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THE FOUNDING OF CHINA'S FIRST POLYTECHNIC INSTITUTION

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Introduction[1]

In China, an interest in Western technology began to develop among a few private citizens and provincial officials in the early 19th century, but their efforts to introduce modern technology received little support from higher authorities. In the opinion of the Manchu court and its administration, Western technology would cost too much and would endanger established interests. In the very same period, the Qing government became even more conservative and unyielding with respect to foreign investment in China. However, interest in Western arms was never entirely lost and began to revive sharply in the early 1860s as the lessons of campaigns against both Taiping and foreign rebel forces fighting in the Opium War[2] were driven home. The Manchu court's interest in Western technology was directly

1 This article is based on a paper written for the *8th International Conference on the History of Science in China* held at the Technical University Berlin, August 23–28, 1998.

2 By the 1830's opium—chiefly imported by the British—poured endlessly into China. The attempt of the Qing government to regain control of the situation resulted in the (first) "Opium War" fought between Britain and China (1839–1842), which was the first serious campaign against Western forces. In the Taiping Uprising (1851–1864), in which an estimated 20 million Chinese lost their lives, the Taiping-armies were finally defeated by provincial armies armed with modern (i.e. Western) weapons. For more details on the Opium War cf. Jonathan D. Spence's *The Search for Modern China* (London: Hutchison, 1990, pp. 152–158). With regard to the Taiping Uprising even today Jen Yu-wen's book *The Taiping Revolutionary Movement* (New Heaven, Conn.: Yale Univ. Pr., 1973) remains the most thorough introduction to the subject. For evidence of the changed attitude of Chinese officials toward Western technology cf. Mary C. Wright, *The Last Stand of Chinese Conservatism: the T'ung Chih Restoration 1862–1874.* – Repr. of the Stanford Univ. Pr. edition, 1966. – Taibei: Hongqiao, 1985, p. 371, n. 84.

inspired by experiences made in warfare. Because they were responsible for national defense, certain high officials made an effort to purchase foreign weapons in their hopes to emerge victorious from the civil war. In 1860 and again in early 1862, when Taiping armies at Shanghai were easily wiped out by the modern armed Anglo-French forces, Chinese generals were deeply impressed by the foreigners' combat effectiveness.[3] On the one hand, since technological change obviously lead to social change, Chinese officials of the mid-18th-century vehemently opposed Western technology. On the other hand, almost every government official conceded the advantage of using Western-type ships and guns. The documents advocating the manufacture of modern arms emphasized that this was simply a craft, one the Chinese could learn.

In order to acquire Western technology, it was first necessary to have knowledge of Western languages. The first schools dealing mainly with Western knowledge were therefore language schools; they opened in several cities in the early 1860s. In 1866 two arsenals were established, and attached to each were schools devoted to the study of Western technology.[4] Among other things, the schools undertook a program of translating Western scientific books. The foreign settlements in the treaty ports—especially Shanghai—became not only a center for the transfer of merchandise, but also for Western knowledge in general. As early as 1857, the *Shanghai Literary and Scientific Society* was founded in Shanghai, with Eliah Coleman Bridgman as its first president.[5] The society published a *Journal*

3 Cf. *The Cambridge History of China*. Vol. 10. *Late Ch'ing, 1800–1911,* Part 1. – Repr. of the Cambridge Univ. Pr. edition, 1978. – Taibei: Caves Books, 1986, pp. 491–504.

4 To get a general idea of this turbulent time cf. John Fryer, "Chinese Education—Past, Present, and Future", in: *Chinese Recorder*, 18 (1897): 381–382. For the paramount importance of early translations see Henri Bernard, "Notes on the Introduction of the Natural Sciences into the Chinese Empire", in: *Yenching Journal of Social Studies*, 3 (1941): 220–241, and Tsuen-hsiun Tsien, "Western Impact on China Through Translation", in: *Far Eastern Quarterly*, (1954): 314–318.

5 In 1831 the American missionary E. C. Bridgman (1801–1861) founded *The Chinese Repository* and managed it untill 1847. Bridgman was the first president of the North-China Branch of the Royal Asiatic Society, 1857–1859.

in 1858, and was affiliated in 1859 with the Royal Asiatic Society, a step which had been contemplated from the beginning. The *Chinese Scientific Book Depot*, another agency in Shanghai, was from its foundation an important center for the exchange of scientific and technical knowledge. It had branches in several treaty ports and sold all kinds of useful literature to the Chinese. Founded in 1885 by the distinguished translator John Fryer,[6] the Depot was kept on a self-supporting basis. Together with the British representative Walter Henry Medhurst,[7] the missionary Alexander Wylie,[8] the Chinese reformer Xu Shou,[9] and a few like-minded personalities, Fryer also founded the Polytechnic, in later years one of the most innovative Municipal Council Schools, during his residence in Shanghai.

6 J. Fryer, born in England in 1839, first came to China in 1861 as a teacher at St. Paul's College, Hong Kong. He afterwards left for Shanghai and took up translation work for the Chinese government. For information on this eminent translator cf. Adrian A. Bennett, *John Fryer: The Introduction of Western Science and Technology into Nineteenth-Century China*. Cambridge, Mass.: Harvard Univ. Pr., 1967.

7 W. H. Medhurst was appointed interpreter to the consulate at Shanghai, and in 1848 became acting-consul at Amoy. He then went to Hong Kong as Chinese interpreter to the Superintendence of Trade, and was made consul at Fuzhou in 1854. Acting as consul at Shanghai in 1860, and appointed to Hankou in 1865, and again in 1868, he officiated at Shanghai, at which time he had to settle the Yangzhou missionary difficulties. In 1870 Medhurst was appointed permanently as Shanghai Consul, and retired from the service in 1876.

8 The English missionary and scholar A. Wylie (1815–1887) was especially noted for his knowledge of Chinese literature. Although his works included many articles on scientific subjects, translations of mathematical, and scientific works into Chinese, his most noted work was the *Notes on Chinese Literature* (Shanghai, 1867).

9 Xu Shou 徐壽 was a leading figure in the scientific modernization movement in China. For a brief biography and portrait, see Gideon Chen, *Tseng Kuo-fan: Pioneer Promotor of the Steamship in China* (Beijing, 1935), pp. 87–90.

The Shanghai Polytechnic

In a letter, first published in 1874, Medhurst—then British consul in Shanghai—proclaimed that in China the appreciation of all kinds of Western knowledge had steadily increased. In passing, this little notice in the *New China Daily News* for the very first time announced the project for a polytechnic institution in China. Shortly after this casual item, in Shanghai an educational establishment called *Gezhi Shuyuan* or *School for search after Knowledge*[10] was launched to introduce Western science in China. This institution sought to educate the Chinese regarding foreign countries and general scientific topics. By establishing an educational institution, the founding committee demonstrate, in a practical manner, the benefits of Western science, arts, and manufacturing processes to the Chinese public.

According to the institution's first report, which covered the period from March 1874 to September 1875 it was decided to put two subscription lists in circulation: one for the foreign residents of Shanghai, issued by Medhurst, and another for the Chinese, issued by Tong King Sing.[11] After the second meeting, held on 11 June 1874, more than Tls. 980[12] was raised for land purchases within the boundaries of the English settlement. The institute procured a complete collection of scientific apparatus, including models of machinery, in order to enable those who used its reading rooms to better understand what they had read and to actually observe the experiments described in Western scientific literature. A lecture room and a series of lectures in Chinese were also planned. In fact, the institution's promoters had in mind to build up "[...] nothing less than a Polytechnic

10 The name "*Gezhi Shuyuan*" 格致書院 (School of Sciences) was translated by the founding committee as "school for search after knowledge" following a well-noted letter Medhurst had sent to the *North-China Herald* (Shanghai). In newspaper articles or private correspondence it was renamed the "Shanghai Polytechnic Institution" or the "Polytechnic". For more information on the first meetings of the committee, see *North-China Herald*, June 20, 1874 and October 22, 1874.

11 Tong King Sing [i.e. Tang Tingshu 唐廷樞] was then Director of the semi-official China Merchants Steam Navigation Company.

12 A Tael was worth about US $1.50 at that time.

Institution, resembling, on a small scale, the well known establishment of that name in Regent Street, London [...]".[13]

In the following I will now expand upon several key features of the *Gezhi shuyuan* only briefly mentioned above: institutional funding, the collection of scientific apparatus, the reading rooms, and the lecture series.

Institutional funding

The funds at the disposal of the funding committee were insufficient from the start. That is, they did not allow for the purchase of those apparatus and models necessary for the establishment of an educational institution. The committee therefore asked United States and European manufacturers to either donate or lend the *Gezhi shuyuan* those devices necessary to best illustrate Western science, arts, and manufacturing processes. The committee's idea was that Western companies would welcome the opportunity to exhibit their wares to the Chinese public, thus promoting the spread of their own business. Consequently, the committee circulated a proposal among the chief manufacturers in England and other countries, that asked the institution for financial support. To attract financial backers, the Polytechnic Institution highlighted the colossal marked potential of China's enormous population and, although hitherto almost disregarded, vast natural resources.[14]

Anticipating that most of the funds for the Polytechnic would have to be raised among foreigners, the committee was perplexed to see that most of the aid secured actually originated from the Chinese community.[15]

13 See "First Report of the Chinese Polytechnic Institution and Reading Rooms, Shanghai: From March 1874 to September 1875" - Repr. of the Shanghai edition, "North-China Herald" Office, 1875. -, in: *Nineteenth Century Books on China*. Published on microfiche by Chadwyck-Healey in association with The British Library. - 1. collection - Cambridge: Chadwyck-Healey, 1995, p. 5. [Identification no.: 110005-19.]

14 Ibid.

15 According to the final list of contributions in the Polytechnic's *First Report*, by 1875 Chinese donators had contributed a total of Tls. 14,612.36 and $ 2281, in

When looking over the list of contributions, which was annexed to the reports, the fact becomes clear that foreigners comprised only a small proportion of donators. The largest donations came from high-ranking Chinese officials, which shows that they took a lively and keen interest in the project. The most important contributions came from three prominent officials, namely, Shen Baozhen and Li Hongzhang, the progressive governors-general of Jiangnan and Zhili, respectively, and Feng Junguang, the intendant of Shanghai, who was concurrently director of the Kiangnan Arsenals.[16]

Until this point, plans devised for the improvement of Western education had been almost entirely supported by foreign contributions. But in the case of the Shanghai Polytechnic Institution, it turned out that officials at the highest administration not only sent large subscriptions, but also openly expressed their approval of a scheme started by foreigners.

Scientific exhibitions

An exhibition consisting of various devices of Western machinery, scientific apparatus, tools, and manufactured articles of all kinds—anything considered useful in promoting the introduction and spread of Western products in China—was planned from the very beginning. Instructors at the

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contrast to the Tls. 1,243.33 and $ 271 contributed by foreigners; see Loc. cit., pp. 11–15.

16 Cf. *North-China Herald*, February 17, 1876. For concise portraits of Shen Baozhen 沈葆楨 and Li Hongzhang 李鴻章 see A.W. Hummel (ed.), *Eminent Chinese of the Ch'ing Period*. – Repr. of the Washington edition, 1943–1944. – Taibei: Ch'eng Wen, 1970, pp. 642–644 and pp. 464–471. (For a thorough study on Shen alone, see David Pong, *Shen Pao-chen and China's Modernization in the Nineteenth Century*. Cambridge: Cambridge Univ. Pr., 1994. For recent research on Li, see Samuel C. Chu and Kwang-Ching Liu (eds.), *Li Hung-Chang and China's Early Modernization*. Armonk, N.Y.: M.E. Sharpe, 1997.) On Feng Junguang cf. *North-China Herald*, August 16, 1867, and Thomas L. Kennedy, *The establishment and development of the Kiangnan Arsenal, 1860–1895*. Ph.D., Columbia Univ., 1968.

Polytechnic were committed to helping those Chinese who visited the exhibition better understand what they saw and to let them observe actual experiments described in Western scientific literature. The name and address of the exhibitor, together with the price of those models exhibited for sale, and any explanatory details, were translated into Chinese and affixed to each exhibit. A descriptive catalogue was prepared in Chinese and circulated widely as well. The committee hoped that foreign mercantile firms in Shanghai and other parts of China would realize that it would be to their great advantage not only to attend the exhibition themselves, but also to request assistance in preparing their exhibits from firms located overseas.

Among the exhibits were astronomical instruments, electrical pyrometers and voltameters, numerous telegraphic apparatus, stationary steam engines, some chemical equipment, and huge globes. Maps of China and neighboring countries, that displayed possible rail routes were included in the reading room as well as photographs of mining machinery, railway locomotives, and artillery of German and British origin.[17]

Library and reading rooms

The original aim of the Shanghai Polytechnic Institution was to provide a reading room with all the Chinese periodicals and newspapers then published, as well as any others that had been selected by the committee. In addition, it provided Chinese translations of standard foreign works, original works in Chinese by foreign authors on general subjects, and purely native books as the committee deemed suitable. The reading rooms were supplied with maps, philosophical instruments of various kinds, and several models of steam engines, locomotives, telegraphic apparatus, etc. At the committee meeting of October 16, 1874, Alexander Wylie, a missionary and himself an important translator of Western scientific writings, was

17 Cf. *North-China Herald*, February 17, 1876 and June 24, 1876. For more details see Knight Biggerstaff:, "Shanghai Polytechnic Institution and Reading Room: An Attempt to Introduce Western Science and Technology to the Chinese", in: *Pacific Historical Review*, 25 (1956): 127–149.

asked to draw up a list of the books and periodicals to be placed in the reading room.[18]

To the disappointment of its founders, the reading rooms of the Shanghai Polytechnic did not attract many visitors. This is but a small wonder, however, when one considers the lack of tradition of public reading rooms in China. The main reason for the Chinese lack of interest in the new institution during its first decades was that the exhibits displayed were quite obscure and, regrettably, few. Besides, there seemed to have been no great curiosity among the Chinese regarding steel constructions, iron tools, and steam engines.

Classes and lecture series

At the institution courses and lectures on scientific subjects were given in Chinese, using explanatory apparatus and working models. It was hoped that manufacturers could be induced to donate apparatus. Lectures on scientific subjects were frequently delivered in Chinese to the attending public. Sufficient interest was shown, classes were available on a range of scientific subjects. The committee made efforts to complete its collection of scientific apparatus with funds from their institution. Boys ages ten to fourteen were admitted to special classes, designed to prepare them for further scientific study. They were taught by a Chinese instructor, and school fees were set to cover the costs of instruction. The English language, elements of mathematics, geography, and other basic subjects were taught from English textbooks. Half of a study period was devoted to instruction in the official Beijing dialect.

In the summer of 1890, an English scientist named Burton was brought out to live in the institution and to teach Western sciences. He was to deliver free public lectures on scientific principles, illustrating them with scientific equipment, and to teach regular classes in the sciences and technology for both day students and students who would live at the institution. Courses in chemistry, mineralogy, and metallurgy were to be organized on

18 Cf. *North-China Herald*, October 14, 1875, p. 379. For an informative survey of Chinese journals then circulated in the treaty ports see Roswell S. Britton, *The Chinese Periodical Press, 1800–1912*. Shanghai, 1933.

a three-year schedule; other subjects, such as electricity, photography, and electroplating, were to be taught when student demand justified them.[19]

In 1894 the committee authorized a program of classes and a series of free lectures, to be conducted entirely in Chinese, on scientific and technological subjects. A detailed curriculum was drawn up, covering six fields of "science": mining, electricity, surveying, construction engineering, steam engines, and manufacturing. However, when qualifying examinations were given, none of the applicants proved to be adequately prepared in mathematics. As a result, a preparatory class in arithmetic was started for twenty students.

In time the number of students increased to the point where it became necessary to use advanced students to instruct the beginners. About fifty students had completed preparatory courses in mathematics by the end of January 1896, and of these, seventeen passed strict examinations and gained admittance to the science course. The classes were conducted on Saturday afternoons and the students came principally from the literati class, some even being holders of civil service degrees. Fryer provided special lectures each Saturday evening for the students and their friends on such topics as mines and mining operations, human physiology and anatomy, and zoology. In this manner, the Polytechnic Institution became an important center for imparting Western science and technological knowledge to China.

Scientific essay contest

When discussing the merits of the Shanghai Polytechnic, the scientific essay contest deserves mention. The "Chinese Prize Essay Scheme", which was established "*to try and induce the Chinese literati to investigate the various departments of Western knowledge with the view to their application in the Middle Kingdom*",[20] was a very successful project launched to promote the development of Western technological knowledge in China. Due to civil service examination requirements, toward which all

19 The whole instruction had to be discontinued after Burton came down with a serious disease and died.

20 Cf. *North-China Herald*, August 8, 1898, pp. 258–259.

traditional Chinese education was geared, any capable student was able to compose and to understand a refined essay on any given subject. Each quarter some high or middle-ranking official of the Chinese government was asked by the Shanghai Polytechnic to select a subject, to agree to read the submitted essays himself, and to contribute to the prize money. The submitted essays were then passed on to this official, who ranked them in order of merit and attached individual assessments, written in his own handwriting, to each essay. Three major and ten minor prizes were awarded and the names of the winners were announced in the Chinese press.[21] Honor and publicity appear to have served as incentives for the students, rather than the prizes, which were actually extremely petty. Although contest participation was not subject to any restrictions, all submitted essays displayed a rather advanced scientific knowledge, and suggested that the competitors had read almost every Western scientific work that had been translated into Chinese and published in newspapers or journals.

Concluding remarks

The Polytechnic's teaching program was remarkably successful, particularly during the crucial decade after 1885, when the institution was a pioneer in the teaching of mathematics and science. While these subjects had been taught since the mid-1860's at the official foreign service training school named *Tongwen guan*[22] and also at the Jiangnan Arsenal,[23] it must be remembered that the students in these schools were actually paid to attend them and were assured of government positions upon completion of their program. The small number of student's who paid tuition to attend the

21 At the end of the year the three major prize winners of each quarter were honored by having their essays—together with the official's judgement—printed in a special volume which was available in the public book trade.

22 To get a general idea on the *Tongwen guan* see Knight Biggerstaff's brief article "The T'ung Wen Kuan", in: *Chinese Social and Political Science Review*, 18 (1934): 332–333.

23 For information on the Jiangnan Arsenals cf. "An Account of the Department for the Translation of Foreign Books at the Kiangnan Arsenal", in: *North-China Herald*, January 29, 1880.

regular classes inaugurated at the Polytechnic in 1885 was not impressive. However, the importance of the development to the Chinese was indicated when the Chinese Foreign Office *(Zongli Yamen)* admitted that the Shanghai Polytechnic Institution was training half of the country's most talented mathematics students.

The most important contributions of the Shanghai Polytechnic to the stimulation of scientific and technological interest and knowledge in China appear to have been made through its essay contests and through its journal, *The Chinese Scientific and Industrial Magazine (Gezhi huibian)*. The contests aroused surprisingly widespread interest in Western science and technology among the intellectual élite of China. They appear to have stimulated both the sale and study of books (including translations from English, French, German, and Japanese) and periodicals relating to these subjects, and also attendance of classes and lectures at the Polytechnic and other schools.

When compared with polytechnic institutions of the West—or even with the ambitious plans of its founders—the achievements of the Chinese Polytechnic Institution and Reading Room seem at first sight rather insignificant. But when examined against the background of the technological and scientific stage of development that prevailed in China during the last decades of the 19th century, we have to concede that the Shanghai Polytechnic was a great success.