Where Did They Get the Information From? The Chinese Prize Essay Contest at Shanghai Polytechnique (格致書院課藝) and Late Qing Encyclopedias (類書) Promoting Science

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Abstract:

The second half of the nineteenth century was the seeding time for modern science in China. During the period from 1850 to 1870, many works on astronomy, mathematics, medicine and related fields of botany, geography, geology, mechanics, and navigation were translated by a core group of Protestant missionaries and Chinese co-workers in Guangzhou, Ningbo, Beijing and Shanghai. Parallel to the arsenals and official schools, private initiatives were also needed to popularize "modern science" (*gezhixue* 格致學) in the treaty ports and among Qing officials and literati. Most of these new translations found their way into the numerous compendia, journals, and encyclopedias that were published in China after 1875.

To attract the interest of the literati mainstream, John Fryer (1839-1928) and Wang Tao 王韜 (1828-1897) devised the "China Prize Essay Contest" (*Gezhi shuyuan keyi* 格致書院課藝) in 1886 at the Shanghai Polytechnic and Reading Room. The essay writing contest was conceived by Fryer as a means to attract the many Chinese literati proficient in civil examination essay writing to write about foreign subjects, including science and technology. What is interesting about the China Prize Essay Contest, which lasted through 1893, is that it used the prestige of the imperial civil service examinations to aid missionary efforts to promote modern science during the late Qing, which in turn created a working partnership between Western translators and Qing high officials, particularly those in provinces with treaty ports. Earlier Chinese encyclopedias since the Song dynasty had provided the classical and traditional, statecraft information that civil examination candidates required. Now the new *leishu* provided the Western knowledge that Chinese literati mastered during the Self-strengthening Movement.

The essay contest helped to popularize the new knowledge contained in the science translations from 1865 to 1885 by employing a traditional vehicle to valorize that knowledge. The Sino-

Japanese War aborted such efforts and made them appear still-born, but had the Chinese won that war, such efforts to spread the new sciences through traditional institutional forms might have been legitimated and expanded. Because of the Sino-Japanese War, these new encyclopedias until quite recently have been overlooked and forgotten.

摘要:

十九世紀的後半葉是中國現代科學的「萌芽期」（seeding time）。在一八五○到一八七○年這段期間，在廣州、寧波、北京和上海有一批以基督新教（Protestant）的傳教士及協同工作的中國人為核心所組成的團體，翻譯了許多闡述天文學、數學、醫學以及植物學、地理學、地質學、機械工程和航海運輸等相關領域的著作。想要在條約港口與清代的官員與士人之間推廣「格致學」（現代科學），除了兵工廠和官方設立的學校之外，還需要由私人策動事業一同前進。一八七五年之後，多出來的叢書，學報，及類書出版了這些新的翻譯著作。

為了吸引主流士人的興趣，傅蘭雅（John Fryer，1839-1928）和王韜（1828-1897）在一八八六年設計出「格致課藝彙編」。傅蘭雅想出用這種文章比試的手段來吸引許多精通科舉制藝的士人撰文討論外國事務的課題，其中包括科學與技術。「格致課藝」一直持續到一八九三年，而有趣的地方在於它利用了清帝國科舉考試的聲望來協助傳教士在晚清時提倡現代科學的事業；這接著又在西方的翻譯家與滿清的高官之間（尤其在設有條約港口的省份中的官員）締造了共同合作的夥伴關係。以前的科舉候選人自從宋代利用傳統的類書學習課程的經學科目。在自強運動的新情況之下，清末的士大夫開始學習新的類書因為它們的內容包括了新來的西學知識。

格制課藝採用傳統的媒介，使得一八六五年到一八八五年間的科學譯著所包含的「西學」更有活力，從而推廣了新的知識。甲午戰爭的爆發使得這項事業為之中斷，使得它們看起來像是胎死腹中，但如果中國贏得了這場戰爭，這些透過傳統體制的形式（institutional forms）來傳布新科學的努力，或將取得正統的地位並且充份開展出去。因甲午戰爭的關係，這些新的類書等，到現在為止被忽略和忘記了。

1. Translations at the Jiangnan Arsenal 江南製造局的翻譯工作

In 1867, a Translation Department was initiated at the Jiangnan Arsenal in Shanghai. The initiative was lead by Xu Shou 徐壽 (1818-1882), Hua Hengfang 華蘅芳 (1833-1902), and Xu Jianyin 徐建寅 (1845-1902), classical scholars with scientific interests. In addition to emphasizing foreign manufacture, Zeng Guofan 曾國藩 (1811-1872) and Li Hongzhang 李鴻章

(1823-1901) regarded translation as the foundation for learning the techniques of modern manufacture and the mathematics on which they were based.[1] Their precedent was the late Ming and early Qing translation projects, which had produced encyclopedic collections such as the *Chongzhen lishu* 崇禎曆書 (Mathematical astronomy of the Chongzhen reign, 1635) and *Lixiang kaocheng* 歷象考成 and its sequel (Compendium of observational and computational astronomy, 1724, 1742). Based on new techniques and models applied in the Astronomy Bureau, the translations enabled successful reform of the imperial calendar.[2]

Invited to join the Department in 1867, John Fryer 傅蘭雅 (1839-1928) wrote in 1880, for instance, that the Jiangnan Arsenal had published translations of Western works since 1871. By June 30, 1879, some ninety-eight works were published in 235 volumes (*juan* 卷). Of these, twenty-two dealt with mathematics, fifteen were on naval and military science and thirteen covered the arts and manufactures. Fryer reported that another forty-five works in 142 volumes were translated but not yet published, and thirteen other works were in process with thirty-four volumes already completed.

Altogether, the Translation Office had sold 31,111 copies representing 83,454 volumes, and this had been accomplished without advertisements or postal arrangements. A work on the German Krupp guns translated in 1872 sold 904 copies in eight years. Another work on coastal

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[1] Knight Biggerstaff, "Shanghai Polytechnic Institution and Reading Room: An Attempt to Introduce Western Science and Technology to the Chinese," *Pacific Historical Review* 25 (May 1956): 127-134.

[2] Pingyi Chu, “Archiving Knowledge: A Life History of the *Calendrical Treatises of the Chongzhen Reign* (*Chongzhen lishu*), in Florence Bretelle-Establet and Karine Chemla, eds., of the special issue on encyclopedias, in *Extrême-Orient, Extrême-Occident, hors série* (2007): 159-184. “Encyclopedias” below refers to edited works that collected information based on a classification scheme for reference purposes. “Compendia” (also called “collectanea”) refers to collections of separate works or bodies of writings that were organized by topics but did not produce an index or classification scheme for reference purposes. Some collectanea included encyclopedias in their contents.

defense published in 1871 sold 1,114 copies in nine years. A treatise on practical geometry (1871) sold 1,000 copies in eight years; and a treatise on algebra (1873) sold 781 copies in seven years. Fryer's work on coal mining published in 1871 sold 840 copies in nine years. Publicizing these works beyond Shanghai, Beijing, and the treaty ports was difficult, and even for the latter venues such numbers were disappointing but not insignificant.[3]

Nevertheless, we should note that the limited number of buyers were the Chinese trend-setters. They eventually tilted the balance in favor of science among China's youth. For example, the controversial reformer and classicist Kang Youwei 康有為 (1858-1927) purchased all the Arsenal works when he was in Shanghai in 1882. Between 1890 and 1892, his disciple Liang Qichao ,梁啟起 (1873-1929) also purchased many of the Arsenal's translations as well as Fryer's science journal entitled *The Chinese Scientific and Industrial Magazine* (*Gezhi huibian* 格致彙編). Liang developed an influential reading list based on these materials known as the "Bibliography of Western Learning" (*Xixue shumu biao* 西學書目表), which was revised and published in 1896. Of these 329 published works, 119 (36%) were translated by Fryer. Tan Sitong 譚嗣同 (1865-98) began writing on scientific topics in the 1890s and mentioned *The Chinese Scientific and Industrial Magazine* as one of his sources of scientific learning. Tan had visited Fryer in Shanghai in 1893 and bought many of the Arsenal's works.[4]

2. Shanghai Polytechnic and *The Chinese Scientific and Industrial Magazine*

上海格致書院和格致彙編

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[3] John Fryer, "An Account of the Department for the Translation of Foreign Books at the Kiangnan Arsenal, Shanghai," *North-China Herald*, January 29, 1880, pp. 77-81.

[4] Adrian Bennett, *John Fryer: The Introduction of Western Science and Technology into Nineteenth-Century China* (Cambridge: Harvard University Research Center, 1967), pp. 42-44.

The Shanghai Polytechnic Institution 格致書院 and Reading Room 格致書室, where *The Chinese Scientific and Industrial Magazine* was published, was founded in 1874-75. Its programs promoted the sciences, arts, and manufactures of the West through exhibitions, lectures and classes, and a Chinese Library and Reading Room. Because the Polytechnic did not draw the expected interest hoped for, Fryer and Xu Shou also created the scientific journal in China to reach out to the Chinese in the treaty ports. In 1885, a project for classes and public lectures was implemented, and the scientific essay contest was initiated and became popular. Instructional plans included an appointment for a foreign professorship of science, which did not materialize.

Fryer's idea for the new journal immediately drew support from the Society for Diffusion of Useful Knowledge (*Guangxue hui* 廣學會) in Beijing, which was closing down in 1875 and ending its illustrated monthly known as *The Beijing Magazine* (*Zhongxi wenjian lu* 中西聞見錄). The Society's members in Beijing transferred their subscriptions to the Polytechnic. Although the Shanghai journal was published and sold through the Polytechnic, it was a separate enterprise that Fryer and his Chinese assistant took responsibility for.

Because Fryer's written classical Chinese was not good enough to produce the journal by himself, he employed Luan Xueqian 欒學謙 as his private secretary to help translate the unattributed Chinese articles in the journal. In the past it was assumed these unauthored pieces were all composed by Fryer. Luan was trained at Calvin Mateer's (狄考文, 1836-1908) Hall of the Culture Society (*Wenhui guan* 文會館) school in Shandong, where science and advanced mathematics courses were taught in Chinese. Luan Xueqian, for example, prepared an account of a chemistry class at Shanghai Polytechnic before he collaborated with Fryer.[5]

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[5] See Biggerstaff, "Shanghai Polytechnic Institution and Reading Room," p. 144.

Fryer had worked with Luan since at least 1877 when *The Chinese Scientific and Industrial Magazine* commenced. Moreover, Luan was probably also involved in the *Science Outline Series* (*Gezhi xuzhi* 格致須知) and *Science Handbook Series* (*Gezhi tushuo* 格致圖說) that were published from 1882 to 1898. In addition, Luan managed the Chinese Scientific Book Depot (*Gezhi shushi* 格致書室) for Fryer from 1885, which Fryer eventually turned over to Luan in 1911.[6]

Copies of the Polytechnic' journal were available at first at twenty-four and then twenty-seven of the most important treaty ports and trading centers in China and Japan. There were thirty agents in early 1880, which increased to seventy by the end of the year. Although *The Chinese Scientific and Industrial Magazine* continued from *The Beijing Magazine*, it went beyond the latter by focusing on the natural sciences and technology in Europe and the United States. With more Chinese participants in the production process, the translations in the Shanghai journal were much better.

The journal initially printed 3,000 copies and usually sold out in several months. Nine months later, the first nine issues were reprinted in a second edition to meet the demand. With 4,000 copies printed per issue at its peak in the 1880s and 1890s, it reached some 2,000 readers in the treaty ports. Fryer hoped that in this way, popular oriented presentations of mathematics and the industrial sciences would become more acceptable among literati and merchants. He expected that *The Chinese Scientific and Industrial Magazine* would also compensate for the

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[6] Wang Yangzong 王揚宗, "Gezhi huibian zhi Zhongguo bianji zhe kao" 格致彙編之中國編輯者考, *Wenxian* 文獻 63 (January 1995): 237-243. See also David Wright, *Translating Science: The Transmission of Western Chemistry into Late Imperial China, 1840-1900* (Leiden: E. J. Brill, 2000), pp. 319-325.

limited scope of the Jiangnan Arsenal's translations, which were usually printed in runs of only a few hundred or more copies. Later in 1891, reprints of previous issues were sold.[7]

Altogether, sixty issues were published intermittently over seven years. After 1880, the magazine shifted its emphasis from introductory essays on science to accounts of the basic fields of science. Moreover, Fryer increasingly paid attention to mathematics as the foundation of scientific knowledge. The Polytechnic's teaching program was most effective after 1885 when it pioneered the teaching of mathematics and science in late Qing China. According to a General Affairs Office (*Zongli yamen* 總理衙門) memorial of May 18, 1887, which advocated modifying the civil examinations to allow candidates to be examined in mathematics, the Shanghai Polytechnic was training half of the talented students of mathematics in the empire.[8]

In addition *The Chinese Scientific and Industrial Magazine* published some 317 inquiries sent in to the journal as "Letters to the editor." The letters stressed the practical value of technology and showed less interest in pure science. About 123 letters (38.2%) showed some interest in or knowledge of scientific theories or abstract scientific models, which is a relatively high percentage for a journal more oriented to popular science or popular mechanics. The queries paralleled the technological interests of those involved in the Self-Strengthening movement. The large volume of letters to Fryer anticipated a more widespread awakening of interest in science after 1895 and paved the way for the general acceptance of Western science in China.[9]

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[7] The venues to buy issues were advertised in the journal. See also Ferdinand Dagenais, *John Fryer's Calendar: Correspondence, Publications, and Miscellaneous Papers with Excerpts and Commentary* (Berkeley: Center for Chinese Studies, University of California, Berkeley, 1999), Version 3, 1891:1, and Bennett, *John Fryer*, pp. 50-55.

[8] *Guangxu chao donghua lu* 光緒朝東華錄 (Shanghai: Zhonghua shuju, 1909), 82.11a. See also Biggerstaff, "Shanghai Polytechnic Institution and Reading Room," pp. 148-149.

[9] San-pao Li, "Letters to the Editor in John Fryer's *Chinese Scientific Magazine*, 1876-1892: An Analysis," *Jindaishi yanjiu suo jikan* 中央研究近代史研究所集刊 (Academia Sinica, Taiwan) 4 (1974): 730-31, 762.

Another hopeful sign that Fryer included in his report was that knowledge of mathematics and science was now required in the Qing civil service examinations. W. T. A. Barber from the Wuchang High School later reported in July 1888, for example: "At the recent examination for the Sin Ts'ai [*xiucai* 秀才] degree held in Han-yang-fu, the district [prefecture] containing the mart of Hankow [Hankou 漢口, Hubei], three candidates presented themselves in mathematics." Two passed by answering questions dealing with four questions on right-angled triangles to find the sides and two questions on solid contents to find the dimensions. Barber somewhat overzealously regarded the answers as equivalent to the "Pass B. A." at Cambridge or Oxford. He added that three years earlier three of the sixty-six graduates had received their provincial degrees for mathematics in Hunan. Candidates for the local degree, he thought, were learning sufficient mathematical knowledge to pass. He was apparently unaware that these problems had long been solvable using traditional Chinese "four unknowns" notations (四元術) for algebraic equations.[10]

In his "Report of the Chinese Scientific Book Depot, Shanghai, 1887," John Fryer summarized the results of the first three years of its operations, which had aimed at "facilitating the spread of all useful knowledge literature in the native language throughout China, and especially of books, maps and other publications of a scientific or technical character." Branch depots were established in Tianjin, Hangzhou, and Shantou in 1886, and four more in Beijing, Hankou, Fuzhou, and Xiamen were added in 1887. Fryer noted that seventeen thousand dollars worth of books and maps had been sold since 1885. That translated into approximately 150

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[10] Mathematics questions had been allowed in civil examinations by an 1887 imperial edict. See W. T. A. Barber, "A Chinese examination paper," *North-China Herald*, July 7, 1888, p. 15.

thousand volumes of scientific and educational literature that had "found their way to the most distant parts of China as well as to Japan and Corea."[11]

The 1886 catalog of the Scientific Book Depot, for instance, included mention of 371 works for sale. Fifty-nine titles were on science, forty-nine on Chinese studies, and thirty-five on mathematics. The catalog also included forty-four works that Fryer had translated, twenty-eight of them for the Jiangnan Arsenal. By 1888, there were 650 titles on Western topics at the Scientific Book Depot. Of these, 228 were original Chinese works. Books on the Sino-Japanese War were popular after 1895 when the Depot became a mecca for young Chinese students of the sciences and mathematics in China.[12]

Besides their use in the increasing number of missionary schools, such translations were also institutionalized as texts within a regional matrix of arsenals, factories, and technical schools that formed the nineteenth century roots of the twentieth century industrial revolution in China. Hence, we should also acknowledge the scope and scale of scientific translation and military arsenals elsewhere in China after 1860. Their publications became the basis for most of the scientific content in the numerous *leishu* dealing with Western learning 西學 that were published from 1877 onwards and which peaked in the 1890s.[13]

3. Contest Procedures and Official Patronage 文章比試的程序與官方的贊助

Despite the considerable efforts Fryer, Xu Shou, and Wang Tao 王韜 (1828-1897) expended on maintaining the viability of the Polytechnic and its affiliated if irregular *The*

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[11] For the 1887 "Report," see the *North-China Herald*, December 28, 1887, pp. 702-703.
[12] Bennett, *John Fryer*, pp. 64-66.
[13] Ting-yee Kuo and Kwang-Ching Liu, "Self-Strengthening: the pursuit of Western technology," in Denis Twitchett and John Fairbank, eds., *Cambridge History of China*, Volume 10, *Late Ch'ing, 1800-1911*, Part 1 (Cambridge: Cambridge University Press, 1978), pp. 519-37. See also Elman, *On Their Own Terms: Science in China, 1550-1900* (Cambridge: Harvard University Press, 2005), pp. 430-432.

Chinese Scientific and Industrial Magazine, as well as the Chinese Scientific Book Depot, they were aware of the limits they faced in reaching educated Chinese outside the exclusive audience of literati in Shanghai and the other treaty ports. The mainstream of Chinese literati was still drawn to what the Protestants belittled as the useless focus in the prestigious civil examinations on Chinese literature and poetry. Assuming approximately 2,500 candidates per county for local qualifying examinations at this time, each civil service aspirant in Qing China's 1,350 counties was one of some 3.4 million classically literate local candidates. Ninety five per cent of the candidates empire-wide failed several times in the local and provincial examinations and never advanced further.[14]

In terms of classical literacy, i.e., mastery of the orthodox canon, dynastic histories, and encyclopedias, there were over 900 thousand male-only licentiates 生員 within an approximate population of 450 million Chinese by 1850. Because the civil service selection process eliminated the vast majority of candidates at the local and provincial competitions, a vast constituency of failures sought alternative careers in teaching, medicine, preparing legal plaints for others, etc., where they could use their classical skills as scholars and writers.[15]

From this milieu of examination failures, however, a new group of artisans, technicians, and engineers gradually emerged between 1865 and 1895. Their expertise no longer depended on the fields of classical learning monopolized by the customary scholar-officials. Increasingly, they were no longer subsidiary to the dynastic orthodoxy or its old-fashioned representatives. Still a necessary part of the cultural, political, and social hierarchies, the new students of the sciences in

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[14] See Fryer's "Report" in the *North-China Herald*, December 28, 1889, pp. 702-03. See also Elman, *A Cultural History of Civil Examinations in Late Imperial China* (Berkeley: University of California Press, 2000), pp. 584, 728, on the 23 per cent increase of gentry with regular degrees to 920 thousand after 1850.

[15] See Elman, *A Cultural History of Civil Examinations*, pp. 125-142.

the arsenals and missionary schools emerged from the older categories of the myriad elite aspirants for official status. Yan Fu 嚴復 (1854-1921) and Lu Xun 魯迅 (1881-1936) were famous examples of this group of outsiders from the civil examinations that initially served as the pool of highly educated men who filled the promising world of late Qing institutions oriented toward science.[16]

To attract the interest of this changing literati mainstream, Fryer and Wang Tao devised the "China Prize Essay Contest" (*Gezhi shuyuan keyi* 格致書院課藝) in 1886. Fryer conceived the essay writing contest as a means to attract the Chinese literati proficient in civil examination essay writing to write about foreign subjects, including science and technology:

> To popularise Western knowledge among the *literati* it is necessary to take advantage of all such existing national characteristics; and hence it was conceived that in essay writing there existed a most powerful means for inducing the better classes of Chinese to read, think, and write on foreign subjects of practical utility, and thus carry out one of the main objects for which the Polytechnic Institution was founded.

Fryer failed to add, however, that numerous prize essays solicited by the Royal academies in London, Paris, and Berlin had similarly been of strategic importance to focus interest on specific issues in the development of the sciences and mathematics during the seventeenth and eighteenth centuries in Europe. Moreover, school examinations in the sciences in Britain had been instrumental in promoting such fields of learning.[17] Fryer described the

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[16] See Elman, *A Cultural History of Modern Science in China* (Cambridge: Harvard University Press, 2006), chapter 6.

[17] See John Fryer, "Chinese Prize Essays . . . for 1886 and 1887," pp. 100-101. Compare Biggerstaff, "Shanghai Polytechnic Institution," pp. 141-143. On prize essay questions in eighteenth century Europe, see Roger Hahn, "Laplace and the Mechanistic Universe," in David

selection process he envisioned:

> A high official is asked to give a subject on which prize essays are invited, and to promise not only to look over the essays himself but to bestow certain sums of money upon some of the more successful essayists in addition to the regular quarterly amount of Tls. 25 [34.75 silver dollars = 25 taels] voted from the funds of the Institution for this special purpose. Every quarter a fresh subject is advertised in the native newspapers, and a date is fixed after which no essay will be received. The bundle of essays is then forwarded to the co-operating official who reads them carefully over and adjudicates their order of merit, affixing a criticism of greater or less length in his own handwriting, pointing out the features of excellence or defect in each. . . . Three receive the highest awards and ten or more receive smaller sums. . . . At the end of each year the three highest names for each quarter are honoured by having their essays, with the criticisms, printed in the form of a book, complimentary copies of which are sent to co-operating high officials and successful essay writers.[18]

Fryer also described the selection process:

> A high official is asked to give a subject on which prize essays are invited, and to promise not only to look over the essays himself but to bestow certain sums of money upon some of the more successful essayists in addition to the regular quarterly amount of Tls. 25 [34.75 silver dollars] voted from the funds of the Institution for this special

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Lindberg and Ronald Numbers, eds., *God & Nature: Historical Essays on the Encounter between Christianity and Science* (Berkeley: University of California Press, 1986), p. 266. See also Keith Hoskin, "Examinations and the Schooling of Science," in Roy MacLeod, ed., *Days of Judgement: Science, Examinations, and the Organization of Knowledge in Late Victorian England* (Driffield, N. Humberside: Studies in Education, 1982).

[18] Fryer, "Chinese Prize Essays . . . for 1886 and 1887," p. 100.

> purpose. Every quarter a fresh subject is advertised in the native newspapers, and a date is fixed after which no essay will be received. The bundle of essays is then forwarded to the co-operating official who reads them carefully over and adjudicates their order of merit, affixing a criticism of greater or less length in his own handwriting, pointing out the features of excellence or defect in each. . . . Three receive the highest awards and ten or more receive smaller sums. . . . At the end of each year the three highest names for each quarter are honoured by having their essays, with the criticisms, printed in the form of a book, complimentary copies of which are sent to co-operating high officials and successful essay writers.[19]

In time this experiment became one of the most successful undertakings of the Shanghai Polytechnic to spread Western learning 西學 beyond the treaty ports. Indeed, the Fryer and the other missionary translators never realized that their works would be reprinted over and over and become the intellectual fodder that fed the many new encyclopedias compiled after 1890. The mushrooming of reference (*leishu*) and daily-use encyclopedias (*riyong leishu* 日用類書) in the sixteenth and seventeenth centuries, after all, had been welcomed by Chinese literati preparing for civil examinations or for collecting source materials needed to carry out their other activities.[20]

Mimicking the palace examination 殿試登科錄, three major and ten minor prizes were usually given annually for the China Prize Essay Contest, and the winners were announced in the Chinese and Western press. The best essays were released to newspapers such as the influential

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[19] Fryer, "Chinese Prize Essays . . . for 1886 and 1887," p. 100.
[20] Elman, “Collecting and Classifying--Ming Dynasty Compendia and Encyclopedias (*Leishu* 類書),” in Florence Bretelle-Establet and Karine Chemla, eds., of the special issue on “Encyclopedias” in *Extrême-Orient, Extrême-Occident, hors série* (2007): 131-157.

Shanghai Journal (*Shenbao* 申報). From 1886 to 1893, the three major prize winners had their essays printed together in a book that was placed on public sale for others to emulate. Wang Tao was also editor for the special prize science essay volumes published by the Polytechnic, which paralleled collections of 8-legged essays for the civil examinations that were widely in print in Ming and Qing China. This tactic also mimicked the official publication of the policy essays of the top three finishers on the regular palace examination. When Fryer prepared his "Second Report of the Chinese Prize Essay Scheme" in 1889, he proudly announced:

> By its means the existence of the Polytechnic Institution has become known far and wide; the cooperation of some of the highest officials in the Empire secured; and an interest in western ideas has been created in some of the most influential quarters. By the annual expenditure of only a hundred Taels (139 silver dollars) or thereabouts, and by working in harmony with the Chinese methods of thought, and time-honoured systems of literary competition, a result has been obtained which the use of large sums of money in other ways would have failed to produce.[21]

For Fryer, one of the most encouraging features of the essay competition was the support it received from Qing officials, who quickly saw the efficacy of applying the civil examination ethos, which was so well entrenched among the literati, to Western learning. The Polytechnic's essay contest closely paralleled the civil examination process of reward and fame for prized essays. Li Hongzhang and Liu Kunyi 劉坤一 (1830-1902) as the Northern and Southern Superintendents of Trade respectively, for example, each consented to give an extra theme every

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[21] John Fryer, "Second Report of the Chinese Prize Essay Scheme in connection with the Chinese Polytechnic Institution and Reading Rooms, Shanghai, From July 1887 to July 1889," *North-China Herald*, July 20, 1889, pp. 85-86. On civil examination essay collections, see Elman, *A Cultural History*, pp. 400-20.

year during the spring and fall, in addition to the quarterly arrangement already in place. Fryer noted that when Li Hongzhang's extra theme for the first half of 1889 was issued, thirty essays were forwarded to him for ranking. Li's list of the names of the twenty-seven successful writers, and the extra awards of $204 given them, together with his personal criticisms, were published in the local Chinese papers."[22]

4. Literati Participation 士人的參與

Literati who sent in essays for the competition between 1886 and 1893 were getting their information for the topics mainly from Jiangnan Arsenal translations, materials prepared at the Beijing School of Foreign Languages 北京同文館, and articles on the sciences that had appeared in *The Chinese Scientific and Industrial Magazine*, *The Beijing Magazine*, as well as the *Shanghae Serial* 六合叢談. The popularity of the "Answers to readers' queries" in *The Beijing Magazine* and "Letters to the editors" in *The Chinese Scientific and Industrial Magazine* also indicates the popularity these journals had elicited among literati in and outside the treaty ports, although the real boom in reprinting such publications came after the Sino-Japanese War.

Following these pioneering compilations, other compendia on the sciences were also widely available. Compiled from 1877 to 1903, they reprinted many science works from the Jiangnan Arsenal Translation Department and from Fryer's "Science Outline Series" 格致須知. Literati found out about these new compilations via book advertisements in the emerging Western and modern Chinese press and the catalogs of Western books mentioned earlier. Advertisements in the 1897 issues of the *Shanghai Journal*, for instance, included mention of

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[22] The essays were collected by Wang Tao 王韜 and published in Shanghai in 1897 under the title of *Gezhi keyi huibian* 格致課藝彙編. Wang Ermin 王爾敏, *Shanghai Gezhi Shuyuan zhilue* 上海格致書院志略 (Hong Kong: Zhongwen daxue chuban she, 1980), pp. 54-55, presents a list of officials involved.

new works on chemistry, and public affairs that aimed at the civil examination market. Candidates were told in one advertisement that a particular book on Western history was absolutely essential for success on the policy essays required in the civil examinations.[23]

The essay competition was enthusiastically received, and many of the essays were printed in newspapers and also included in reformist encyclopedias such as the *Collected Writings on Political Economy from the August* [*Qing*] *Dynasty* (*Huangchao jingji wenbian* 皇朝經濟文編). In a "Table Showing the Results of the Chinese Prize Essay Scheme," Fryer indicated that he received an average of forty-eight essays for each of the 15 contests. Nineteen essayists (39.5 %) received prizes. Based on the figures for 42 contests held between 1886 and 1893, in which 2,236 candidates presented essays, an average of 46.1% were awarded prizes. Overall, about 53 candidates sent in essays for each contest.[24]

Seventeen Chinese officials presented a total of eighty-six questions, with several presenting questions a number of different times:[25]

Gong Zhaoyuan 龔照瑗	4 times	4 questions
Li Hongzhang	5 times	15 questions
Liu Kunyi	3 times	7 questions
Sheng Xuanhuai 盛宣懷	6 times	6 questions
Wu Yinsun 吳引孫	6 times	12 questions
Xue Fucheng 薛福成	3 times	3 questions

[23] The lead article "The Progress of Foreign Studies" in the *North-China Herald*, April 14, 1893, pp. 513-14, described some sources for answering the questions. See also Shang Zhicong 尚智叢, "1886-1894 nianjian jindai kexue zai wan Qing zhishi fenzi zhong de yingxiang – Shanghai Gezhi shuyuan Gezhi lei keyi fenxi" 1886-1894 年間近代科學在晚清知識分子中的影響—上海格致書院格致類課藝分析, *Qingshi yanjiu* 清史研究 3 (August 2001): 73, 82n6.

[24] Fryer," Second Report," p. 86. Fryer presented figures through spring 1889, and I have updated these to include contests through 1893.

[25] Xiong Yuezhi 熊月之, *Xixue dongjian yu wan Qing shehui* 西學東漸與晚清社會 (Shanghai: Renmin chuban she, 1994), pp. 385-386.

Altogether 1,878 Chinese submitted essays over the nine years of the competition. Among the ninety-two essayists who were honored (4.9 %), several produced five or more essays that were awarded prizes:

Yang Minhui 楊毓煇	Licentiate	14 essays
Li Dingyi 李鼎頤	2nd class provincial	7 essays
Xu Keqin 許克勤	Supplementary student	7 essays
Wang Zuocai 王佐才	Senior tribute student	6 essays
Yin Zhilu 殷之輅	Polytechnic graduate	6 essays
Li Jingbang 李經邦	2nd class provincial	6 essays
Zhong Tianwei 鍾天緯	Expectant official	5 essays
Ye Han 鍾天緯	County purchase	5 essays[26]

Despite such success and patronage, Fryer was still troubled by the small number of essays Chinese sent in for the extra spring 1889 competition: "The fact that only thirty essayists dared to tackle all three subjects is an evidence of the general ignorance of the literati on everything outside the ordinary curriculum of Chinese study; while at the same time it shows how effectively this prize essay scheme is doing its work." Fryer also saw some limits in the sorts of questions that other officials such as the Shanghai circuit intendant or governor-general in Nanjing prepared: "[A]lthough their questions relate, perhaps, more to political economy and commerce than to the severer branches of science, it is still gratifying to see how patriotic they

[26] Xiong Yuezhi, *Xixue dongjian*, pp. 387-391. Compare Shang Zhicong, "1886-1894 nianjian jindai kexue zai wan Qing zhishi fenzi zhong de yingxiang," p. 81, and Wang Ermin, *Shanghai Gezhi Shuyuan zhilue*, pp. 69-72.

are, and how they regard knowledge from the practical, utilitarian point of view, rather than from the theoretical alone."[27]

In time, the Shanghai Polytechnic prize essays themselves, discussed below, became sources of information, as indicated by the publication of the *Compendium of Prize Essays on Science* (*Gezhi keyi huibian* 格致課藝彙編) in 1897 and the *Shanghai Polytechnic Prize Essay Competition* (*Gezhi shuyuan keyi* 格致書院課藝) again in 1898. Key bibliographies of Western Learning were also compiled in the 1890s such as *Books on Eastern and Western Learning* (*Dong Xixue shulu* 東西學書錄), when published in 1899 praised *The Chinese Scientific and Industrial Magazine* published by the Polytechnic's for introducing the sciences to a generation of literati since the 1870s.

These essay competitions impacted as model essays on the reformed 1901-1904 civil examinations, which were promulgated after the Boxer Rebellion and required all candidates to be knowledgeable of the new fields in the sciences and world affairs. Often, candidates who had prepared essays for the Polytechnic Prize Essay Competition, such as Zhong Tianwei 鍾天緯 (1840-1900), went on to take the reformed civil examinations. In addition, many of the policy questions used in the reformed civil examinations were derived from the topics chosen by officials such as Li Hongzhang for the essay competition. Although the civil examinations were abrogated in 1904, these scientific texts and science topics remained important educationally in the textbooks required in the new schools (*xuetang* 學堂) formed after 1905.[28]

Hence, from the 1880s to the end of the Qing dynasty, a significant increase in numbers of literati, such as Du Yaquan 杜亞泉 (1873-1933), who were educated in the modern sciences

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[27] Fryer, "Second Report of the Chinese Prize Essay Scheme," p. 85.
[28] Wang Ermin, *Shanghai Gezhi Shuyuan zhilue*, pp. 69-72.

in this period. In 1911, Du became the editor of *Eastern Miscellany* (*Dongfang zazhi* 東方雜誌), a scholarly journal published by Commercial Press 商務印書館, one of the leading textbook publishers in Shanghai, but he had gained his knowledge of science at the end of the nineteenth century and first served as a science educator in Zhejiang province before taking charge of the science publications section of the Press in 1904. The growth of scholar-officials conversant with science, which accompanied the growth of thousands of technicians, engineers, and artisans in the empire-wide arsenals, began in the 1880s and 1890s--before the Sino-Japanese War.[29]

5. Prize Essay Topics and Their Scientific Content 課藝的考題及其內容的科學性

Between 1886 and 1894, 46 prize essay contests were held on Western learning. A total of 92 essay topics were selected by the Polytechnic and Qing officials. Of these, 33 (36%) dealt with political economy and industry (*fuqiang* 富強). The sciences (*gezhixue* 格致學) were next with 24 topics (26%). Fryer noted the importance of the latter in his first report for 1886 and 1887. For example, Zhong Tianwei, an expectant appointee to be a magistrate's aide in Guangdong province from Huating, Jiangsu, prepared an essay for Li Hongzhang's spring 1889 "Extra Theme" on native and Western science. Parts of his answer, presented below, were written following the exact parallelism of an 8-legged civil examination essay:

> With regard to the sciences, China and the West are different.
>
> 格致之學，中西不同。
>
> Speaking of it from the angle of what is above form,

[29] *Zhongwai shiwu cewen leibian dacheng* 中外時務策問類編 (1903 edition), 16.1a-b (essay prepared by Zhong Tianwei), 18.2b-3a (civil examination question taken from Xu Xingtai's 許星臺 spring 1887 Polytechnic essay competition topic). See also Elman, "Naval Warfare and the Refraction of Qing Nineteenth Century Industrial Reforms into Failure," *Modern Asian Studies* 38, 2 (2003): 283-326.

自形而上者言之，

then earlier literati scholars clarified everything leaving nothing out.

則中國先儒闡發已無餘韻。

Speaking of it from the angle of what is below form,

自形而下者言之，

then the new principles of the West daily emerge without end.

則泰西新理方且日出不窮。

It is likely that China has emphasized the Way while undervaluing the arts.
蓋中國重道而輕藝，

Therefore, Chinese science solely prioritized meaning and principles as important.

故其格致專以義理為重。

The West has emphasized the arts and undervalued the Way.

西國重藝而輕道，

Therefore, Western science has focused more on the principles of things

故其格致偏於物理為多。

This is why China and the West have diverged.

此中西之所由分也。[30]

In another spring 1889 essay prepared for Li Hongzhang's "Extra Theme" on the development of Western science since Aristotle, Wang Zuocai, a student at Shanghai Polytechnic, argued:

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[30] See GZSYKY, Vol. 1, 1889, p. 20b. The essay is cited from another edition in Xiong Yuezhi, *Xixue dongjian*, pp. 371-372. See also Elman, *A Cultural History*, pp. 389-99, for stylistic examples of the 8-legged essay.

> Therefore, Master Zhu [Xi 朱熹] appended a chapter to the [Great Learning 大學] commentary . . . , but what was elucidated was a form of science [*gezhi* 格致] that stressed meanings and principles and not the *gezhi* that emphasized the principles of things. China has stressed the Way and undervalued the arts. Anything to do with statutes and institutions, or rituals and music for moral edification and civilizing, were always stressed without leaving anything undone. If a sage were to reappear, he would have nothing to add. Only the makeup of the principle of things, which have examinable forms, have been discarded.
>
> 故朱子補傳一章……然所釋者，乃義理之格致，而非物理之格致也。中國重道輕藝，凡綱常法度、禮樂教化，無不闡發精微，不留餘蘊，雖聖人復起，亦不能有加。惟物理之精粗,誠有相形見絀者。[31]

This perspective stressed that since the Greeks the West had focused on things themselves as objects of analysis in contrast to the political, moral, and institutional focus of classical scholars in imperial China.

6. Medical Questions as Prize Essay Topics 課藝考題中的醫學題目

Since Dr. Benjamin Hobson's (合信, 1816-1873) pioneering translations of nineteenth century Western medicine in the 1850s, the anatomical and surgical strengths of Western medicine, when compared to the therapeutic efficacy of traditional Chinese medicine, were increasingly noted. The missionary vocation that informed Hobson's work and that of his successors had focused on medical education and missionary hospitals. For example, the English

[31] See GZSYKY, Vol. 1, 1889, p. 6b, which is also cited from another version in Xiong Yuezhi, *Xixue dongjian*, p. 371.

missionary and physician John Dudgeon (德貞, 1837-1901) introduced courses in anatomy and physiology at the School of Foreign Languages in Beijing in 1872. Dudgeon also published a six volume work in Chinese on anatomy, which the Qing government subsidized in 1887. A companion volume on physiology also came out.[32]

Between 1874 and 1905, the number of professional medical missionaries had risen from 10 to some 300. In 1876, there were 40 missionary hospitals and dispensaries treating 41,281 patients. Three decades later, there were approximately two million treated annually in 250 mission hospitals and dispensaries. Dr. John G. Kerr (嘉約翰, 1824-1890), who was associated with the American Presbyterian Mission, took over Peter Parker's (伯駕, 1804-1888) Guangzhou hospital, and supervised the treatment of over a million patients during his half century of service to his Cantonese patients.

Other large missionary hospitals were established in Hangzhou and Tianjin. The latter was endowed by Li Hongzhang's wife to repay Dr. John K. Mackenzie 馬根濟 for saving her life. In addition, a generation of Chinese trained as modern physicians also emerged after 1870. Many, such as Sun Yat-sen 孫中山 (1866-1925), were trained in missionary hospitals in China or Hong Kong. By 1897, there were about 300 Chinese doctors who had graduated from missionary medical schools, with another 250-300 then in training. Many more, fully trained native assistants made up the staffs of most such hospitals and dispensaries.[33]

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[32] See Su Jing 蘇精, *Qingji Tongwen guan ji qi shisheng* 清季同文館及其師生 (Taibei: Shanghai yinshua chang, 1985), pp. 252-255. See also Ting-yee Kuo and Kwang-Ching Liu, "Self-Strengthening: the pursuit of Western technology," pp. 531-532, and Bridie Andrews, "Tailoring Tradition: The Impact of Modern Medicine on Traditional Chinese Medicine," in Viviane Alleton and Alexeï Volkov, eds., *Notions et Perceptions du Changement en Chine* (Paris: Collège de France, Institut des Hautes Études Chinoises, 1994), p. 152.

[33] See Paul Cohen, "Christian Missions and Their Impact to 1900," in Denis Twitchett and John Fairbank, eds., *Cambridge History of China*, Volume 10, *Late Ch'ing, 1800-1911*, Part 1

Several Chinese revolutionaries studied Western medicine early in their careers. Sun Yat-sen, for example, was a member of the first graduating class of the Hong Kong College of Medicine in 1892. Both Guo Moruo 郭沫若 (1892-1978) and Lu Xun had traveled to Japan to study modern medicine, and Guo completed his premedical and medical courses there. Lu Xun turned to literature after viewing depressing news reels of the Russo-Japanese War fought on Chinese soil, but he described his youthful zeal for Western medicine as a reaction against the "unwitting or deliberate charlatans" who posed as traditional Chinese physicians. Lu also gleaned from existing translations that the Japanese revival had been based in part on the "introduction of Western medical science to Japan."[34]

Not yet triumphant until the twentieth century, Western medicine still faced a sizeable opposition among traditional Chinese physicians in the late Qing, although many Chinese had joined Xu Shou in his critique of the conceptual weaknesses in Chinese medical theories. Moreover, the Western anatomy of blood vessels and the nervous system were gradually more integrated by traditional Chinese physicians. Accordingly, when the Polytechnic included medical topics for the Prize Essay Contest, the rout of traditional medicine was not yet on.[35]

In spring 1891, for instance, the topic chosen dealt with the medieval traditions of *materia medica* 本草 that had linked particular foods to human health. This query was directed at "students who researched the principles of things" (*wuli* 物理). Moreover, it was framed in light

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(Cambridge: Cambridge University Press, 1978), pp. 574-575.

[34] Bridie Andrews, "Medical Lives and the Odyssey of Western Medicine in Early Twentieth-Century China," paper presented at the History of Science Society Annual Meeting, San Diego, CA, November 8, 1997. See also Lu Xun, *Selected Works of Lu Hsun*, translated by Yang Hsien-yi and Gladys Yang (Beijing: Foreign Languages Press, 1956), p. 2, and Howard Boorman and Richard Howard, eds., *Biographical Dictionary of Republican China* (New York: Columbia University Press, 1967), pp. 170-189. Compare Elman, "Wang Kuo-wei and Lu Hsun: The Early Years," *Monumenta Serica*, 34 (1979-80): 389-401.

[35] Bridie Andrews, "Tailoring Tradition," pp. 152-153.

of Ji Kang's 稽康 (233-262) medieval advocacy of medical and spiritual techniques for "nourishing life" 養生論, which informed many late Ming encyclopedias.

The prize essays appealed to the methods for investigating things that had informed medieval lexicographies 訓詁 such as the Jin 晉 (265-419) scholar Yang Quan's 楊泉 *On the Principles of Things* (*Wuli lun* 物理論) and Zhang Hua's 張華 (232-300) *Treatise on Broad Learning of Things* (*Bowu zhi* 博物志). In addition, the essays engaged in a comparative pharmacopoeia that related Chinese and Western foods. Most importantly, however, the essays pointed to the strength of modern chemistry to elucidate the alchemical findings of medieval masters of *esoterica* 方士學. Citing William Martin's (丁韙良, 1827-1916) *Elements of Natural Philosophy and Chemistry* (*Gewu rumen* 格物入門), one essay noted that native traditions for "nourishing life" could be complemented by Western chemistry to get a better sense of the efficacy of *materia medica* in China. When Wang Tao added his comments for the published version, he agreed that medieval *esoterica* had paralleled Western chemistry in important ways.[36]

Similarly, when Liu Kunyi prepared an essay topic on medicine for the special fall 1892 Prize Essay Contest, he asked authors to address which medical tradition, Chinese or Western, was superior theoretically. The Zhejiang literatus Xu Keqin, who submitted seven prize essays, stressed the achievements of ancient Chinese physicians, especially Zhang Ji 張機 (150-219) , whose *Treatise on Cold Damage Disorders* 傷寒雜病論 had by early Ming times reached canonical status. Xu added that Western physicians emphasized the nervous system but they were unaware of the meridian system of twelve circulation tracts (*jingluo* 經絡) needed to understand the human body and its susceptibility to illness. In particular, Xu and the other essays

[36] GZSHKY, Vol. 2, 1891, p. 1b (topic), pp. 1a-17a (prize essays).

focused on the strength of "heat factor" 熱病 and "cold factor" 傷寒 therapies in Chinese medicine, while pointing to the dangers in the surgical techniques employed by Western physicians.[37]

In his prize essay for the summer 1893 contest, Xu Keqin again addressed a query by the Ningbo circuit intendent Wu Yinsun on the comparative strengths and weaknesses in Chinese and Western medicine. This time, however, the essayists were asked to demonstrate their knowledge of the history of Western medicine and its most famous physicians. Xu provided such a summary, but he still concluded that Chinese therapies were superior to the more invasive, i.e., surgical techniques, used in Western countries and now in China. He admitted, however, that each tradition had certain strengths that should be selected out and combined.

The 1893 prize essay on medicine by the Anhui literatus Li Jingbang 李經邦 pointed to the stress on the brain 腦 in Western medicine, but Li also noted the institutional importance of the Western hospital for the success of Western medicine. Li claimed that traditional medicine had also stressed the brain, but his apologetics were a transparent effort to apply the still prominent claim of the "Chinese origins of Western learning" (*Xixue Zhongyuan* 西學中源 to medical studies.

Li claimed, for example, that during the Roman empire Westerners had come to China and that they had taken back copies of the *Basic Questions* (*Suwen* 素問) part of the *Inner Canon of the Yellow Emperor* (*Huangdi neijing* 黃帝內經), among other canonical medical texts. Over time, Western medicine had built on these Chinese texts to produce new findings drawn from chemistry. Such traditionalistic claims were increasingly suspect by 1900 as more Chinese were

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[37] GZSHKY, Vol. 2, 1892, pp. 3a-b (topic), pp. 4b-6b, 33b-34b (prize essays). See also Shang Zhicong, "1886-1894 nianjian jindai kexue zai wan Qing zhishi fenzi zhong de yingxiang," p. 81.

trained as modern physicians. Moreover, Li placed the blame for the decline of Chinese medicine on its recent practitioners, who had failed to live up to the comprehensive understanding that the ancient physicians had achieved.

Yang Minhui's prize essay for the summer 1893 medicine theme betrayed the fact that Western medicine was increasingly respected in official and popular circles and feared by native physicians. Yang tackled this change by appealing to the theoretical superiority of traditional medical principles while at the same time admitting the advantages of Western medical practices. Western knowledge of electricity and chemistry, according to Yang, were two areas that when applied therapeutically superseded native medicine. Altogether Yang presented ten areas in which Western medicine was superior but only four for native medicine. To salvage the strengths in Chinese medical principles, Yang proposed that a "great medium" (*dazhong* 大中) could be achieved if ancient principles were informed by the new medical procedures from the West.[38]

After Wang Tao's death and Fryer's departure for Berkeley University, the essay contests were not as enthusiastically promoted, although they were still held regularly, sometimes monthly, sometimes quarterly in 1901, 1904, 1906, and 1907. The Sino-Japanese War heightened the disjunction between events before the war and those after. In particular, many of the events from 1865 to 1894 leading up to the establishment of modern science in late imperial China were replaced by the public attention that reformers, iconoclasts, and revolutionaries received after 1895. Their generation was designated as the decisive one, and not those who had been part of the Protestant era or the arsenals and schools associated with the dispersed foreign affairs movement.

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[38] GZSHKY, Vol. 2, 1893, p. 2a (topic), pp. 4a-9b (prize essays).

One example of this displacement of pre-1894 literati efforts to master Western learning and modern science was the meteoric rise of Yan Fu as a public figure. His reputation vis-à-vis his predecessors as an iconoclast and the pioneer translator of Spencer and introducer of Darwin's theories replaced his earlier career as a graduate of the Fuzhou Navy Yard and naval school teacher and administrator. This spotlight on Yan Fu after 1895 has overlooked the historical events in the rise of modern science and Western learning in China before the Sino-Japanese War.

Similarly, Liang Qichao overlooked "the explosion of the newspaper market" after 1850 in his own self-serving accounts of the heroic emergence of a new and critical journalism in late nineteenth century China. In the process, Yan and others such as Tan Sitong, Liang Qichao, and Kang Youwei who rose to prominence after the war have received the credit for many of the contributions that Li Shanlan, Hua Hengfang, Wang Tao, and others had already made in breaking new intellectual ground in the 1870s and 1880s. Both Tan Sitong and Kang Youwei as publicists appropriated science to legitimate their millennial visions but understood very little of science on its own terms.[39]

7. *Leishu* as Late Qing Sources of Knowledge about Science

What is interesting about the China Prize Essay Contest is that it used the prestige of the imperial civil service examinations to aid missionary efforts to promote modern science during the late Qing, which created a working partnership between Western translators and Qing high

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[39] See *North-China Herald*, January 29, 1902, p. 180, September 22, 1905, pp. 697-98, January 25, 1907, p. 202, February 21, 1908, pp. 418-19. See also Xiong Yuezhi, *Xixue dongjian*, p. 373, and Chen Liwei 陳力衛, "Meiji shoki ni okeru Kan yakusho no shūyō" 明治初期における漢譯書の受容, *Tōhōgaku* 東方學 99 (2000): 54-57. Compare Natascha Vittinghoff, "Unity Vs. Uniformity: Liang Qichao and the Invention of a 'New Journalism' for China," *Late Imperial China* 23, 1 (June 2002): 91-143.

officials, particularly those in provinces with treaty ports. At the same time, those who were drawn to scholarly and technical work in the new industrial arsenals after the Taiping Rebellion in Fuzhou, Shanghai, and elsewhere, or to translation positions in the official Foreign Language Schools in Beijing, Shanghai, and Guangdong, tended to be somewhat marginal literati. They often had failed the more prestigious civil examinations several times and saw Western learning and the sciences as an alternative route to fame and fortune.

Until the 1894-95 Sino-Japanese War , missionaries in China generally remained sanguine about the civil examinations. Thereafter, China's naval defeats contributed to the transformation of official, elite, and popular perceptions of the Self-Strengthening era. New public opinions appeared in the Chinese and missionary press that shaped the emerging national identity and sense of crisis among Han Chinese, who increasingly opposed the Manchu regime in power. Disappointment with the military losses convinced many Chinese that the Foreign Affairs Movement 洋務運動 had failed and that more radical political, educational, and cultural changes were required to follow Japan's lead in modernizing and coping with foreign imperialism.

The Sino-Japanese War provoked a striking switch in Protestant confidence about the future of Qing China. An account of the Chinese defeat prepared by one of the leading Protestant missionaries and translators in Beijing, Young J. Allen (林樂知, 1836-1907), when translated into Chinese, was frequently pirated, for example, and became required reading for the 1896 Hunan provincial examination in Changsha and was included in many *leishu* of the time. Allen's account of the defeat outlined his views of needed reforms in China. In the essay, Allen traced China's backwardness to three root causes: 1) superstition (*mixin* 迷信) ; 2) opium 鴉片 ; and 3) civil examinations 科舉. In this series, he also stressed the importance of science (*gezhi* 格致) as a corrective for the causes of China's backwardness.

Native studies, according to Allen, had failed to grasp the universal lessons of modern science. In particular, China's assimilation of Western science was missing the importance of the "study of the principles of things" (*wuli zhi xue* 物理之學), or what in the late 1890s would increasingly be called "physics" based on Japanese translations of Western scientific texts. Moreover, Allen used "superstition" as a modern cultural category to pigeon hole the entire Chinese classical tradition, a reduction that would become de rigueur among many Chinese radicals in the twentieth century.[40]

Similarly, before his departure for California to take up the chair of Oriental Languages at Berkeley College 柏克萊大學, which he had been offered in 1895, John Fryer publicly announced a competition for "new-age novels" (*xin xiaoshuo* 新小說) in Chinese that would enhance the morals of China and eviscerate the triple evils of opium, stereotypical examination essays, and footbinding. This appeal for a new literature written in "easy and clear language with meaningful implications and graceful style" attracted the interest of Liang Qichao and other reformers who would provide the foundations for the call for a new culture in China, which was premised on the failure of traditional Chinese civilization symbolized by the bound feet of Chinese women.[41]

Like the Protestant missionaries, Chinese literati also attacked the civil examinations and footbinding after 1895. The race to establish Chinese institutions of higher learning that would stress modern science accelerated after the occupation of the capital by Western and Japanese troops in 1900. The Boxer popular rebellion in north China and the response of the Western powers and Japan to it unbalanced the power structure in the capital so much that foreigners were

[40] The essay is abridged in *Wan'guo gongbao wenxuan* 萬國公報文選, edited by Qian Zhongshu 錢鍾書 and Zhu Weizheng 朱維錚 (Beijing: Sanlian shudian, 1998), pp. 179-201.
[41] Patrick Hanan, "The Missionary Novels of Nineteenth-Century China," *Harvard Journal of Asiatic Studies* 60, 2 (December 2000): 440-441.

able to put considerable pressure on provincial and metropolitan leaders such as Li Hongzhang. Foreign support of reform and Western education thus strengthened the political fortunes of provincial reformers such as Yuan Shikai 袁世凱 (1859-1916) and Zhang Zhidong 張之洞, who had opposed the Boxers.[42]

In 1902 the first civil examinations since enactment of the reforms took place in Kaifeng 開封, the capital of Henan province. Because the provincial examination halls in Shuntian 順天科場, where the metropolitan examinations in Beijing had also been held, had been burned down by the foreign troops sent in to relieve the Boxer siege of the international legations, the metropolitan examination could not be held in Beijing. The 1902 examination reforms failed in the short run to accomplish their goals because of the tenacity of the examiners; nevertheless the overall scope of the examinations became decidedly more institutional and international in focus.[43] A catalog of policy questions used in the examinations after the reforms, which was compiled in 1903, identified thirty-two knowledge categories that were used:[44]

1. Way of ordering 治道
2. Scholarship 學術
3. Domestic government 內政
4. Foreign relations 外交
5. Current affairs 時事
6. Civil examinations 科舉
7. Schools 學校
8. Official institutions 官制
9. Assemblies 議院
10. State organization 政體
11. Public laws 公治
12. Penal laws 刑律
17. Mathematics 算學
18. Sciences (I) 格致 (上)
19. "" (II) 格致 (下)
20. State finance 財政
21. Monetary system 布制
22. Military system (I) -軍政 (上)
23. "" (II) 軍政 (下)
24. Defense matters 防務
25. Agriculture system (I) 農政 (上)
26. "" (II) 農政 (下)
27. Public works 工政
28. Commercial system 商政

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[42] Elman, *A Cultural History*, pp. 608-618.
[43] For the impact on family schools, see Guo Moruo 郭沫若, *Guo Moruo xuanji* 選集 (Chengdu: Sichuan People's Press, 1979), p. 38.
[44] See *Zhongwai shiwu cewen leibian dacheng*, *mulu* 目錄 (Table of contents), pp. 1a-28b.

13. Education affairs 教務
14. Astronomy 天文
15. Geography 地理
16. Calendrical studies 曆算
29. Roads & mines 路礦
30. Topography 輿地
31. History 史學
32. Foreign history 外史

The earlier questions that Li Hongzhang and his Qing colleagues prepared also influenced the reformed civil examinations initiated after 1900 as part of the "New Governance" (*Xinzheng* 新政) policies initiated in the last decade of the Qing dynasty.[45] The revamping of the civil examinations held empire-wide for some 150 thousand provincial candidates meant that science questions were now regularly introduced under the category of science (*gezhixue* 格致). For example, five of the eight post-1900 essay topics on the natural sciences were phrased as follows:

1. Much of European science originates from China; we need to stress what became a lost learning as the basis for wealth and power. 歐洲格致多源出中國，宜精研絕學以爲富強基策。
2. In the sciences, China and the West are different; use Chinese learning to critique Western learning. 格致之學中西異同，以中學駁西學策。
3. Substantiate in detail the theory that Western methods all originate from China. 問西法悉本中國，能詳徹其說否。
4. Prove in detail that Western science studies mainly were based on the theories of China's pre-Han masters. 問西人格致之學多本于中國諸子之說，試詳證之。

[45] See GZSYKY, Vol. 1, 1887-90, Vol. 2, 1891-93. Compare Xiong Yuezhi, *Xixue dongjian*, p. 374n3 and Shang Zhicong, "1886-1894 nianjian jindai kexue," pp. 79-80, with Wang Ermin, *Shanghai Gezhi Shuyuan*, pp. 56-68.

5. Itemize and demonstrate using scholia that theories from the Mohist Canon preceded Western theories of calendrical studies, optics, and mechanics. 墨子經上及說上已啓西人所言曆學、光學、重學之理。其條舉疏證以聞。[46]

Such questions and their answers revealed that in official terms, the wedding between the traditional Chinese sciences and Western science was still in effect among imperial examiners.

Beginning with the first civil examinations since the enactment of the post-Boxer reforms in 1902, many of the essays in the Shanghai Polytechnic Prize Essay Contest became model essays for the required science policy questions. Xu Xingtai's 許星臺 spring, 1887, theme comparing the sciences of China and the West, and Nie Jigui's 聶緝槼 spring, 1894, question on locating the Western principles of calendrical studies, optics, and mechanics in the ancient text of *Master Mo's Teachings* (*Mozi* 墨子) became a model policy question that Qing examiners might use for civil examination policy questions between 1902 and 1903.

The Polytechnic's Prize Essay topics on medicine also influenced the science questions that official examiners used in the reformed civil examinations after 1901. Essays from both the 1891 Polytechnic query on the medieval *materia medica* and the 1892 theme of "which medical tradition was superior theoretically" 中西醫理孰長 were presented as model policy essays for the civil examinations. Moreover both the Shandong licentiate Sun Weixin's 孫維新 1891 prize essay on the *materia medica* and Li Jingbang's 1893 essay on the history of Western medicine were included verbatim as model essays in a 1903 collection of "New Governance" era policy questions and answers. More significantly, medicine was now regarded officially as one of the

[46] See *Zhongwai shiwu cewen leibian dacheng*, "Mulu," pp. 13a-b.

modern natural sciences, whereas before the nineteenth century it had been considered an unofficial part of the investigation of things and extension of knowledge (*gezhi* 格致).[47]

The Polytechnic's prize essays thus give us a unique vantage point from which to evaluate the more common understanding of modern science among Qing literati. The 92 questions prepared by eighteen Qing officials for the Polytechnic's forty-six regular and special essay competitions from 1886 to 1894 provide a better overall frame of reference. Moreover, these questions became the object of attention for the compilers of late Qing encyclopedias who hoped that students would welcome compendia like theirs that would help them answer such questions.[48]

After the civil examinations were abrogated in 1904, the Qing dynasty quickly lost control of its science policies, which increasingly fell under the control of local Chinese intelligentsia and overseas students. What should be added, however, is that the radical reforms in favor of new schools allowed the sciences to develop independently of the political system for the first time. Via new school-based national examinations, the Manchu court tried in vain to maintain control over the delegitimated remnants of the older examination constituencies while at the same time gain control over education in the new schools. The Qing dynasty never reestablished its control of the provincial and local educational systems, which it had irrevocably lost in 1905. Power shifted to the new schools and more importantly to the Han Chinese gentry constituencies they served.

In this rapid parade of events, the 1886-1893 Chinese Prize Essay Contest was quickly discarded as a failed experiment and ultimately forgotten. I would suggest, however, that the

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[47] *Zhongwai shiwu cewen leibien dacheng*, *mulu*, pp. 14a-b, 19.15a-22b, especially 18b-20b.
[48] Ibid. For discussion of the civil examination reforms of 1901-02, see Elman, *A Cultural History of Civil Examinations*, pp. 594-602. See also Xiong, *Xixue dongjian*, pp. 362-363.

second half of the nineteenth century was the seeding time for modern science in China. During the period from 1850 to 1895, many works on astronomy, mathematics, medicine and related fields of botany, geography, geology, mechanics, and navigation were translated by a core group of Protestant missionaries and Chinese co-workers in Guangzhou, Beijing and Shanghai. The essay contest helped to popularize the new knowledge contained in those translations by employing a traditional vehicle to valorize that knowledge. The Sino-Japanese War made such efforts appear still-born, but had the Chinese won that war, such efforts to spread the new sciences through traditional institutional forms might have been legitimated and expanded. Most of these new translations found their way into the numerous compendia 叢書, journals 學報, and encyclopedias 類書 that were published in China after 1875.[49]

By going outside the orthodox curriculum of the civil service examination, those newly educated in the sciences inhabited the unprecedented arsenals, shipyards, and factories that offered engineering and mathematical training. The regional leaders of the foreign affairs movement emphasized technical expertise in engineering and mechanics and specialized knowledge of the modern sciences. Eventually, thousands of administrative experts, translators, and advisors--including hundreds of foreigners--served in provincial schools and arsenals under the chief provincial ministers of the late Qing. Chinese regional and provincial elites were the tip of an iceberg, the leaders of the post-Taiping turn toward foreign studies focusing on science and industry. Literati associated with statecraft and evidential studies after the Taiping Rebellion legitimated literati study of natural studies and mathematics within the framework of Chinese studies.[50]

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[49] Biggerstaff, "Shanghai Polytechnic Institution and Reading Room," p. 127. See also Elman, "Naval Warfare," pp. 283-326.

[50] Kwang-ching Liu, "Nineteenth-Century China," in Ping-ti Ho and Tang Tsou, eds., *China in*

In the late Qing, new types of *leishu* developed for these new literati constituencies. Owing to the steady expansion of modern typesetting and lithographic printing, as well as literacy and the continuing proliferation of an already bookish print culture, encyclopedias reached a much wider readership than ever before. On the one hand, these new types of *leishu* covered a wider range of knowledge that included Western learning. On the other hand, they represented a form of revisionist classicism that appropriated modern science as the "investigation of things." Ironically, late Qing encyclopedias drew on earlier publications that were initially conceived of as compendia providing information for an essay-writing contest that mimicked the infamous Chinese civil service examinations. We should continue to reassess the wide variety of such *leishu*, which were published as modern repositories of Western, historical, institutional, medical, and technical knowledge in a time of dynastic collapse and socio-political transition.

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