Rethinking the Twentieth Century Denigration of Traditional Chinese Science and Medicine in the Twenty-first Century

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Abstract:

Western scholars and westernized Chinese scholars have often essentialized the European history of science as the universalist progress of knowledge. When Chinese studies of the natural world, her rich medieval traditions of alchemy, or pre-Jesuit mathematical and astronomical achievements are discussed, they are usually treated dismissively to contrast them with the triumphant objectivity and rationality of the modern sciences in Western Europe and the United States. Many twentieth century scholars were rightly convinced that pre-modern China had no industrial revolution and had never produced capitalism. As the evidence of a rich tradition of natural studies and medicine has accrued in volume after unrelenting volume of Joseph Needham's *Science and Civilisation in China* project after 1954, it has become harder and harder to gainsay it all as superstition or irrationality or inductive luck. Ironically, the long-term history of Western science has been decisively refracted when viewed through the lenses chronicling the demise of traditional Chinese natural studies, technology, and medicine. Study of pre-modern Chinese science, technology, and medicine has restored a measure of respect to traditional Chinese natural studies and thereby granted priority to research in areas where the received wisdom was suspect, based as it was on careless speculation about banal generalities. Scholars now build on those contributions to search beneath the surface of self-satisfied discourses about "Western science" and the self-serving appeals to Greek deductive logic upon which they were rhetorically based.

The beginnings of the "failure narrative" for Chinese science, i.e., why China of her own had not produced science or technology, has paralleled the story of political decline (why no democracy?) and economic deterioration (why no capitalism?) during the late empires of Ming (1368-1644) and Qing (1644-1911). During the twentieth century, the traditional Chinese sciences were increasingly seen as incompatible with the universal findings of "Western science." As part of a complex historical process that began in the late nineteenth century, the denigration of traditional Chinese natural studies and medicine became a prerequisite among iconoclasts and revolutionaries for the institutional formation of modern science and medicine based on Western models that were decisively mediated by Japan.[1]

The Late Qing Stress on the Chinese Origins of Western Learning 西學 中源

Until 1900, however, some cultural conservatives such as Tang Caichang 唐才 常(1867-1900) confidently argued that Zhu Xi 朱熹 (1130-200) had already enunciated many of the principles of Western science in Song times through his advocacy of the investigation of things (*gewu* 格 物). Similarly, Zheng Guanying 鄭 觀 應 (1842-1923) contended that the investigation of things section of the Great Learning (*Daxue* 大學) had been lost in antiquity and yielded empty scholarship thereafter. Another popular position among late Qing classical scholars was to appeal to the origins of Western science in the practical and seemingly proto-scientific teachings of the Warring States philosopher Mo Di 墨 翟. Appeals to the *Master Mo's Teachings* (*Mozi* 墨 子), became an important feature of the late Qing claim that Western

[1] James Reardon-Anderson, *The Study of Change: Chemistry in China, 1840-1949* (Cambridge: Cambridge University Press, 1991), pp. 76-78. For background, see Nathan Sivin, "Science and Medicine in Chinese History," in Paul Ropp, ed., *Heritage of China: Contemporary Perspectives on Chinese Civilization*. Berkeley: University of California Press, 1990, pp. 164-196.

learning was derived from ancient China ever since Cantonese scholars such as Zou Boqi 鄒伯奇 (1819-1869) and others had revived interest in the long forgotten Mo Di in academies such as the Sea of Learning Hall (*Xuehai tang* 學海堂) in Guangzhou.[2]

The distinguished Cantonese classicist Chen Li 陳澧 (1810-1882), whose teaching career at the Sea of Learning Academy influenced many local students, including Liang Qichao 梁啓超 (1873-1929) and Kang Youwei 康有爲 (1858-1927), linked the empiricism associated with "searching truth from facts" (*shishi qiushi* 實事求是) to the "investigation of things," and affirmed the Han Learning critique of Cheng-Zhu 程朱 learning. Chen also contended that the split between the classic and commentary of the Great Learning that Zhu Xi had introduced was unnecessary. Nevertheless, Chen Li concluded that Zhu Xi had gotten the meaning of the investigation of things essentially right. Later, Chen Li equated the "investigation of things" (格物) with concrete affairs (*shishi* 事實 = "facts") and identified the "extension of knowledge" (*zhizhi* 致知) with the search for truth (*qiushi* 求是).[3]

Even liberal critics accepted the late Qing distinction that was drawn between Zhu Xi's positivism and Wang Yangming's 王陽明 (1472-1528) idealism. Yan Fu's 嚴復 (1853-1921) criticism of Wang Yangming's view of the investigation of things (*gewu*), for example, also allowed him to place Zhu Xi's agenda for investigating things and extending knowledge (*gezhi* 格致) in a more positive light. In this period, Chinese scholars increasingly employed Wang Yangming as a foil to explain the Chinese failure to develop a positivist attitude more amenable

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[2] Tang Caichang, "Zhuzi yulei yiyou Xiren gezhi zhi li tiaozheng" 朱子語類已有西人格致之理條, in *Tang Caichang ji* 唐才常集 (Beijing: Zhonghua shuju), 1980, pp. 172-76. Compare David Reynolds, "Redrawing China's Intellectual Map: Images of Science in Nineteenth-Century China," *Late Imperial China* 12, 1 (June 1991): 47-48, and Elman, *From Philosophy to Philology: Social and Intellectual Aspects of Change in Late Imperial China* (2nd edition. Los Angeles: Asia Pacific Monograph Series, 1999), pp. 99, 112-113.

[3] Chen Li, *Dongshu dushu ji* 東塾讀書集 (Taipei, Commercial Press, 1970), 9.14.

to scientific discovery. In the 1890s, classically trained scholars like Yan reassessed the classical tradition for investigating things and where it went wrong.[4]

Some like Liu Shipei 劉 師 培 (1884-1919) and Zhang Binglin 章炳 麟 (1868-1936) preferred Later Han glosses for the investigation of things, which had been canonical, they contended, until the Song when Zhu Xi revised the Great Learning and placed it within the Four Books 四書 . Both Li and Zhang were critical of Zhu Xi for straying from original version of the Great Learning in the *Record of Rites* 禮 記. A more positivistic interpretation had emerged, according to Liu, when the Jesuits brought Western learning 西學 to China in the late Ming, but because the Yongzheng 雍正 emperor had limited the impact of such new trends in mathematics and algebra 借 根 方, Zhu Xi's views had remained pervasive. Their views reveal how classical themes pro or contra Zhu Xi and Wang Yangming could be appropriated by intellectual radicals in the late Qing.[5]

Wang Renjun ¤ý 仁 俊 and the *Ancient Subtleties of Science* 格 致古微

Wang Renjun 王 仁 俊 (1866-1914), an 1890s partisan of Zhang Zhidong (1837-1909), brought the late Qing "Chinese origins" position to scholarly completion. After arriving in Shanghai in 1897, he edited the reformist journal known as the *Journal of Concrete Learning* (*Shixue bao* 實學 報). Since the Sino-Japanese War, he had also worked on the *Ancient Subtleties of Science* (*Gezhi guwei* 格 致古微), which followed the traditional "four

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[4] Wang Hui, "The Fate of 'Mr. Science' in China: The Concept of Science and Its Application in Modern Chinese Thought," *positions: east asia cultures critique* 3, 1 (spring 1995): 21-23. Mark Elvin's *The Structure of the Chinese Past* (Stanford: Stanford University Press, 1975), pp. 203-234, draws on this stock view of Wang Yangming's idealism.

[5] See Liu Shipei 劉 師 培, "Gewu jie" 格 物解, in *Zuo'an waiji* 左盦外 集 in *Liu Shenshu xiansheng yishu* 劉 申 叔先 生遺 書 (4 vols. Taibei: Daxin shuju, 1965), Vol. 3, 1.23b-24b, in *Liu Shenshu xiansheng yishu*, Vol. 3. See also Zhang Binglin 章炳 麟, "Zhizhi gewu zhengyi" 致知 格 物正 義, in *Zhang Taiyan quanji* 章太 炎全 集 (Shanghai: Renmin chuban she, 1982), Vol. 5, pp. 60-62. For discussion, see Elman, *From Philosophy*, pp. 18-23.

classifications" 四部 for citing native works in natural studies. Another was the *Record of the Essence of Science* (*Gezhi jinghua lu* 格 致精華 錄), which represented a revised version of the *Ancient Subtleties* 格 致古微 and was rearranged according to Western categories for the sciences. Neither was entirely unprecedented, and each drew on earlier works which had been included in the *Qing Exegesis of the Classics* (皇 清 經解).[6]

As early as 1870, Liu Yueyun 劉 嶽 雲 (1849-1917) had prepared materials for his encyclopedic *Chinese Methods for the Investigation of Things* (*Gewu Zhongfa* 格 物中 法, i.e., science), which was completed in its final form in 1899 but not printed in Beijing until after the Boxer uprising 頤 和 園 in 1900. Although more complete in comparative scope and Western content than Wang Renjun's *Ancient Subtleties*, the late printing of the *Chinese Methods* limited its influence at a time when the conservative agenda was in complete disarray.

The "Chinese origins of Western learning" and Zhang Zhidong's "substance and function" 體 用dichotomy were also implicit in Wang Renjun's *Ancient Subtleties*. The two claims worked as complements in legitimating Western learning as a balance for Chinese learning. Wang stressed the importance of science in the creation of a strong China, and rationalized this mastery by affirming the ancient foundations of Chinese learning. Within the "substance and function" dichotomy, both Chinese and Western learning were affirmed in the name of preserving China.[7]

Many could see that Wang's use of "Chinese origins" 西學 中 源 to legitimate Chinese natural studies was based on forced parallels with the specialized fields of Western science. Such obligatory appeals were in turn motivated chiefly by wishful thinking that ancient Chinese

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[6] Zeng Jianli 曾建 立, "Gezhi guwei yu wan Qing 'Xixue Zhongyuan' lun" 格 致古微與 晚清 西學 中 源說 *Zhongzhou xuekan* 中 州學 刊 6 (November 2000): 146-50.

[7] See Wang Renjun 王仁 俊, "Lueli" 略例, in *Gezhi guwei* 格 致古微 (Wuchang: Zhixuehui 質 學 會, 1897 edition), p. 2b. On the *tiyong* 體 用framework as a rationalization of Western learning, see Levenson, *Confucian China and Its Modern Fate: A Trilogy* (Berkeley: University of California Press, 1968), Vol. 1, pp. 59-78.

masters such as Master Mo or Zhu Xi had already enunciated the principles of modern science. These claims also indicated to those trained in the sciences in China or abroad that Wang had a weak grasp of modern science as a field of technical knowledge. Wang's emotionalist defense of Chinese learning as the basis for adopting Western science appeared to Yan Fu and others as an exercise in self-delusion.[8]

A more sweeping approach to science was the product, which was tied to a more radical political agenda by literati disenchanted by the dynasty's failures in wars with France and Japan. No longer could the imperial court speak for the literati as a whole as they had in the late eighteenth century. Domestic public opinion tied to better educated Chinese literati who had worked with the Protestant missionaries could see through the "Chinese origins" schema and declared it intellectually bankrupt. By the time of the May 4th period, circa 1919, the claim that China was the source for Western learning provided proof that late Qing scholars had failed to grasp the essentials of modern science. What was plausible during the Kangxi reign no longer carried as much conviction during the late Qing.[9]

Chinese Learning 中學 Versus Western Learning 西學 Mediated Through Meiji 明治 Japan

Since 1865, literati inside and outside the bureaucracy had distinguished between "Chinese learning" (*Zhongxue* 中學), which represented the whole of native learning, from Western studies (*Xixue* 西學), within which science was prioritized. Neither term was successful as a monolithic designation, but each was politically charged in the 1890s when they were used by conservatives and radicals as a "dominant binary" in the struggle for political

[8] See Zeng Jianli, "Gezhi guwei yu wan Qing 'Xixue Zhongyuan' lun," pp. 149-50.
[9] Wang Renjun, *Gezhi guwei*, 5.26b-40a. See also Quan Hansheng 全漢昇, "Qingmo de 'Xixue yuanchu Zhongguo' shuo" 清末的西學源出中國說 *Lingnan xuebao* 嶺南學報 4, 2 (June 1935): 89-91.

modernity. As Western learning gained momentum as a proper model for science and modern institutions, mediating terms for science such as investigating things and extending knowledge (*gezhixue* 格 致學) were discarded as concepts. Educational institutions that used such accommodations were considered old-fashioned.

The increasing numbers of overseas Chinese students in Japan, Europe, and the United States perceived that outside of China the proper language for modern science included a new set of universal concepts and terms that superseded traditionalist literati notions of "Chinese" natural studies. For example, Japanese scholars during the early Meiji period had demarcated the new sciences by referring to *wissenschaft* as science (*kagaku* 科學 , lit., "classified learning based on technical training") and natural studies as the "exhaustive study of the principles of things" (*kyûri*, *qiongli* 窮 理). The latter term, long associated with the classical stress on the "investigation of things" popular in early Tokugawa 德 川 Japan, was reinterpreted in Japan based on the Dutch Learning 蘭 學 tradition of the late eighteenth century, when Japanese scholars interested in Western science still used terms from Chinese learning (*Kangaku* 漢學) to assimilate European natural studies and medicine.[10]

As traditional accommodational terminology receded from use so too the multiple identity of science and technology as native and Western disappeared. "Modern science" now meant simply "Western science." When the Qing court launched its "New Governance" 新政 policies in 1901 however, this turn could not be described internally as a "Westernizing policy."

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[10] Albert Craig, "Science and Confucianism in Tokugawa Japan," in Marius Jansen, ed., *Changing Japanese Attitudes Toward Modernization* (Princeton: Princeton University Press, 1965), pp. 139-42. See also Numata Jirô, *Western Learning: A Short History of the Study Of Western Science In Early Modern Japan*, translated by R. C. J. Bachofner (Tokyo: The Japan-Netherlands Institute, 1992), pp. 60-95.

Just as the early Qing court had refused to call the Jesuit calendar "Western" 西曆 , so now the late Qing court also called its reform policies "new" rather than "Western" 西政.

Both Liang Qichao 梁啓 超 (1873-1929) and Zhang Zhidong changed the title of their earlier accounts of "Western learning" (*Xixue* 西學) to "new learning" (*xinxue* 新學) to follow suit. As in the late Ming, the binary opposition between native and European learning was transformed in favor of the dichotomy between "old" and "new" learning. Lacking the notion of "Chinese origins," however, such parallel moves left the Qing state and its conservative literati bereft of a rationale for compelling study of "ancient learning" 古學 as a complement for "Western learning." Native learning now was simply "ancient learning," with no ties to the new learning from the West.[11]

Science and the Reformers

Among the more "westernizing" literati elites who played important roles in the 1898 Reform Movement, a more assertive approach to modern science was enunciated. Many reform advocates believed that scientific knowledge was a prerequisite for economic productivity in both industry and agriculture. Kang Youwei, like many others, believed that the military successes of Meiji Japan served as a model for China. Expanded education in the sciences and industry were required.[12]

In his 1905 essay on industrialization, for instance, Kang Youwei emphasized that China like Japan needed to master Western forms of mining, industry, and commerce. Because machines were industrial inventions that had augmented the economic and military power of European states and enhanced the welfare of the people there, Kang contended that the Qing

[11] Wang Hui, "The Fate of 'Mr. Science' in China," pp. 1-68.)
[12] Kung-chuan Hsiao, *A Modern China and a New World: Kang Yu-wei, Reformer and Utopian, 1858-1927* (Seattle: University of Washington Press, 1975), pp. 328-346.

dynasty had to change its goals and educate the people in technology and not just build factories and arsenals based on foreign models. Often, Kang and the reformers demeaned the results that were achieved when the foreign affairs movement had promoted industrialization from 1865-1895.

In the post-1895 political environment, reformers claimed they were championing unprecedented policies. In fact their calls for science and industry built on the efforts of their predecessors. Where Kang Youwei et al. did break new ground was in their demand that traditional, subsistence agriculture was outdated and should be replaced by the mechanization of farming. A new industrial-commercial society was the goal. Kang's focus on the required educational transformation that would increase the numbers of those trained to industrialize China through science and technology was on target, however. By 1905, when the civil examinations were abrogated, most literati now faced a new world of career expectations that drew them away from the classical curriculum that had remained prestigious until 1900.[13]

In particular, Kang was influenced by late Qing translations of Western political economy. Kang was also influenced by the missionary Timothy Richard (1845-1919), who had more confidence in the Qing reform movement underway. In 1895, Richard had published an influential essay "New Policies" (*Xin zhengce* 新政 策), which had received as much attention as Young J. Allen's (1836-1907) account of the Chinese defeat by Japan. Richard also prepared a series of forward looking essays on policy matters, which the reformers published in Shanghai together under the title *Tracts for the Times* (*Shishi xinlun* 時 事 新論 , lit., New views of

[13] Elman, *A Cultural History of Civil Examinations in Late Imperial China* (Berkeley: University of California Press, 2000), pp. 585-594, 608-618.

contemporary affairs). Kang Youwei, and Liang Qichao consulted with Richard and drew on his essays for inspiration during the 1898 Reforms.[14]

Based on his limited understanding of modern science, Kang Youwei contended that primal *qi* 氣 was the creator of Heaven and earth. He also believed that *qi* was a sort of pervasive ether that lent spiritual form to both electricity and lightning. Similarly, Tan Sitong 譚 嗣同 (1865-1898) became an amateur mathematician and advocate of science when he established a mathematical academy in 1895, with the help of his teacher. A typical reformer, Tan believed that mathematics was the foundation for both science and technology. Tan also read both traditional and Western mathematical works and became interested in geometry and algebra. In his major published work, *Studies of Benevolence* (*Renxue* 仁學), for example, Tan relied on mathematics as an authority more than as a tool in his writings to reveal the unity of all learning. Moreover, like Kang Youwei, he regarded "ether" 以太 as the "element of elements."[15]

Tan was most impressed with a work on psychology by Henry Wood (1834-1909) entitled *Method of Avoiding Illness by Controlling the Mind* (*Zhixin mianbing fa* 治心免病法), which later informed Tan's stress on the dynamics of mental power in *Studies of Benevolence* as an example of the power of benevolence. There, Tan declared the axiom: "Ether and electricity are simply means whose names are borrowed to explain mental power." Tan's views of the "ether," however bizarre at first site, were drawn from trends in late nineteenth century physics

[14] Hsiao, *A Modern China and a New World*, pp. 306-307, 331-346. See also *Eminent Chinese of the Ch'ing Period*, Hummel, Arthur, ed. (Reprint. Taibei: Chengwen Bookstore, 1972), hereafter ECCP, pp. 703-704.

[15] Tan Sitong, "Xing suanxue yi" 興算學 議, in *Tan Sitong quanji* 譚 嗣同全集(2 vols. Beijing: Zhonghua shuju, 1981), pp. 153-194.

that seem equally bizarre from the standpoint of contemporary physics after 1905 when the nature of electromagnetic fields was better understood.[16]

During this period, a wave of translating Japanese mathematics texts also took hold, which proved to be a convenient shortcut to modern mathematics. The conversion to Western mathematics was also aided by the many Chinese students who returned from studies abroad, particularly from Japan after 1895. Over ten thousand Chinese traveled to Japan to study from 1902 to 1907. Some ninety percent of the foreign trained students who joined the Qing civil service after 1905, for instance, graduated from Japanese schools.[17]

Because civil examination credentials no longer confirmed gentry status after 1905, sons of gentry turned to other avenues of learning and careers outside officialdom. Du Yaquan 杜亞泉(1873-1933), Ding Wenjiang 丁文江(1887-1936), Cai Yuanpei 蔡元培(1868-1940) and others, quickly left behind the typical classical education of a literatus and increasingly traveled to treaty ports such as Shanghai or abroad to seek their fortunes as members of a new gentry-based Chinese intelligentsia that would be the seeds for modern Chinese intellectuals, scientists. doctors, and engineers. Yan Fu, whose poor prospects in the civil examinations led him to enter the School of Navigation of the Fuzhou Shipyard in 1866, associated the power of the West with modern schools where students were trained in modern subjects requiring practical training in the sciences and technology.

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[16] See Chan Sin-wai, trans., *An Exposition of Benevolence: The Jen-hsueh of T'an Ssu-t'ung* (Hong Kong: The Chinese University Press, 1984), pp. 10-20, and Richard Shek, "Some Western Influences on T'an Ssu-t'ung's Thought," in Paul Cohen and John Schrecker, eds., *Reform in Nineteenth-Century China* (Cambridge: Harvard University Research Center, 1976), pp. 200-201, 237.

[17] Paula Harrell*, Sowing the Seeds of Change: Chinese Students, Japanese Teachers, 1895-1905* (Stanford: Stanford University Press, 1992), p. 214, and Barry Keenan, "Beyond the Rising Sun: The Shift in the Chinese Movement to Study Abroad," in Laurence Thompson, ed., *Studia Asiatica* (San Francisco: Chinese Materials Center, 1975), pp. 157-169.

For Yan Fu and the post-1895 reformers, Western schools and Westernized Japanese education were examples that the Qing dynasty should emulate. The extension of mass schooling within a standardized classroom system stressing science courses and homogeneous or equalized groupings of students seemed to promise a way out of the quagmire of the imperial education and civil examination regime, whose educational efficiency was now, in the 1890s, suspect.[18]

Among those affected by the educational changes after 1898, Ren Hongjun 任鴻 雋 (1886-1961) would become one of the founders of the Science Society of China (*Zhongguo kexueshe* 中 國科學 社) in 1914. He had passed the last county civil examinations in 1904, and by 1907 he was a student in Shanghai where he met Hu Shi 胡適 (1891-1962). Ren then traveled to Japan in 1908 where in 1909 he entered the Higher Technical College of Tokyo as a student subsidized by the Qing government. The Qing dynasty had reached a 15-year agreement with the College to send 40 students annually to Tokyo.

While in Tokyo, Ren also joined Sun Yat-sen's early partisans in the Alliance Society (*Tongmenghui* 同盟 會) and rose to an important position in the Tokyo Sichuan branch. When he returned to China after the 1911 revolution, Ren served in Sun's provisional government, but he received a Qinghua 清 華 大學 University fellowship in 1912 to study chemistry at Cornell. Ren received his B.A. in chemistry from Cornell, where he studied from 1912 to 1916, and his M.A. in chemistry from Columbia in 1917, during which time he assumed a leading role in forming a Chinese science organization that would replace the old-style literary societies (see below).[19]

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[18] Marianne Bastid, *Educational Reform in Early 20th-Century China*, translated by Paul J. Bailey (Ann Arbor: University of Michigan China Center, 1988), pp. 12-13, and Y. C. Wang, *Chinese Intellectuals and the West, 1872-1949* (Chapel Hill: University of North Carolina Press, 1966), pp. 52-59. See also Elman, *A Cultural History*, pp. 585-594.

[19] Ferdinand Dagenais, "Organizing Science in Republican China (1914-1950), presented at the

Influence of Meiji Japan on Modern Science in China

In the late nineteenth century, an increasing familiarity with Western learning exposed the Chinese to the limits of traditional categories such as investigating things 格 物 for scientific terminology. Increasingly, the claim that Western learning derived from ancient China became unacceptable. Younger literati perceived in the revival of such traditionalistic positions after the Sino-Japanese War, the third stage of the "Chinese origins" 中 源 argument, a latent conservatism that obstructed the introduction of modern science and technology rather than facilitating it.

Hence, those students who studied abroad in Japan and the West after 1895 began to question the use of "investigating things and extending knowledge" (*gezhi*) as a traditional trope of learning to accommodate modern science. By 1903, state and private schools increasingly used the modern classifications of social science (*shehui kexue* 社 會科學), natural science (*ziran kexue* 自 然 科學), and applied science (*yingyong kexue* 應 用科學) as terminology for science, which were borrowed from Japanese translations.[20]

Accordingly, there was a decisive sea change from China-based terminology for science from the 1840s to Japan-based terminology from 1900 with the Sino-Japanese War as key point of change. From 1896 to 1910, Chinese translated science books from Japan that were based on Japan's own translations that were possible there because unlike the Chinese the Japanese no longer worked with foreigners to produce science translations. By 1905, when educational

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"Ideology and Science Symposium," Center for Chinese Studies, University of California, Berkeley, October 19, 2001. See also Douglas Reynolds, *China, 1898-1912: The Xinzheng Revolution and Japan* (Cambridge: Harvard University Press, 1993).

[20] Li Shuangbi 李 雙 璧, "Cong 'gexhi' dao 'kexue': Zhongguo jindai keji guan de yanbian guiji" 從 格 致到科學 : 中 國近代 科技 觀 的演變 軌跡, *Guizhou shehui kexue* 貴 州社 會 科學 137 (1995.5): 105-107.

reforms were introduced as the key to the "New Governance" policies of the Qing dynasty, the new Ministry of Education 學 部was staunchly in favor of science education and textbooks based on Japanese scientific system. Japan now became the mediator of West for Chinese literati and officials.[21]

After the Sino-Japanese War, reformers such as Kang Youwei and Zhang Zhidong encouraged Chinese students to study in Japan. Zhang's *A Plea for Learning* (*Quanxue pian* 勸學 篇), which was presented to the throne and then distributed widely, was particularly influential in this regard. Kang promoted Meiji Japan scholarship in his *Annotated Bibliography of Japanese Books* (*Riben shumu zhi* 日本書 名志) and in his reform memorials to the Guangxu 光緒emperor (r. 1875-1908). Kang recommended 339 works in medicine and 380 works in the sciences (*lixue* 理學). The Guangxu emperor's edict of 1898 encouraged study in Japan. By 1905, eight thousand Chinese were studying in Japan, and this number increased dramatically by 50% in 1906, before declining to four thousand by the end of the decade. Between 1900 and 1937, about 34,000 Chinese studied overseas in Japan.[22]

The failure of the 1898 reforms, which led to Tan Sitong's martyrdom and the flight of Kang Youwei and Liang Qichao to Japan, did not prevent the mediation of science in China via Japan. Luo Zhenyu 羅振玉 (1866-1940), for example, published the *Agricultural Journal* (*Nongxue bao* 農學 報) from 1897 to 1906 in 315 issues. He also compiled the *Collectanea of Agricultural Studies* (*Nongxue congshu* 農學 叢 書) in 88 works with 48 based on Japanese

[21] Wang Yangzong 王揚宗 , "1850 niandai zhi 1910 nian Zhongguo yu Riben zhi jian kexue shuji de jiaoliu shulue" 1850年代 至1910年中國與日本之間科學 書 籍 的交 流 述略, *Tôzai gakujutsu kenkyûjo kiyô* 東西學 術研究所 紀 要(Kansai University) 33 (March 2000): 139-144.

[22] Wang Yangzong, "1850 niandai zhi 1910 nian Zhongguo yu Riben," pp. 144-145. See also ECCP, p. 30. Compare Douglas Reynolds, *China, 1898-1912: The Xinzheng Revolution and Japan* (Cambridge: Harvard University Press, 1993), pp. 48, 58-61, and Keenan, "Beyond the Rising Sun," p. 157.

books. Du Yaquan edited journals in 1900 and 1901 that translated science materials from Japanese journals. These were the first science journals edited solely by a Chinese. The 1904 translation in Shanghai of a Japanese encyclopedia contained over 100 works with 28 in the sciences and 19 in applied science.

Post-Boxer educational reforms of 1902-1904 were decisive in the transformation of education in favor of Japanese-style science and technology. The last bastion of modern science as "Chinese science" (*gezhi* 格 致) remained the civil examinations, where the "Chinese origins" 中 源 approach to Western learning remained obligatory. After the examination system was abolished in 1904, Japanese science texts finally became model for Chinese education at all levels of schooling. In 1886-1901, for instance, Japan officially approved eleven different texts on physics. Eight of those produced after 1897 were translated for Chinese editions. In 1902-1911, 22 different physics texts were approved in Japan , and seven were translated into Chinese.

Similarly, in chemistry from 1902 to 1911, 71 Japanese texts were translated into Chinese. Most were produced for middle schools and teacher's colleges. Twelve middle school chemistry texts were produced in Japan between 1886 and 1901. Of these, six were translated into Chinese. Eighteen Japanese middle school chemistry textbooks were produced between 1902 and 1911. Five were translated into Chinese. Japanese scientists were also invited to lecture in China. More technical physics and chemistry works were also translated from the Japanese. Iimori Teizô's 飯盛挺 造 (1851-1916) edited volume on *Physics* (*Wulixue*; *Butsurigaku* 物理學), which was completed in Chinese at the Jiangnan Arsenal from 1900-1903. Iimori's influence on Chinese physics grew out of this project.[23]

[23] Wang Yangzong, "1850 niandai zhi 1910 nian Zhongguo yu Riben," p. 146-147. See also Xiaoping Cong: "Localizing the Global, Nationalizing the Local: The Role of Teacher's Schools in Making China Modern" (Los Angeles: UCLA Ph.D. dissertation in History, 2001).

Updated Sino-Japanese dictionaries such as the 1903 *New Progress Toward Elegance* (*Xin Erya* 新爾雅), which modernized ancient lexicographies (訓詁學), were also compiled. By 1907, the use of Japanese scientific terms was formally approved by Yan Fu when he was in charge of the Ministry of Education 學部 committee for science textbooks. During the last decade of the Qing dynasty, the terminology in science journals in China shifted dramatically away from the Protestant terminology associated with investigating things and extending knowledge (*gezhixue* 格致學) to Japanese terms in science texts such as: *World of Science* (*Kexue shijie* 科學世界,1903-04); *First Level in Science* (*Kexue yiban* 科學一斑, 1907); *Science Journal* (*Lixue zazhi* 理學雜誌, 1906-07); and *Science* (*Kexue* 科學, 1908-10).

The historical importance of Japanese translations for the development of modern science in China should not be underrated. Japanese translations were much more widely available in China than those produced earlier by the Jiangnan Arsenal had been. In addition, the new Japanese science textbooks contained newer content than the 1880s Arsenal and missionary translations, which were already outdated by European standards in the 1890s. The introduction of post-1900 science via Japan, which included new developments in chemistry and physics, went well beyond what Fryer et al. had provided to the emerging Chinese scientific community.

Changes in the classical language used to make the translations more easily understood also helped produce a new literary form for presentation of the sciences that contributed to the rise of the vernacular for modern Chinese scholarly and public discourse. The new texts translated from Japanese made modern science available to a wider audience and raised the level of knowledge among students and teachers. Among urbanites, especially in Beijing and Shanghai, the first decade of the twentieth century provided the basic education in modern

science via Japanese textbooks for the generation that matured from the New Culture Movement 新文化 運動 of 1915 to the May 4th generation of 1919 五四運動.[24]

The Institutional Formation of Modern Science in Republican China

Many university and overseas students were by 1915 as radical in their political and cultural views, which carried over to their convictions about science. Traditional natural studies became part of the "failed" history of traditional China to become "modern" 從前進到落後, and this view now included the assertion that the Chinese had never produced any science. The earlier claim for the "Chinese origins" of Western science 西學 中源, so prominent until 1900, was now deemed superstition (*mixin* 密信). Both "modernists" and "socialists" in China accepted the West as the universal starting place of all science, which was diametrically opposed to Chinese superstitions.[25]

After 1911, some scientists such as Ren Hongjun linked the necessity for Chinese political revolution to the claim that a scientific revolution was also mandatory. Those Chinese who thought a revolution in knowledge based on universal Western learning was required not only challenged classical learning, or what they now called "Confucianism" (*Kongjiao* 孔教), but they also unstitched the patterns of traditional Chinese natural studies and medicine long accepted as components of imperial orthodoxy.[26]

Chinese students educated abroad at Western universities such as Cornell University or sponsored by the Rockefeller Foundation after 1914 for medical study in the United States, as

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[24] Wang Yangzong, "1850 niandai zhi 1910 nian Zhongguo yu Riben," pp. 147-150.
[25] Compare Hildred Geertz,"An Anthropology of Religion and Magic, I," *Journal of Interdisciplinary History* 6, 1 (Summer 1975): 71-89. She notes: "It is not the 'decline' of the practice of magic that cries for explanation, but the emergence and rise of the label 'magic.'"
[26] See Elman, "The Formation of '"Dao Learning"' as Imperial Ideology During the Early Ming Dynasty," in T. Huters, R. Bin Wong, and P. Yu, eds., *Culture and the State in Chinese History*, (Stanford: Stanford University Press, 1997), pp. 58-82.

well as those trained in the sciences locally at higher-level missionary schools and the new universities, regarded modern science in light of the Japanese appropriation of Western science (*kexue* 科學), and not investigating things and extending knowledge (*gezhixue* 格 致學). They believed the latter term was derived from the language of the discredited, "Chinese" past and inappropriate for universal, modern science.

The belief that Western science represented a universal application of scientific methods and objective learning to all modern problems was increasingly articulated in the journals associated with the New Culture Movement. The journal *Science* (*Kexue* 科學), which was created by the newly founded Science Society of China 中國科學 社 in 1914, assumed that an educational system based on modern science was the panacea for all of China's ills because its universal knowledge system was superior.[27]

Patterned after the journal *Science* published by American Association for the Advancement of Science, the first issue of the Chinese version included an article on why China lacked science. Ren Hongjun, who pioneered the promotion of modern science in China, helped organize the Society at Cornell in 1914 and became its first president from 1914 to 1923. Later he served two more terms as president in 1934-1936, and 1947-1950. He contended that China had failed to develop the research methodology of modern science.[28]

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[27] Ferdinand Dagenais, "Organizing Science in Republican China," pp. 1-31.

[28] Yang Cuihua (Tsui-hua) 楊翠 華 , "Ren Hongjun yu Zhongguo jindai de kexue sixiang yu shiye" 任 鴻 雋與 中 國近代 的科 學 思想與 事 業, *Jindai shi yanjiu suo jikan* 近代 史 研 究所 季 刊 (Academia Sinica, Taiwan) 24 (June 1995). Compare Howard Boorman and Richard Howard, eds., *Biographical Dictionary of Republican China* (New York: Columbia University Press, 1967), Vol. 1, pp. 219-222.

The Science Society of China

When the Science Society was founded, the choice of the Japanese term for modern science (*kexue* 科學) for the society and its journal represented a break with tradition and was seen as transcending the limits of the past focus on the investigation of things and the "Chinese origins" 中 源 claim. Too(1873-1933 often, however, the notion that Chinese scientists shared the iconoclasm of their intellectual peers after the 1911 Revolution has been exaggerated. Many of the members of the Science Society, once it moved to China, were not in favor of the cultural iconoclasm associated with the New Culture or the May 4th movements. As cultural reformers, many scientists actually favored a blending of modern science with traditional values. Many scientists, unlike revolutionaries who championed science such as Chen Duxiu 陳獨 秀(1880-1939), were traditionalistic in their impulses.[29]

Although Ren et al. may not have intended to equate science with traditional learning, they were referring to late Ming and early Qing trends toward empiricism and practical learning that they found amenable with modern science. Like Hu Shi, they at times equated the spirit of critical inquiry found in Qing evidential studies 考證 學 with the methodology of modern science. In the same way, the scientist Ding Wenjiang often appealed to the travel diary of the late Ming adventurer Xu Xiake 徐 霞 客 (Hongzu 宏祖, 1586-1641) as a model and precedent for his own intellectual pursuits in geology.[30]

Hu Shi 胡適 published an article in 1921 that presented the scholarly methodology of Qing dynasty textual scholars as a Chinese precedent for contemporary scientific research. The

[29] David Reynolds, "The Advancement of Knowledge and the Enrichment of Life: The Science Society of China and the Understanding of Science in the Early Republic" (Madison: University of Wisconsin Ph.D. dissertation in History, 1986), pp. 15, 107, 116-117, 294, 300-301. See also Teng and Fairbank, *China's Response to the West*, pp. 244-246.
[30] Compare Reynolds, "The Advancement of Knowledge," pp. 84, 124, 147. See also ECCP, pp. 314-315.

English version of this essay was reworked in 1962 when it was published under the title "The Scientific Spirit and Method in Chinese Philosophy." The essay in Chinese was followed in 1922 by the publication in Shanghai of Hu's 1917 Columbia University dissertation entitled *The Development of the Logical Method in Ancient China*.[31]

An uncritical faith in science, i.e., "scientism" 科學 主義, on the part of some Chinese scientists trained abroad, many from Cornell, did influence other intellectuals such as Chen Duxiu, who argued in the issues of the journal *New Youth* (*Xin 'qingnian* 新青 年), which he helped found in 1915, that science and democracy were the twin universal pillars of a modern China that must dethrone the Chinese imperial past. In the process, post-imperial scholars and novelists such as Ba Jin 巴 金(Li Feigan 李 芾甘; b. 1904) in his 1931 novel *Family* 家 , for example, initiated an assault on pre-modern Daoism 道 教 and traditional medicine 中 醫 as a haven of superstition and backwardness.

Although many iconoclasts such as Hu Shi moderated their views after the first world war, they remained public advocate s of the West and saw modern science as the universal model. When China conformed with that model, as with aspects of Qing evidential studies 考 證 學 , Hu Shi and others praised China; when it didn't, then China had to change. Despite their rhetorical appeal to the empirical tradition for the investigation of things, the scientists who joined the Science Society were reading the presuppositions of modern science from Bacon to Newton into a popular slogan from traditional learning. Ren Hongjun maintained that the goal of

[31] Hu Shi 胡適 , "Qingdai xuezhe de zhixue fangfa" 清 代 學 者 的治學 方法 , in *Hushi wencun* 胡適 文存 (4 vols. Taibei: Yuandong dashu gongsi, 1968), Vol. 1, pp. pp. 383–412. See also Hu, "The Scientific Spirit and Method in Chinese Philosophy," in Charles A. Moore, ed., *The Chinese Mind (*Honolulu: University of Hawai'i Press, 1967), pp. 199-222.

science was to open up the secrets of nature by investigating things and extending knowledge (*gezhi* 格 致), which depended on the search for truth (*shishi qiushi* 實事 求 是).[32]

Peter Buck has described the role of Cornell University and American science in influencing the members of the Chinese Science Society, particularly their confidence about the proper relations between science and society and the value of the scientific method for educational, intellectual, and cultural enlightenment. The Rockefeller Foundation simultaneously sponsored the professionalization of American medicine in China by building a leading medical center for research and teaching in Beijing. The medical center attempted to raise the prestige of modern medicine in China by linking it with laboratory research in the 1920s.[33]

Nathan Sivin has noted that the scientism the Chinese imbibed in America fared very poorly when the returned students faced a Republican China in an era of rampant warlordism from 1915 to 1927. The refraction of American scientific values in the Chinese context could not replicate the social and scientific changes in late nineteenth and early twentieth century America. Moreover, the American myth that the scientific method could be used to justify social change was tempered in China by the many more Chinese scientists, physicians, and engineers who were trained in Japan than in the United States.[34]

From 1900 until 1937, when the second Sino-Japanese War commenced, some 34 thousand Chinese had studied in Japan, while up to 1953 only about 20 thousand trained in the United States. Science and state power were indelibly linked in Japan and China. Few of the

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[32] Compare Jia Sheng, "The Origins of the Science Society of China, 1914-1937" (Ithaca: Cornell University Ph.D. dissertation in History, 1995).
[33] See Peter Buck, *American Science & Modern China* (Cambridge Univ. Press, 1980), pp. 171-85, and D. W. Y. Kwok, *Scientism in Chinese Thought, 1900-1950* (New Haven: Yale University Press, 1965), *passim*.
[34] See the Sivin review of Buck, *American Science & Modern China*, in *Journal of Asian Studies*, 1981, p. 231.

returned scientists from Japan entertained the sort of scientism that the iconoclasts trained in the United States envisioned.[35]

At its inception in 1915, the Science Society of China had only 115 members on three continents. By 1920, the Society had some 500 members in China alone. It grew to 1,000 members in 1930 and reached 1,500 by 1935. There was a comparable increase in the number of publications associated with the new fields science from 1920 to 1930. Initially, the Society's journal promoted the research of its founders: Zhao Yuanren 趙元任 (b. 1892; mathematics, physics, and psychology); Hu Da 胡達 (1891-1927, physics and mathematics); Bing Zhi 秉志 (1886-1965, biology and agricultural science); as well as Jin Bangzheng (b. 1887, forestry), president of Qinghua University from 1920 to 1922. Altogether the twelve issues in the first volume ran to almost 1,400 pages. Approximately 1,000 copies were printed of each issue, which appeared monthly from 1915 to 1940, occasionally from 1940 to 1946, and again monthly until 1950, for a total of 32 volumes.[36]

In March 1917, Beijing University under the leadership of Cai Yuanpei began contributing a monthly subsidy. When the Society received additional funds from the China Foundation after 1926 to supplement its income from subscriptions, its activities included: 1) publishing the Society's journal, transactions, monographs, and memoirs; 2) maintaining a library that had 37 thousand volumes by 1929; 3) operating a biological laboratory in Nanjing from 1922; 4) promoting science education through public lectures, standardizing terminology, and participation in international scientific congresses. Boxer indemnity funds that we returned to China were also used to support the Science Society. From 1930, the Society also served as the Bureau of Scientific Information for the Nanjing government.

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[35] See Barry Keenan, "Beyond the Rising Sun," pp. 157-169.
[36] Dagenais, "Organizing Science in Republican China," p. 25a. See also Reynolds, pp. 152 ff.

Thereafter, many other scientific societies were formed in China between 1915 and 1927:

- National Medical Association: 1915 in Beijing.
- The Geological Society of China: 1922 in Beijing.
- The Wissen and Wissenschaft Society: founded in 1916 by Chinese students in Tokyo.
- The Société Astronomique de Chine: 1922 in Beijing.
- The Chinese Meteorological Society: 1924 in Qingdao.
- The Chinese Chemical Industry Society: 1922 in Beijing.
- Academia Sinica: 1927 in Nanjing.
- Chinese Engineering Society and Engineer's Society: 1912 in Beijing.

Several non-missionary foreign societies were also founded in China:

- The Anatomical and Anthropological Association of China: 1920 in Beijing.
- The China Society of Science and the Arts: 1923 in Shanghai.
- Shanghai Chemical Society: 1922.
- Peking Natural History Society: 1925.[37]

Modern Medicine in China

Traditional Chinese medicine 中醫, which was the strongest field of the Chinese sciences during the transition from the late Qing to the Republican era, 1895-1911, was also derided by those trained in modern, Western medicine, although it was more successful in retaining its prestige than Chinese astrology 天文, geomancy 風水, and alchemy, which were dismissed by modern scholars as purely superstitious forms of knowledge. Chinese scholars

[37] See Lin Mousheng, *A Guide to Chinese Learned Societies* (New York, 1936), and Reynolds, pp. 312-314.

increasingly called for a cosmopolitan synthesis of Western experimental procedures with traditional Chinese medicine.

Chinese physicians, however, remained very large in numbers and very influential despite the inroads of missionary physicians, Western hospitals, and the success of anatomy in mapping the internal venues for bodily illnesses. Coexisting for several decades since 1850, Western-style doctors and Chinese physicians had remarked upon the limitations in each other's theories of illness and therapeutic practices, but for the most part each was practiced in its own institutional matrix of care-giving traditions. Moreover, until the "miracle drugs" were discovered and anesthesiology was introduced early in the twentieth century, the curative power of Western medicine, especially surgery, remained problematic when compared to the non-invasive pharmacopoeia traditions of Chinese physicians.[38]

One of the new aspects of the "New Governance" 新政 policies after 1901 was the increasing involvement of the Qing state in policing public health. Unlike the Song dynasties 宋代 , when the government had created local medical bureaus to deal with epidemics, state involvement in local health issues since the late Ming had markedly diminished Local elites filled the vacuum by making charitable contributions to deal with health emergencies at a time when literati also took an increased interest in medical knowledge. Late Qing public heath policies signified a decisive break with this long-term secular decline of dynastic interference in local affairs since the middle of the Ming dynasty, a devolution that had allowed medical issues to become the prerogative of local gentry and Chinese literati-physicians.[39]

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[38] Yili Wu, "Transmitted Secrets: The Doctors of the Lower Yangzi Region and Popular Gynecology in Late Imperial China" (Yale University Ph.D. dissertation in History, 1998), passim.

[39] Angela Leung, "Medical Learning from the Song to the Ming," in Paul Smith and Richard von Glahn, eds., *The Song-Yuan-Ming Transition in Chinese History* (Cambridge: Harvard Asian

The late Qing government increasingly saw its role in more statist terms. Using Germany as a model, which Meiji Japan had also emulated, the New Governance courses of action encouraged the Qing government to carry out new disease control methods such as quarantine and isolation hospitals to deal with epidemics caused by infectious diseases. During the Ming and Qing, when local physicians had faced southern epidemics they associated with "heat factor" (*rebing* 熱 病) causes, the state was minimally involved in dealing with illnesses when they broke out. The emergence of the modern Chinese state during the Qing-Republican transition was increasingly tied to the extension of Western medicine and the appropriation of Western models for government run public health systems.[40]

One by-product of the expansion of state involvement in public health, however, was that the state was now drawn into the contest between Western-style physicians and traditional Chinese doctors who organized into separate medical associations. Hence, the modernizing state was progressively tied to Western medical theories and institutions, while Western-style doctors controlled the new Ministry of Public Health 衛 生部. When the Guomindang-sponsored Health Commission proposed to abolish traditional Chinese medicine (*Zhongyi* 中 醫) in February 1929, however, traditional Chinese doctors immediately responded by calling for a national convention in Shanghai on March 17, 1929, which was supported by a strike of pharmacies and surgeries nationwide on that day. The protest succeeded in having the proposed abolition withdrawn, and the Institute for National Medicine (*Guoyi guan* 國醫 館) was

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Center Monograph, 2003), pp. 374-398.

[40] Carol Benedict, "Policing the Sick: Plague and the Origins of State Medicine in Late Imperial China," *Late Imperial China* 14, 2 (December 1993): 60-77, and Ruth Rogaski, "From Protecting Life to Defending the Nation: Emergence of Public Health in Tianjin" (New Haven: Yale University Ph.D. dissertation in History, 1996).

subsequently established. One of its objectives, however, was to reform Chinese medicine along Western lines.[41]

The consequences of increased state involvement in Chinese medical policy after 1901 were significant for both Western and Chinese medicine. After 1929, two parallel institutions, one Western and one Chinese, emerged in the political and educational frameworks that the government established to monitor both public health and medical instruction. This dichotomy between Western and traditional Chinese medicine became de rigueur throughout the twentieth century under both the Guomindang Republic 中華 民 國and the Communist People's Republic 中華 人 民 共和 國. The bifurcation also entailed the modernization of traditional Chinese medicine, or what Bridie Andrews has called the "re-invention" of Chinese medicine in the early decades of the century. [42]

The influence of Western medicine in early Republican China presented a substantial challenge to traditional Chinese doctors. The practice of Western medicine in China was assimilated by individual Chinese doctors in a number of different ways. Some defended traditional Chinese medicine, but they sought to update it with Western findings. Others tried to equate Chinese practices with Western knowledge and equalized their statuses as medical learning. The sinicization of Western pharmacy by Zhang Xichun 張錫純 (1860-1933), for example, was based on the rich tradition of pharmacopoeia in the Chinese medical tradition.

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[41] See Bridie Andrews, "Tailoring Tradition: The Impact of Modern Medicine on Traditional Chinese Medicine 1887-1937" (Cambridge University Ph.D. dissertation in History and Philosophy of Science, 1996), and Hsiang-lin Lei, "When Chinese Medicine Encountered the State: 1910-1949" (Chicago: University of Chicago Ph.D. dissertation in Humanities, 1999), pp. 1-24. See also Bridie Andrews, "Tuberculosis and the Assimilation of Germ Theory in China, 1895-1937," *Journal of the History of Medicine and Allied Sciences* 52, 1 (1997): 142-43.

[42] See Ralph Crozier, *Traditional Medicine in Modern China: Science, Nationalism, and the Tensions of Cultural Change* (Cambridge, MA: Harvard University Press, 1968), pp. 151-209. Compare Bridie Andrews, "Traditional Chinese Medicine as Invented Tradition," *Bulletin of the British Association for Chinese Studies* 6 (1995): 6-15.

Another influential group associated with the Chinese Medical Association, which stressed Western medicine, criticized traditional Chinese medical theories as erroneous because they were not scientifically based.[43]

In this cultural encounter, techniques such as acupuncture were modernized by Chinese practitioners such as Cheng Dan'an 承 澹盦 (1899-1957), whose research on acupuncture enabled him to follow Japanese reforms by using Western anatomy to redefine the location of the acupuncture points. Cheng's redefinitions of acupuncture thus revived what had become from his perspective a moribund field that was rarely practiced in China and, when used, mainly served as a procedure for "primitive" blood-letting. In this manner, acupuncture survived mainly as an artisanal procedure among the populace, but the Imperial Medical Academy (*Taiyi yuan* 太 醫院) had banned it in court, along with moxibustion, since 1822.

This Western reform of acupuncture, which included replacing traditional coarse needles with the filiform metal needles in use today, ensured that the body points for inserting needles were no longer placed near major blood vessels. Instead, Cheng Dan'an associated the points with the Western mapping of the nervous system. A new "scientific acupuncture" sponsored by Chinese research societies emerged, which presented a better map of the human body that would enhance diagnosis of its vital and dynamic aspects.[44]

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[43] Andrews, "Tuberculosis and the Assimilation of Germ Theory in China, 1895-1937," pp. 114-57, and her "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.

[44] Andrews, "Tailoring Tradition: The Impact of Modern Medicine on Traditional Chinese Medicine," pp. 154-155, 158-59. For other fields, see Laurence Schneider, "Genetics in Republican China," in J. Bowers, J. Hess, & N. Sivin, eds., *Science and Medicine in Twentieth-Century China: Research and Education*, pp. 3-29, and Yang Tsui-hua, "The Development of Geology in Republican China, 1912-1937," in Lin Cheng-hung & Fu Daiwie, eds., *Philosophy & Conceptual History of Science in Taiwan* (Dordrecht: Kluwer Academic Publishers, 1993), pp. 221-44.

The Legacy of the 1923 "Debate on Science and Philosophy of Life"

After 1915, the teleology of a universal and progressive "science" first invented in Europe replaced the Chinese notion that Western natural studies had their origins in ancient China 西學 中源. The dismantling 博物學 of the traditions of natural studies (*gezhixue* 格致學) and natural history (*bowuxue*), among many other categories, which had linked the pre-modern sciences and medicine to classical learning from 1370 to 1905 climaxed during the New Culture Movement. Through their opposition to classical learning and its traditions of natural studies, New Culture advocates helped replace the imperial tradition of natural studies with modern science and medicine.[45]

As elites turned to Western studies and modern science, fewer remained to continue the traditions of classical learning (Han Learning 漢學) or Cheng-Zhu moral philosophy (程朱理學 , increasingly called "Neo-Confucianism" 新儒學 in the twentieth century) that had been the basis for imperial orthodoxy and literati status before 1900. Thereafter, the "traditional Chinese sciences" 格致學 , classical studies 經學 , "Confucianism" 儒學 , and "Neo-Confucianism" survived as vestigial native learning 絕學 in the public schools 學堂 established by the Ministry of Education after 1905. They have endured as contested scholarly fields taught in the vernacular in universities since 1911.[46]

Even the protagonists of Chinese moral philosophy involved in the 1923 "Debate on Science and Philosophy of Life" (*Kexue yu rensheng guan* 科學與人生觀), which will be our final topic, accepted the West as the repository of universal scientific knowledge. They

[45] See Min-chih Maynard Chou, "Science and Value in May Fourth China: The Case of Hu Shih" (University of Michigan Ph.D. dissertation in History, 1974), pp. 23-35, and James R. Pusey, *China and Charles Darwin* (Cambridge: Harvard University Press, 1983), *passim*.
[46] Elman, *A Cultural History of Civil Examinations*, pp. 608-625.

sought to complement such knowledge of nature with Chinese moral and philosophical purpose. Both Western scholars and Westernized Chinese scholars and scientists essentialized European natural studies into a universalist ideal. Until Joseph Needham, when Chinese studies of the natural world, her rich medieval traditions of alchemy and medicine, or pre-Jesuit mathematical and astronomical achievements in China were discussed, they were usually treated dismissively and tagged with such epithets as "superstitious," "prescientific," or "irrational" to contrast them with the triumphant objectivity and rationality of the modern sciences.[47]

The Impact of the First World War

The "Great War" from 1914 to 1919 acted as a profound intellectual boundary between those in Republican China who still saw in modern science a universal intellectual model for the future and the "New Confucians" (*Xinru* 新儒), such as Zhang Junmai 張君 勱 (1886-1969), who showed renewed sympathy for distinctly Chinese moral teachings after the devastation visited on Europe. The former reformer and now scholar-publicist Liang Qichao, who was then in Europe leading an unofficial group of Chinese observers at the 1919 Paris Peace Conference, visited a number of European capitals. Both Zhang Junmai and Ding Wenjiang, the future antagonists in the 1923 "Debate on Science and Philosophy of Life" were part of Liang's traveling group. Each witnessed the war's deadly technological impact on Europe. They also met with leading European intellectuals, such as the German philosopher Rudolf Christoph Eucken

[47] Wang Hui, "The Fate of 'Mr. Science' in China," pp. 14-29. See also Charlotte Furth, *Ting Wen-chiang: Science & China's New Culture* (Cambridge: Harvard University Press, 1970), and Roger Hart, "Beyond Science and Civilization: A Post-Needham Critique," *East Asian Science, Technology, and Medicine* 16 (1999): 88-114.

(1846-1926), Zhang Junmai's teacher, and the French philosopher Henri Bergson (1859-1941), to discuss the moral lessons of the war.[48]

In his influential *Condensed Record of Travel Impressions While in Europe* (*Ouyou xinyinglu jielu* 歐 遊心影 錄節錄), Liang Qichao related how the Europeans they met regarded the first world war as a sign of the bankruptcy of the West and the end of the "dream of the omnipotence of modern science." Liang found that these Europeans now sympathized with what they considered the more spiritual and peaceful "Eastern civilization" and bemoaned the legacy in Europe of an untrammeled material and scientific civilization that had fueled the world war. Liang's account of the spiritual decadence in post-war Europe included an indictment of the materialism and the mechanistic assumptions underlying modern science and technology. A turning point had been reached, and the dark side of "Mr. Science" had been exposed. Behind it lay the colossal ruins produced by Western materialism.[49]

Liang Qichao was still careful to criticize the mythology surrounding science and not science itself. He added a note: "Readers, please do not misunderstand this as an attack on science. I definitely do not acknowledge the bankruptcy of science. However, I do not acknowledge the omnipotence of science either." It was clear from Liang's account that the West had produced the science that now troubled him. To remedy its excesses, he appealed to the spiritual resources that traditional Chinese civilization could provide. Liang made no mention of the pre-modern scientific achievements of Chinese civilization in 1919 (he had in some of his

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[48] See Ding Wenjiang 丁 文江, *Liang Rengong xiansheng nianpu changbian chugao* 梁 任公 先 生年 譜 長編 初稿 (2 vols. Taibei, Shijie shuju, 1972), pp. 551-74.

[49] See Liang, *Ouyou xinyinglu jielu*, in Liang Qichao, *Yinbingshi zhuanji*飲 冰室 專 集(10 vols. Taibei: Zhonghua shuju, 1972), Vol. 7, pp. 10-12. For discussion, see Chow Tse-tsung, *The May 4th Movement: Intellectual Revolution in Modern China* (Cambridge: Harvard University Press, 1960), pp. 327-29, and Jerome Grieder, *Hu Shih and the Chinese Renaissance: Liberalism in the Chinese Revolution, 1917-1937* (Cambridge: Harvard University Press, 1970), pp. 129-35.

earlier writings), because his measure of science and technology was modern science (*kexue* 科學) and not traditional natural studies (*gezhixue* 格致學).[50]

In the comparison between China and Liang's "imagined" West, China's pre-modern science was not worth taking seriously. Earlier in 1902, while Liang was living in exile in Japan, he had composed a three-part article surveying the history of science in the West, probably based on Japanese translations, which he entitled "Synopsis of the Vicissitudes in the History of Science (*Gezhixue yange kaolue* 格致學沿革考略). There Liang noted that 200-300 years ago, except for "modern science" (i.e., *gezhixue* 格致學), China had been comparable to the West in all other fields of learning. Liang's article presented the scope of science in the West and its relation to other specialized fields since the ancient Babylonians and Greeks. He then discussed the Arab transmission of Greek science to Europeans.

Liang added, ironically, that printing, gunpowder, and the compass, which all came from China to Islam and were then transmitted to Europe, had enabled the scientific revolution in sixteenth century Europe but not in China. Although Liang occasionally used the term "investigating and extending knowledge" for modern science in the essay, in addition to the Japanese term (*kexue* 科學), the former no longer evoked memories of the patient "investigation of things" that late-Qing literati had inscribed in its semantic life as a translation for "science." Liang's intellectual transition from parochial science (*gezhixue* 格致學) in 1902 to universal science (*kexue* 科學) in 1919 was not mentioned in the *Condensed Record of Travel Impressions While in Europe* 歐遊心影錄節錄.[51]

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[50] Liang, *Ouyou xinyinglu jielu*, p. 12.
[51] Liang Qichao, "Gezhixue yange kaolue" 格致學沿革考略, in *Yinbingshi wenjii* 飲冰室文集 (8 vols. Taibei: Zhonghua shuju, 1970), Vol. 2, pp. 3-14.

Liang Qichao's postwar disillusionment with Western civilization and its belief in the omnipotence of science and technology impacted Chinese students and scholars when his travel impressions of Europe were syndicated in China in 1919 and again when published as a separate work. Subsequently in 1921 Liang Shuming (1893-1988) presented a series of lectures at Beijing University and elsewhere in 1920 and 1921 that addressed the subject of Eastern and Western civilizations, specifically comparing the West, China, and India. Liang Shuming's lectures reopened the "cultures controversy" that Liang Qichao's travel impressions had initiated. After it was published in late 1921, Liang Shuming's book on the subject went through eight printings in four years, signaling that the nativist backlash against the excesses of the 1915 New Culture Movement and its faith in "Mr. Science" was gaining a wider audience.[52]

Evoking the legacy of the German romantics and their anti-materialist appeals to human voluntarism and vitalism, Liang Shuming was in many ways reiterating for Chinese what Eucken and Bergson were arguing in Europe in the aftermath of World War One. Oswald Spengler's (1880-1936) *Der Untergang des Abendlandes* (The decline of the West), for example, was first published in 1918, at the moment of Germany's bitter defeat, and became a bestseller in Europe. Its central premise was that all cultures had their peculiar configurations and therefore must be studied to understand their unique strengths and weaknesses. The cultural life of all nations and peoples followed cultural cycles that by necessity must run their course, as Western civilization now realized. Liang Shuming revived China as an antidote [53]

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[52] See Guy Alitto, *The Last Confucian: Liang Shu-ming and the Chinese Dilemma of Modernity* (Berkeley: University of California Press, 1979), pp. 77-81.

[53] See Elman, "Wang Kuo-wei and Lu Hsun: The Early Years," *Monumenta Serica*, 34 (1979-80): 389-401, Alitto, *The Last Confucian*, pp. 82-125, and Grieder, *Hu Shih and the Chinese Renaissance*, pp. 137-44. Cf. Paul Edwards, ed., *The Encyclopedia of Philosophy* (8 vols. New York: Macmillan Publishing Co., Inc. and The Free Press, 1967), 1/287-95, 3/134-35, 7/527-30.

This approach struck a responsive cord among many Chinese intellectuals who thought that cultural iconoclasm in China under the Republic had gone too far. Traditional Chinese culture and values could now be salvaged intact because their anti-materialist spiritual foundations were the remedy for modern European excesses. The Beijing University philosophy professor Feng Youlan 馮 友蘭 (Fung Yu-lan), for instance, while at Columbia University in 1922 published an article in English explaining "Why China Has No Science." Contributors to the journal *Science* 科學 published by the Science Society of China, such as Ren Hongjun, had thought that China was three centuries behind the West in terms of science.

Feng argued instead that according to her own traditional standard of values China did not need science. Daoism had emphasized the return to nature against human artificiality. The pre-Han philosopher Master Mo 墨 子 had stressed utilizing the past to control the future, which included a system of logic or definitions. Later literati, had debated whether knowledge of external things took priority (following Zhu Xi 朱熹), or the internal stress on the mind (following Wang Yangming 王陽明) was more important than mastering the world. Since Chinese did not regard life as a search for power, Feng continued, they stressed human and practical affairs and thus had no need of scientific certainty. The lesson Feng Youlan drew, however, was that Wang Yangming had been wrong. Chinese must stop searching for the truth in the "barren land of the human mind." The sciences of the outside world must be studied.[54]

Zhang Junmai Versus Ding Wenjiang

The cultures controversy boiled over, however, when Zhang Junmai presented a lecture at Qinghua University 清 華 ¤j 學 in Beijing on February 14, 1923, before a group of science

[54] Feng Youlan (Fung Yu-lan), "Why China Has No Science--An Interpretation of the History and Consequences of Chinese Philosophy," *International Journal of Ethics* 32, 3 (April 1922): 237-63.

students. There Zhang laid down the gauntlet to those who championed science in China, notably at Qinghua and Beijing universities. Borrowing ideas from Rudolf Eucken, Zhang contended that science must be secondary to and complement a viable "philosophy of life" (*rensheng guan* 人生觀). Science of itself, Zhang contended, could not provide a vision of life that people could follow because its materialist assumptions ruled out a spiritual vision of human values. It was intriguing that Zhang based his defense of spirituality and moral conscience on the subjectivity of human values, which in effect jettisoned the universalistic pretensions prominent in traditional Chinese classical learning.[55]

As one of Liang Qichao's travel companions in Europe in 1919, Zhang shared Liang's views of Europe. In addition, he had studied abroad in Japan and later in Britain and Germany, which put him in touch with European thinkers such as the philosopher Eucken at the University of Jena. For Zhang, science must be complemented by a spiritual vision giving it moral direction and purpose. China's spiritual legacy was rich and must be restored if China was to avoid the materialist excesses of Europe.[56]

Another of Liang Qichao's 1919 travel companions in Europe, Ding Wenjiang, found Zhang's views outrageous. Two months after Zhang Junmai's lecture at Qinghua, Ding picked up the gauntlet. A noted scientist who had trained for seven years in London and Glasgow and

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[55] See Zhang's "Rensheng guan" 人生觀, in *Kexue yu rensheng guan* 科學與人生觀 (2 vols. Shanghai: Dongya tushuguan, 1923), I, pp. 4-10. See also Saitô Tetsurô 齊藤哲郎, "Chi no ryôan--Chûgoku no 'kagaku to jinseikan' ronsô o chûshin ni" 知の両岸 -- 中國の '科學と人生觀' 論爭を中心に --, *Chûgoku – shakai to bunka* 中國 -- 社會と文化 8 (1993): 133-155, and Lin Yü-sheng, "The Origins and Implications of Modern Chinese Scientism in Early Republican China: A Case Study – The Debate on 'Science vs. Metaphysics' in 1923," in *Zhonghua min'guo chuqi lishi yantaohui lunwenji* 中華民國初期歷史研討會論文集*1912-1927* (2 vols. Taibei: Academia Sinica, Taiwan, Institute of Modern History, 1985), p. 1183.

[56] See Kwok, *Scientism*, pp. 140-160,, Chow Tse-tsung, *The May 4th Movement*, pp. 333-34, and Grieder, *Hu Shih*, pp. 145-150.

received degrees in biology and geology, Ding Wenjiang published a rejoinder in April 1923 to Zhang's lecture. Lasting a year, the controversy led to the publication of some 250-300 thousand words on both sides. All the rejoinders and surrejoinders were then published in a memorable collection that went through three printings by 1928 and successfully aired in public the misgivings scholars such as Zhang Junmai had concerning the modernist agenda that scientists and radicals had promoted as in China's best interests.[57]

Ding's initial reply to Zhang Junmai was entitled "Metaphysics and Science" ("Xuanxue yu kexue," lit., "dark studies and science") and appeared in April 1923 in a journal that Ding and Hu Shi had established in Beijing as a forum for political discussion. A distinguished scientist at Beijing University, Ding had initiated the Chinese Geological Survey while chief of the geology section of the Ministry of Industry and Commerce after his return from his studies in Britain. Hence, his credentials as a scientist were impeccable. At the outset, he accused Zhang of resurrecting the "ghost of metaphysics" in Zhang's fanciful and relativistic account of traditional spirituality, human intuition, and humanistic values:

> Metaphysics is really a worthless devil--having scraped along in Europe for something over two thousand years, until he is now coming to find himself with no place to turn and nothing to eat, suddenly he puts up a false trade mark, hangs out a new signboard, and comes swaggering along to China to start working his swindle. If you don't believe it,

[57] See *Kexue yu rensheng guan* 科學 與人 生觀 (2 vols. Shanghai: Dongya tushuguan, 1923). Another series of essays prefaced by Zhang Junmai appeared in Shanghai in 1924.

please just take a look at Zhang Junmai's "The Philosophy of Life" in the *Qinghua Weekly*.[58]

Ding accused Zhang Junmai and others of trying to turn the tables and claim that science and technology via materialism had bankrupted Europe and would do the same in China. According to Ding, the European debacle had been the result of international politics and not science per se. To blame science and its constant search for the truth for world war one was misguided. Its technologies had been misused by European politicians. The problem was politics, not science.

Zhang Junmai countered with a long article on the philosophy of life in which he invoked European thinkers such as Eucken and Kant to show that scientific knowledge was limited to phenomenal experience and thus could not reach the higher levels of human feelings, art, and religion. These were separate domains of human experience that the scientism of Ding Wenjiang refused to acknowledge. Ding replied immediately in May 1923 that Zhang was confusing the difference between spiritual and material matters, which was neither absolute nor inaccessible to human reason. Only the scientific method, Ding argued, was the universal means to solve the quandaries of human life.[59]

Liang Qichao tried, unsuccessfully, to mediate. He repeated that he had never stated that science per se was bankrupt, but he added that human feelings did go beyond science and reason and must be addressed through art, religion, and philosophy. The debate, however, had polarized Chinese intellectuals in Beijing and elsewhere. Hu Shi, who had been ill for much of 1923, had

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[58] See *Kexue yu rensheng guan* 科學 與人 生觀, I, p. 1, translated in Grieder, p. 150. Compare Saitô Tetsurô, "Chi no ryôan--Chûgoku no 'kagaku to jinseikan' ronsô o chûshin ni," pp. 140-142.

[59] See Kwok, *Scientism in Chinese Thought*, pp. 142-48,, Chow Tse-tsung, *The May 4th Movement*, pp. 334-35, and Grieder, *Hu Shih*, pp. 150-51.

earlier written a critical review of Liang Shuming's book on Eastern and Western cultures. He noted that the only way to solve human problems was to apply the scientific method to them. According to Hu Shi, Liang Shuming and Zhang Junmai wrongly challenged the universal basis of science by appealing to the subjective world of human feelings, art, and religion.[60]

In his preface to the volume devoted to the controversy, Hu Shi added that Liang Qichao's 1919 travel impressions had initiated the challenge to the materialistic foundations of science. The discussions and debates had been useful, Hu added, but in the end he sided with the Guomindang spokesman Wu Zhihui 吳稚暉 (1864-1953), who in the second stage of the debate went beyond even Ding Wenjiang by acknowledging that science could only provide a philosophy of life that was purely materialist and mechanistic. Both Hu and Wu held that a "naturalistic conception of life " was the only position that science could uphold. China's pretensions to spiritual superiority would hide the country's material and spiritual backwardness. Universal science was the only solution.[61]

The "Debate on Science and Philosophy of Life" continued for several years, and it is usually argued that the advocates of science gained the upper hand in this brouhaha. Many others joined in the fray, including leading members of the newly established Communist Party, who saw the debate as a chance to promote the scientific pretensions of Marxist socialism.

During the third stage of the debate, which lasted from December 1923 to August 1924, Qu Qiubai 瞿 秋白 (1899-1935) prepared an essay for *New Youth* entitled "Freedom and Necessity" (*Ziyou shijie yu biran shijie* 自由 世 界與必然 世 界) in which he stressed the

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[60] For Hu's review of Liang's book, see *Hushi wencun* 胡適 文存 (4 vols. Taibei: Yuandong dashu gongsi, 1968), Vol. 2, pp. 158-77.

[61] *Kexue yu rensheng guan*, Hu Shi "Xu" 胡適 序, pp. 10-13. The preface can also be found in *Hu Shi wencun*, Vol. 2, pp. 120-147. See also Kwok, pp. 154-155,, Chow Tse-tsung, pp. 336-337, Alitto, pp. 126-129, Grieder, pp. 151-152, and Saitô Tetsurô, "Chi no ryôan," pp. 142-44.

social realities conditioning human agency. Similarly, Chen Duxiu, one of the founders of the Chinese Communist Party, denied that human agency depended on individual subjectivity in an August 1923 essay for *New Youth* 新青 年, which gainsaid the claims made by Zhang Junmai and Liang Qichao. Human choice was based on social and economic factors that could be scientifically delineated.[62]

What is significant here is that the followers of scientism and Marxism both championed modern science and materialism. Moreover, the humanist appeal to China's spiritual resources never questioned that "science" meant "Western science and technology." When Wu Zhihui presented a materialist philosophy of life to complement his view of science, he revealed that the significance of modern science carried over to human agency, which the Marxists also readily accepted in their appropriation of science to serve socialism.

Accordingly, the 1923 debate was premised on the value of universal science in its modern Western form. Neither side wished to appeal to traditional Chinese achievements in astronomy, mathematics, or medicine because for each side China had "failed" to develop science. When Liang Qichao appealed for a new unity of Chinese cultural values and modern science, his position required the amalgamation of European science and technology, that is, what China lacked, with Chinese culture, i.e., what China already had.[63]

Those who saw in modern science the intellectual revolution of the future, such as Chen Duxiu, would march on in the name of Communism and modern science. Mao Zedong 毛 澤 東 and other Communists would leave Chen Duxiu behind after 1927, but they always carried modern science along with them in their quest for socialism. Many of those who saw modern

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[62] Saitô Tetsurô, "Chii no ryôan--Chûgoku no 'kagaku to jinseikan' ronsô o chûshin ni," pp. 144-46.
[63] Kwok, pp. 160-62, and Saitô, " Chi no ryôan," p. 138.

science as a rival, such as Zhang Junmai, would continue to appeal to the preservation of traditional philosophical values from the borderlands in Hong Kong and Taiwan. Like German romantic philosophers, such as Heidegger and Gadamer, who also questioned the moral meaningfulness of modern science, however, "New Confucians" after 1949 would have to find a middle ground that would allow "Confucian hermeneutics" to continue to affirm scientific and medical research.[64]

Final Comments

In the early twenty-first century, we tend to forget the degree of skepticism that Joseph Needham's remarkable collectanea, *Science and Civilisation in China*, initially provoked five decades ago. Many dismissed the great embryologist's foray into the history of Chinese science as a dead-end, a project they felt revealed Needham's wishful thinking about premodern China. The consensus then drew on heroic accounts of the rise of Western science to demonstrate that China had had no "science."

Western scholars and westernized Chinese scholars had essentialized the European history of natural studies as the universalist progress of science . When Chinese studies of the natural world, her rich medieval traditions of alchemy, or pre-Jesuit mathematical and astronomical achievements in China were discussed, they were usually treated dismissively to contrast them with the triumphant objectivity and rationality of the modern sciences in Europe and the United States.[65]

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[64] See Elman, "Rethinking 'Confucianism' And 'Neo-Confucianism' In Modern Chinese History," in John Duncan, Benjamin Elman, and Herman Ooms, eds., *Rethinking Confucianism: Past and Present in China, Japan, Korea, and Vietnam* (Los Angeles: UCLA Asia Pacific Monograph Series, 2002), pp. 518-554.

[65] For more informed accounts, see the "Review Symposia" on Needham's work in *Isis* 75, 1

Many twentieth century scholars were convinced that pre-modern China had no industrial revolution and had never produced capitalism. Therefore, they contended, the Chinese could never have produced science. While Needham granted that China lacked capitalism, he did not stop there. Few besides Needham, his collaborators, and Nathan Sivin stopped to consider what the rich archives in Taiwan, China, and Japan might yield if someone bothered to go through them. As the evidence of a rich tradition of natural studies and medicine accrued in volume after unrelenting volume of the *Science and Civilisation in China* project after 1954, it became harder and harder to gainsay it all as superstition or irrationality or inductive luck.

The largest archive of premodern records for the study of nature most likely remains in China.

By better understanding the history of imperial Chinese natural studies, technology, and medicine, we are more perceptive about ourselves and the mystifications that undergird our contemporary versions of modern science. Now that "Chinese science" has grown in respectability among the members of the International Society for the Study of East Asian Science, Technology, and Medicine worldwide, the romanticized story of European science, whether capitalist or socialist in genre, has slowly unraveled under the onslaught of Thomas Kuhn and his historicist successors.

No longer reified and automatically placed on a sacred pedestal as the successor to our pre-1900 religions, the story of Western science became more complicated, more tragic, and more tense. The boyhood dreams of invention among Europeans, and their shrieks of "eureka" after new discoveries have been revisited. The historical accounts of Newton's mystical fascination with alchemy, Copernicus' devout religiosity that informed his astrology, and the

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(1984): 171-189.

deadly serious but ungentlemanly competitive nature of "priority" in science and invention have challenged earlier fictions about the allegedly apolitical scientific revolution.

Study of pre-modern Chinese science, technology, and medicine has restored a measure of respect to traditional Chinese natural studies and thereby granted priority to research in areas where the received wisdom was suspect, based as it was on careless speculation about banal generalities. Scholars now build on those contributions to search beneath the surface of self-satisfied discourses about "Western science" and the self-serving appeals to Greek deductive logic upon which they were rhetorically based.[66]

Unraveling a consensus of scholarly opinion about the "failed" history of science in China and the "victorious" history of European science reveals that both histories were pieces in the larger global narrative of Western success and Chinese failure. With the exception of a reformed version of traditional Chinese medicine that has survived and is now thriving as one version of "holistic" medicine, the traditional fields of natural studies in imperial China were redirected by the impact of modern science. The historical construction of Western success in science, technology, and medicine was confirmed simultaneously by the delineation, unfairly and prematurely, of imperial China's scientific failure during the Ming and Qing dynasties.

When the history of Chinese science is rewritten in an age of Chinese landings on the moon and mars later this century or next, it will be presented more positively and triumphantly in Beijing, Taibei, and Hong Kong from a new linear framework whose teleology will be success and not failure. The twenty-first century will mark the end of the triumphal narrative of Euro-American success at the expense of much of the world. By mid-century there will likely be more scientists and engineers in China and India than the rest of the world combined.

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[66] See G. E. R. Lloyd and Nathan Sivin, *The Way and the Word: Science and Medicine in Early China and Greece* (New Haven: Yale University Press, 2002).