sup>(50)</sup> In the meantime, during the summer of 1866, the Tsungli Yamen proposed to the throne

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(48) *LWCK*, tsou-kao, 8:52-54.

(49) *HFT*, III, p. 21.

(50) *HFT*, III, pp. 28-29.



the idea of establishing an arsenal equipped with foreign machinery and employing foreign technicians at Tientsin to provide for the logistical needs of the northern armies. It was suggested that financing be provided from the maritime customs income by Ch'ung-hou. Although imperial approval was given to this plan, Ch'ung-hou hedged, objecting that the demands placed upon the customs income were already excessive.<sup>(51)</sup>

Furthermore, the Board of War and the Governor General of Chihli, Liu Ch'ang-yu, had a separate proposal for an arsenal to produce six hundred pieces of heavy ordnance, the traditional "mountain splitting" guns, along with three hundred gun carriages, accessory parts, powder and ammunition at an estimated cost of 69,000 taels. All were urgently needed to equip the new armies which had been recruited for the defense of Chihli. Before the end of the year, Ch'ung-hou was successful in gaining imperial approval for an alternative plan to finance the production for Chihli from the Ch'ang-lu salt revenue. An arsenal was established and in mid-March 1868 Ch'ung-hou reported the production mission completed and distribution accomplished at a cost slightly above the original estimate.<sup>(52)</sup> There is no evidence to suggest that foreign machinery or modern methods were employed in this undertaking. In fact, it may have been at cross purposes with the Tsungli Yamen's intention to bolster logistical potential in North China through the establishment of a modern machine operated arsenal since it drew from the fiscal resources of this area at a time when the arsenal proposed by the Tsungli Yamen was encountering grave financial obstacles.

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(51) *YWYT*, IV, pp. 231-235. *CCKT*, p. 346.

(52) *YWYT*, IV, pp. 232-235, 238-239.

Though Ch'ung-hou was unable to provide establishment funds for a modern arsenal in Tientsin from the maritime customs income at his disposal, he supported the Tsungli Yamen's proposal for such a plant and looked elsewhere for financing. However, information which he received on the availability and price of foreign machinery from the Danish Consul in Tientsin, an Englishman named Meadows, convinced Ch'ung-hou that the original plans for a large modern arsenal would have to be scaled down considerably. Consequently, in the fall of 1866, he came up with an alternative and much more modest proposal. This plan eliminated the immediate purchase of ordnance machinery because of the great expense involved and suggested instead that Meadows be commissioned to purchase powder-making machinery valued at about 80,000 taels. The required funds would be derived from the liquidation of the steamships of the Lay-Osborn Flotilla. The additional costs of establishment, estimated at several tens of thousands of taels, would be raised by Ch'ung-hou himself. For the regular operating expenses of the arsenal after establishment, he proposed the allocation of funds from both the Tientsin and the Chefoo customs income from the part that was regularly forwarded to the Board of Revenue. The funds for the purchase of machinery were promptly approved but the Board of Revenue succeeded in influencing the court to veto the use of the central government's share of customs funds on the conventional grounds that no alternative arrangement for supplementing central government income had been made.<sup>(53)</sup>

Ch'ung-hou went ahead with the establishment of the arsenal despite the uncertainty about regular operating funds. Meadows was commis-

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(53) *IWSM*, T'ung-chih, 46:18-19. *CCKT*, pp. 348-349.

sioned to purchase powder machinery and hire technicians from Great Britain. Te-ch'un, a Taotai of Fengtien Province, experienced in maritime defense affairs, was named to head arsenal establishment. Some of the troops from the capital who had formerly trained at Li's arsenal in Kiangsu were appointed to the arsenal for further training and Meadows was made director. A location was selected at Chia-chia-ku Tao about six miles east of Tientsin and work was formally begun in May 1867. The site was low and considerable filling had to be accomplished before construction could begin. Channels in the river approach also had to be dredged. In the fall of 1867, Ch'ung-hou forwarded another 33,333 taels from customs and opium taxes to Great Britain to cover shipping, purchase of coal and other expenses associated with the acquisition of the powder machinery. But the question of operating capital after the machinery arrived remained unsettled. This was the Tientsin Powder Bureau (huo-yao chü), subsequently referred to as the East Arsenal.<sup>(54)</sup>

By late 1867, iron casting equipment and machine tools had been purchased from Shanghai and an arsenal was established at Hai-kuang Szu south of Tientsin. This was known as the West Arsenal. Its purpose was to produce machinery and parts for the powder plant, when that was established, and to make ordnance parts and steamship fittings. Mr. Stewart, an Englishman, was placed in charge. In January 1868, Ch'ung-hou reported that he had spent 22,000 taels in the establishment of this plant. He predicted that expenses would increase steadily, especially after the arrival and installation of the powder machinery and he took the opportunity to reiterate his request for an allocation from the central government's portion of the Tientsin and Chefoo customs.<sup>(55)</sup>

(54) *IWSM*, T'ung-chih, 78:12-15. *CCKT*, pp. 346-347. *YWYT*, IV, pp. 235-237.

(55) *IWSM*, T'ung-chih, 78:12-15. *CCKT*, pp. 347-348, 349-350. *YWYT*, IV, p. 237.

The establishment of arsenal industry in Tientsin had been delayed during late 1865 and early 1866 when Li resisted the Tsungli Yamen's efforts to have him ship machinery from the Kiangnan Arsenal to Tientsin, pleading that technical and personnel difficulties experienced in the initial operations at Kiangnan made such support temporarily impossible. Indeed, the initial operations at Kiangnan were far from smooth. From May 1865 until November 1866, Li supervised the Shanghai plant from his new post as acting Liangkiang Governor General at Nanking. The operating costs of approximately 15,000 taels each month came from the military budget which he raised entirely from the revenues of the Liangkiang Provinces. The new Chinese management retained the foreign foreman and eight technicians (shipwrights) from the staff of the foreign machine shop. Their first task was the construction of forty odd pieces of machinery necessary to convert the plant to ordnance production.<sup>(56)</sup> By the spring of 1866 technical and personnel problems at the arsenal had reached a critical stage. Director Shen Pao-ching reported that small arms production machinery had been inoperative during a week long period in the middle of February due to a loss of boiler pressure. Though repair of the boiler had been accomplished, the lining of the furnace was defective and could not withstand the temperatures necessary for the production of small arms. Machinery for the manufacture of rifle stocks was incomplete. Rather than wait any longer for this equipment, Shen proposed to go ahead and make the stocks by hand so that they would be available when small arms production began. Several thousand gun shells had been produced and these were sent to Li's headquarters during March and April; but it was well into the spring of

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(56) Chou Shih-cheng, *Op. cit.*, 11:9. *LWCK*, tsou-kaio, 9:31-35.

1866 before the machine production of ammunition for rifled small arms began. Available information indicates that no more than two thousand rounds were ever produced. At that time the arsenal was awaiting delivery of a British four and one quarter inch caliber twelve pounder cannon to serve as a model to begin production.<sup>(57)</sup>

Li expressed his extreme dissatisfaction with the arsenal's attempts at small arms production. Many months had elapsed and enormous sums had been spent; still nothing had been accomplished. He felt that Feng Chün-kuang had placed undue reliance on the foreign foreman who in turn shifted the blame to inadequacies in the equipment. Li directed that the furnace be rebuilt so as to deny the foreman the opportunity for making further excuses. He warned that, if the arsenal was not turning out foreign style small arms within one month after the furnace was completed, the officials would be deprived of their salaries and the foreign foreman would be paid what was coming to him and deported with a letter to his consul explaining the unsatisfactory nature of his employment. Li advised the arsenal officials to eliminate the manual labor in the production of small arms and find a more economical and productive method of making them; otherwise, he feared that they would be unsatisfactory when completed if that day ever came. Meanwhile, rifles needed for the forces battling the Nien under Liu Ming-ch'uan and Tseng Kuo-fan were to be purchased.<sup>(58)</sup> In the summer of 1866, Li wrote to the Tsungli Yamen that the small cannon produced at the arsenal were comparable to foreign models but few small arms were

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(57) Wei Yun-kung, *Chiang-nan chih-tsao-chü chi* (The record of the Kiangnan Arsenal), Shanghai: Wen-pao shu-chu, 1905. 3:57-58.

(58) *Ibid.*, 3:58-59.

being turned out and these were of poor quality.<sup>(59)</sup>

Aside from the technical and personnel difficulties which hampered production at Kiangnan during its first year of operation, there was another matter of serious concern to Li and to arsenal director Ting Jih-ch'ang. The location in Shanghai posed a number of problems. Ting had purchased the machinery in this plant but the buildings remained under foreign ownership. The arsenal was paying six to seven thousand taels per year rent for their use, a figure which Ting regarded as exorbitant. Furthermore, the buildings were fast becoming inadequate for the rapidly expanding plant of machinery. In addition to the more than one hundred machines which Yung Wing had purchased, thirty to forty more had been built at the arsenal. The location was in a section of Shanghai heavily populated by foreigners and well known for its gaiety and bustle. Ting felt the environment would affect the morale of the work force and he feared that incidents might erupt between the Chinese artisans and the foreign residents. Foreign residents of the area also objected to the presence of the arsenal. Li himself regarded the Hung-k'ou site as unsuitable for long range planning. He favored a move to Nanking along the bank of the river where it would be more convenient for for him to exercise personal supervision.<sup>(60)</sup>

Despite its many problems and its poor location, Kiangnan was the only domestic arsenal producing for the forces campaigning against the Nien during 1865 and until the Nanking Arsenal opened in May 1866; and this campaign was not going well. By the fall of 1866, the court was growing impatient with the anti-Nien strategy employed by Tseng

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(59) *HFT*, III, pp. 27-28.

(60) *LWCK*, tsou-kao, 9:33-35.

Kuo-fan; after almost eighteen months in command, Tseng seemed a long way from bringing the campaign to a successful conclusion. In December 1866, he was summoned to the capital and Li Hung-chang was appointed to replace him in command of the forces fighting the Nien. Although the production of arms and ammunition from the Kiangnan and Nanking arsenals played an increasingly important role in the supply of the forces which Li commanded against the Nien, the overall military situation went from bad to worse during 1867 for the government forces. By early 1868, Peking was in a state of alarm. The Western Nien had advanced from Shansi and reached Lu-kou Ch'iao. The Eastern Nien, which had reportedly been wiped out during December 1867 by Li's forces in Shantung, reappeared in Chihli during January and penetrated to within several miles of Paoting.<sup>(61)</sup>

It was against this background of events in January of 1868 that Northern Commissioner Ch'ung-hou reiterated his request for an allocation of forty percent of the revenue of the Tientsin and Chefoo customs for the support of arsenal operations in Tientsin.<sup>(62)</sup> In 1865 Li and Ting Jih-ch'ang had been hesitant to establish an arsenal in Tientsin fearing that it would drain resources from the Kiangsu arsenals. Now the military situation in North China had deteriorated markedly and Li was charged with command responsibility for suppression of the rebels. It was not long before a sharp change in his attitude toward arsenal establishment became apparent. In late January 1868, he wrote to the Tsungli Yamen forwarding Ting Jih-ch'ang's recommendations for an arsenal in Tientsin and expressing his own concurrence:

(61) Spector, *Op. cit.*, pp. 117-119. Wright, *Op. cit.*, pp. 106-107. *LWCK*, tsou-kaio, 16:23a.

(62) *YWYT*, IV, pp. 237-238.

Machine shop establishment should be expanded to include Tientsin so as to provide supply for guarding the capital. Tientsin is not far from Peking and it is on the seacoast; the purchase of material for production will not be difficult; we should quickly establish another machine shop in this strategic spot to facilitate study close at hand by the troops at the capital in order that we may consolidate our base. After this has been successfully done, we should also establish additional machine shops at the ports along the coast....<sup>(63)</sup>

The final obstacle to the establishment of machine production of modern arms in Tientsin was overcome; Ch'ung-hou's request for forty percent of both the Tientsin and the Chefoo customs to support the arsenal received imperial approval. The Tientsin Arsenal began receiving its regular operating income from these funds from February 1868.<sup>(64)</sup>

Foreign technicians for powder production began arriving in the spring of 1868. The machinery purchased from Great Britain was shipped in and installed in the summer. In August and September several shipments of arsenal equipment were sent from the Kiangnan Arsenal to the Tientsin Arsenal, the equipment which Li Hung-chang had promised to Ch'ung-hou in 1865. Included were fittings for casting guns and ammunition as well as a large iron and brass casting furnace. Part of this equipment was purchased while another part was made at the Kiangnan Arsenal. Kiangsu Province stood the expense which amounted to something less than 10,000 taels.<sup>(65)</sup>

Although the crisis caused by the Nien offensive in North China loosened the imperial purse strings resulting in the provision of customs

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(63) *IWSM*, T'ung-chih, 55:23a.

(64) *YWYT*, IV, p. 239.

(65) *IWSM*, T'ung-chih, 78:12-15, *HFT*, III, p. 45, 65-66. *CCKT*, p. 348.



funds for the operation of a modern arsenal at Tientsin, establishment of the Eastern Arsenal was not completed until 1870. Meanwhile the Western Arsenal began production in 1868 but on an extremely limited scale. This plant under the direction of Mr. Stewart consisted of an iron foundry, a gun casting shop, and woodworking shop; a staff of about fifty Chinese artisans was employed. During 1868 the arsenal produced twelve 450 lb. brass cannons which threw a twelve pound ball and, by 1870, some 7000 pieces of ordnance and steamship equipment had been produced.<sup>(66)</sup>

### CONCLUSIONS

The 1860's witnessed the establishment of modern machine industry in China; arsenals at Shanghai, Tientsin and Nanking had begun to turn out Western style war material. Although production had not yet reached levels sufficient to gauge the progress which these institutions were making, the record of their establishment reveals much regarding the motivation of the founders and the problems which they encountered. Indeed, the record of arsenal establishment during these years is essentially an account of how the impulse to effect change in the ancient civilization took root in the minds of Chinese leaders and found expression in their actions.

First, it seems clear that the motivation for the introduction of modern machine industry to China was the result of multiple causes: foreign and domestic, military and non-military. Although the military emergencies created by domestic rebellion provided the immediate background in which the arsenals were established, the reasoning of the

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(66) *IWSM*, T'ung-chih, 78:12-15. *CCKT*, pp. 349-350.

individual officials who brought the plants into being, as well as Prince Kung of the Imperial Government, leaves no doubt that their ultimate purpose was to help rid China of foreign influence. This concern is central also in the writings of Feng Kuei-fen and Wang T'ao, two of the most outspoken Confucian intellectuals of the day. There is no doubt that their writings provided the font of ideas from which men such as Tseng Kuo-fan, Li Hung-chang and Ting Jih-ch'ang drew inspiration. But the arsenals, with their strange new machinery, should not be regarded simply as pragmatic departures from the pattern of Chinese civilization prompted solely by military considerations. The idea of adjusting institutions to meet contemporary needs was characteristic of the nineteenth century Confucian School of Statecraft. This was the rubric of Confucian political theory under which Chinese leaders rationalized the establishment of modern machine industries for military production. In short, it seems entirely appropriate to regard these plants as examples of institutional innovation in line with the spirit of practical reform characteristic of nineteenth century Confucianism, inspired partly by a desire to protect the Dynasty from domestic foes and partly by the aim of anti-imperialism.

Although the motives which prompted the establishment of modern arsenal industry in China were largely military, the founders of the arsenals were aware that far-reaching changes in the economy would likely result from the introduction of steam-powered production equipment. They seem to have accepted this, in some cases, even welcoming it as desirable. Similarly they appear to have viewed the matter of educational changes necessary to support industrial modernization quite open-mindedly. There were proposals to overhaul the civil service ex-

aminations to reward accomplishment in sciences and technology among aspirant official personnel. Technical training under foreign instructors was instituted for the schooling of artisans. The notion of overseas education though discussed was dismissed by Li Hung-chang on the grounds that the problems involved simply made it impractical at the moment. It seems that although Li favored educational change to support industrialization, he had a limited appreciation, at this time, of how thorough-going this change would have to be. Within a few years, he would change his views and enthusiastically support the Chinese Educational Mission to the United States.

In these early years, the emphasis was necessarily on entering production as quickly as possible to meet urgent demands for war material. The gravity of the military situation virtually precluded the broad-gauged approach to socio-economic change needed for balanced industrialization. Indeed, military pressures prompted the Dynasty to take unprecedented emergency measures. Among these, the delegation of extraordinary military, administrative and fiscal powers to local officials engaged in rebellion suppression would have far-reaching consequences. It was under the aegis of such local power that the arsenals were founded. They were more an expression of the innovative reform programs of provincial officials, such as Li Hung-chang, Tseng Kuo-fan, Ting Jih-ch'ang and others, than they were the result of any conscious policy of the imperial government. The court limited its role to sanctioning, approving, encouraging and sometimes discouraging (by withholding funds) the establishment of machine production in the arsenals. Most of the initiative and all of the actual work of establishment was from provincial officials. Although officials such as Tseng and Li were usually able to cooperate

quite effectively, the lack of centralized planning and direction had its ill effects, as when Li Hung-chang balked at supporting the establishment of a modern arsenal in North China while his responsibility was concentrated in the Yangtze Valley. Although the absence of strong centralized imperial leadership was not at this time a serious problem in the development of the arsenals, it did not augur well for the continued growth of an industry of such crucial significance to the survival of so vast an empire.

Perhaps the most interesting aspect of the establishment of modern arsenals in China is the introduction of Western influence which began through these institutions. Those leaders who promoted the machine production of modern arms were remarkably successful in getting these plants into production in a short period of time. Of course, this was just the beginning. It remained to be seen whether China's society and economy would support continued development of machine industry through adaption of its own resources or whether further transfusions of Western technology, personnel and material would be required to keep these Western style institutions alive in China's preindustrial environment. In this respect, the Westerners who served as advisors, instructors and technicians in the arsenals during the establishment years were of enormous importance for it was they who were the bridge between the civilizations. The mysteries of Western technology, the training necessary to employ it, even the scientific principles upon which it was founded, were imparted to the Chinese by the foreigners who served in the arsenals. Most Western observers of the Chinese arsenals and some Chinese as well have assumed that China's industrial technology was so backward that anything which the Chinese could learn from the West

would be a step in the right direction. Li Hung-chang himself reflected this view in 1865 when he observed that even if the best technicians did not come to China, there was much that the Chinese could learn from any that did come.

This is an oversimplified and overly optimistic view of a complex problem of cultural interaction; it ignores potential problems, many of which actually did occur as the Chinese began to import Western technology. The foreigners who served as advisors and technicians during the establishment of China's first arsenals were at best a mixed lot. There is little direct information pertaining to the qualifications of most; however, the data which we have raises serious questions about some. Halliday Macartney, the best known foreigner in the Chinese arsenals during these years, was unquestionably an enthusiastic employee of Li Hung-chang, but he was a physician without qualifications or experience as an ordnance engineer. Chinese funds melted away on several occasions when they were entrusted to foreigners for purchasing missions. And, by 1866, Li Hung-chang himself seems to have realized the folly of his earlier naïve admiration for the skills of foreign technicians. He became exasperated and embittered by what he saw as incompetence and procrastination on the part of the foreign staff at Kiangnan who, it should be recalled, were shipwrights engaged in small arms manufacture. In short, it seems that the foreigners in the Chinese arsenals were in some cases poorly suited to serve as transmitters of Western science and technology. The success or failure of the first phase of this cultural exchange so crucial to the survival of Chinese civilization depend largely on the effectiveness of a small group of foreigners which included adventurers, opportunists and incompetents.