

11 The Cold War and the Reshaping of Transnational Science in China

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In an article in the October 1967 issue of *Foreign Affairs*, former vice president Richard Nixon advocated a more active US foreign policy toward China, declaring “There is no place on this small planet for a billion of its potentially most able people to live in angry isolation.”¹ During the next several years, the perception of a China insulated from the outside world would receive confirmation as the country spiraled further into the Cultural Revolution maelstrom at home and engaged in conflicts with both the United States and the Soviet Union abroad. In science, technology, and education, almost all universities and research institutes were shut down, international scientific interactions ceased, and importation of foreign journals and books stopped. Yet less than five years later Nixon, as president, would land in Beijing, and a new era in the history of the Cold War and in China’s scientific relations with the rest of the world would begin.

In this chapter I will sketch, in very general terms, how the Cold War reshaped China’s scientific enterprise, especially its transnational character. The Cold War will be understood here not as a straightforward bipolar US-Soviet competition, but rather as a series of triangular US-Soviet-Chinese geopolitical interactions with alternating periods of alliance and hostility as seen from the Chinese perspective.²

The dynamics of the Cold War conditioned China’s choice of major partners in international scientific exchanges and shaped domestic scientific priorities and institutions, which served to alter the existing patterns of Chinese transnational scientific interactions, sometimes in surprising ways. Thus, chronologically, the chapter takes into account both the conventional periodization of the Cold War—from the late 1940s, as US-Soviet tension rose, to the early 1990s, when the Soviet Union fell apart—and two major events in the history of modern China: the establishment of the People’s Republic of China (PRC) in 1949 after the Communist revolution and a series of dramatic changes in late 1980s and the early 1990s that included not only the government’s crackdown on a pro-democracy movement at Tiananmen Square in 1989 but also the subsequent acceleration of reform and opening up. Although the chapter focuses on the period 1949–1989, it also examines the years before and after

that period in order to illuminate the background and the legacy of the development of transnational science in China during the Cold War. Specifically, the chapter examines five periods: the half-century before the 1949 revolution, when the influence of the United States was dominant; the decade that followed it, shaped by an alliance with the Soviet Union; the 1960s, the era of self-reliance; the Nixonian exchange of the 1970s, which reopened US-China scientific interactions; and the reform era of opening to the outside world that began in the late 1970s.

Here the term *transnational science* refers to the movements of scientists, scientific institutions, practices, instruments, and ideologies across national boundaries and how such movements interacted with the indigenous traditions and contexts within any particular nation-state to shape and shift scientific developments within it and internationally. As such, the concept of the transnationalization of science includes both formal, state-sponsored international activities and the informal, private cross-national networking that scientists engaged in outside the framework of the nation-states. It also refers to aspects of scientists' activities as they confront and even challenge the authority of the nation-states.³

It should be noted that to characterize science in modern China as transnational does not mean that nationalism didn't play an important role.⁴ Clearly, both the pre-1949 Nationalist government and its Communist successors sought foreign aid, including technological aid, for the purpose of fulfilling their own national developmental aspirations.⁵ Even the Western-trained Chinese scientists held a strong sense of Chinese nationalism, often sharpened by the history of national humiliation at the hands of Western powers and Japan, and generations pursued various versions of the dream of "saving China through science."⁶ The Cold War, however, accentuated the latent tensions between the national and the transnational for both the Chinese party state and the Chinese scientists: the former had to balance its need for technical manpower for national security and its political distrust of Western-trained scientists; the latter had to deal with the intensified role of the party state in their scientific and personal lives, and also to reconcile their Chinese nationalism and their transnational scientific background and ideals.

In this chapter all Chinese names, except for those of overseas Chinese, are rendered in *pinyin*, with the family name first and the given name second.

Americanization before the Cold War, ca. 1900–1949

In the case of science in China, transnationalism predated the Cold War. International politics and scientific currents defined the social and political context of the introduction of modern science in China from the late nineteenth century onward.⁷ The Sino-Japanese war of 1895 led to the end of the traditional civil service examination system and the introduction of the modern educational system in 1905, with the inclusion, for the first time, of natural science as part of formal schooling. Both before

and after this educational reform, missionaries, most of them from the United States, established schools in China in which some modern science was taught. The anti-foreign Boxer Rebellion of 1900 and the subsequent intervention by Western powers and Japan eventually led to the establishment of the Boxer indemnity fellowships, first and foremost by the United States and later, on a much smaller scale, by other countries, to sponsor Chinese students to study abroad. These fellowships were made possible by funds remitted to China when it became clear that the massive indemnities (\$330 million) that China was forced to pay the foreign powers were often based on exaggerated claims. The Boxer fellowships also played an important role in the emergence of the US as a dominant influence in the development of science in China in the first half of the twentieth century and thus deserve closer examination.

As the historian Michael Hunt convincingly argued, even though the United States publicly touted its first partial remission of the Boxer indemnity as a gesture of good will in 1908, its original claim of \$25 million, with 4 percent of interest amortized until 1940, had been widely recognized from the beginning as excessive and subsequently proved to be so. Furthermore, when the US later forced the Chinese government to use the remission to send Chinese students to the US, it acted out of self-interested calculations at least as much as out of altruism.⁸ Such a move would enable the US to influence China and, as Edmund J. James, president of the University of Illinois, put it in a letter to President Theodore Roosevelt, even control it with “the intellectual and spiritual domination of its leaders.”⁹ Roosevelt largely agreed. On December 3, 1907, in a message to Congress, he declared:

This Nation should help in every practicable way in the education of the Chinese people, so that the vast and populous Empire of China may gradually adapt itself to modern conditions. One way of doing this is by promoting the coming of Chinese students to this country and making it attractive to them to take courses at our universities and higher education institutions. Our educators should, so far as possible, take concerted action toward this end.¹⁰

Yet, even though the Boxer indemnity funds emerged from one of the most humiliating episodes in modern Chinese history, as a transnational institution it probably played a more important role than any other financial and educational programs in the making of modern science and especially in the training of the first generation of modern scientists in China. During the negotiations leading to the establishment of the Boxer fellowship program, the Chinese government and the US government both agreed to emphasize science and technology. The “Proposed Regulations for the Students to Be Sent to America” prepared by Yuan Shikai, head of the Chinese Foreign Ministry (*wai wu bu*) in late 1908 contained this stipulation:

The aim in sending students abroad at this time is to obtain results in solid learning. Eighty per cent of those sent will specialize in industrial arts, agriculture, mechanical engineering, mining, physics and chemistry, railway engineering, architecture, banking, railway administration, and similar branches, and 20 per cent will specialize in law and the science of government.¹¹

According to these regulations, the Chinese Foreign Ministry and one official from the American legation in China would together design “the detailed method of procedure” for implementing the program. In the end, an Office for Students Going to the United States was established jointly by the Chinese Foreign Ministry and the Chinese Ministry of Education (*xue bu*) to oversee the selection of 180 students in China and their distribution in the US for the period 1909–1911 (47 in 1909, 70 in 1910, and 73 in 1911).¹² In 1911, the Tsinghua (Qinghua) School was set up in Beijing under heavy American influence to take over the job of preparing the Boxer fellows before their departure for the US and to supervise their activities thereafter. In all, from 1909 to 1929, the Boxer fellowship program brought about 1,500 Chinese men to study in the US, a majority of them studying engineering, science, agriculture, and medicine.¹³ In addition, there were 54 women selected from outside of Tsinghua through special national competitions before 1928, when the school began to admit women.¹⁴

The admission of women came as part of a major transformation of Tsinghua that year: it became an independent national university under control of the Ministry of Education (not the Foreign Ministry as before). The broader context was the movement to recover Chinese rights in education after the establishment of the Nationalist government in 1927. The new Tsinghua also stopped the practice of automatically sending all its graduates to the US. Many of them continued to go to American universities with the special Tsinghua funds drawn from the original American Boxer remission, but some now could choose to go to Europe on Boxer indemnity fellowships from countries there when they became available. Most of them also now went abroad as graduate students, instead of undergraduates as before the change.¹⁵

A second and final remission of excessive Boxer indemnity funds by the US in the mid 1920s led to the establishment of the autonomous China Foundation for the Promotion of Education and Culture. Governed by a board of ten Chinese and five American educational leaders, the foundation used its funds to support not only Tsinghua but also a number of other universities and research institutions, including the Science Society of China. The foundation also sponsored graduate studies in the United States by non-Tsinghua graduates.¹⁶ Likewise, the Rockefeller Foundation financed the creation and operation of the Peking Union Medical College and funded research and teaching at many other Chinese universities in this period.¹⁷

Significantly, the US Boxer funds, through both Tsinghua and the China Foundation, and the Rockefeller influence not only put a heavy American accent on Chinese science and education but were also among the few continuous institutional threads in these areas in China through the turbulent first half of the twentieth century, from the Republican Revolution of 1911, through the ensuing era of warlord chaos to the establishment of the Nationalist government in 1927, and through the War of

Resistance against Japan (1937–1945). Together with American missionary universities in China, they helped explain why an overwhelming number of Chinese students pursuing scientific studies abroad went to the US, even though it was widely recognized, even in China, that the center of most fields of science, especially during the early twentieth century, was in Europe and not the US. A survey published in China in 2007 of Chinese scientists and engineers who returned to China after studying abroad during the period 1879–1949, for example, found that about two thirds (66.14 percent) of them had returned from the US.¹⁸ (See table 11.1.)

Although the United States played the most active role in Chinese science and education in this period, it was by no means the only foreign influence. Chinese students took advantage of the returned Boxer funds from other countries, especially from Great Britain in the 1930s, for studying abroad there as well. Indeed, because of a higher standard of selection, a disproportionate number of the leaders of Chinese science emerged out of the dozens of Boxer fellows who went to Britain.¹⁹ Even before Tsinghua became autonomous in 1928, its graduates, aware of the gap between American and European science and the fact that many American scientists themselves had studied in Europe, found their way there at some points in their careers. Physicists were especially eager to get the European exposure after their American education. For example, Ye Qisun, a founding figure of modern physics in China and a Boxer fellow, received his bachelor's degree from the University of Chicago in 1920 and his PhD from Harvard University in 1923, then went on a four-month tour of Europe, then returned, after a short stint at Southeastern University in Nanjing, to Tsinghua, where he remained for the rest of his career.²⁰ As professors, the returned students intentionally sent their own students to strategically selected Western institutions and scientific fields so as to give China a balanced coverage in science. Ye Qisun, for example, helped arrange for the first three graduates of Tsinghua's Physics Department to go to Germany, France, and the United States respectively for graduate studies.²¹ Thus, by the 1930s, Tsinghua had Chinese faculty members who had trained at and returned from not only the United States but also England, Germany, and France, as Norbert Wiener of MIT observed when he served as a visiting professor in mathematics at Tsinghua.²²

Perhaps no institution epitomized the transnational features of Chinese science and the American scientific influence in China better than the Science Society. Founded in 1914 by Chinese students studying science at Cornell University, it was the first comprehensive scientific organization in China. Its membership grew rapidly, especially after it moved its headquarters to China in 1918 as its founders finished their studies in the US and returned home.²³ Ironically, owing to a number of factors, including their sense of Chinese nationalism, few of the US-trained Chinese scientists left with the US-backed Nationalists when the latter retreated to Taiwan in the wake of their defeat by the Communists in 1949.

Table 11.1

Numbers of Chinese scientists and engineers who returned to China after studying abroad by periods of return and countries of study, 1879–1949.

	US	UK	Japan	Germany	France	Canada	Belgium	Russia	Switzerland	Austria	Others	Total	%
1879–1911	109	62	41	19	37	0	7	0	0	0	1	276	7.15
1912–1928	815	59	129	43	38	3	9	4	3	5	12	1120	29.02
1929–1937	424	72	80	104	58	2	6	4	9	8	26	793	20.54
1938–1945	227	85	31	64	13	7	7	6	2	5	25	472	12.23
1946–1949	978	113	4	18	9	22	3	3	7	1	41	1199	31.06
Total	2553	391	285	248	155	34	32	17	21	19	105	3860	100
Percentage	66.14	10.13	7.38	6.42	4.02	0.88	0.83	0.44	0.54	0.49	2.72		100

Source: Ma Zusheng (T. S. Ma), *Limian chuguo/huiguo keji renyuan zonglan (1840–1949)* (Social Sciences Academic Press, 2007), 4.

Transnational currents also left imprints on some of the political events that occurred during this period. The republican Xinhai Revolution of 1911 was launched with strong support from overseas Chinese, especially in the United States and Japan, and in turn led to the establishment of a relatively stable Nationalist government that provided support for science. The importation of communism from Russia in the 1910s and the 1920s sowed the seeds for a Communist science policy. The May Fourth Movement of 1919 carried the banners of highly Westernized science and of democracy. The Nationalist government, based in Nanjing, made strides in science, technology, and education in the golden decade of 1927–1937, establishing universities (most of them American-style) and also establishing the Academia Sinica (modeled after the Soviet Academy of Sciences and the Kaiser Wilhelm Society of Germany).

During the Nanjing decade (1927–1937), the Nationalists also initiated ambitious technological development projects supported by international aid. The 1937–1945 war with Japan, however, disrupted progress and institution-building in science and other areas, and the Civil War between the Communists and Nationalists, which took place within the context of the global Cold War, irreversibly changed the fate of all Chinese, including scientists. Disgusted with the corruption-ridden Nationalists, most Chinese scientists, even those who had been educated in the West, stayed on the mainland instead of fleeing with the Nationalists to Taiwan. Few among them probably foresaw the nearly complete cut-off of transnational scientific communication after 1949 and especially after the outbreak of the Korean War in 1950. Yet the enlightened science policy of the early PRC years under the leadership of Mao Zedong seemed to have vindicated the scientists' choice. Under the direct leadership of Premier Zhou Enlai, whose vision for a developmental state best matched the nationalist aspiration of the scientists, the government seemed to support science and to make good use of the mostly Western-trained scientists.

Sovietization and Countercurrents, 1949–1960

During the 1950s, the first decade of the existence of the PRC, a geopolitical alliance with the Soviet Union, first launched in part as a way to fend off a possible American intervention in China and later consolidated during the Korean War, resulted in a massive Soviet technological transfer to China.²⁴ With it also came a wholesale restructuring of Chinese science, technology, and education policy and institutions from ones shaped by Western, especially American, practices to ones dominated by those of the Soviet Union. Yet even during this period of Sino-Soviet alliance one finds strong countervailing forces that resisted "Sovietization." They derived from several sources: ideological and political differences between the Chinese Communist Party (especially Mao) and the Soviet leadership under Nikita Khrushchev; the different social and cultural contexts for technological development in the two countries; and

the presence of Chinese scientists and engineers who were trained in the West, especially in the US. Surprising as it may seem, the post-World War II Americanization of international science didn't leave China untouched even at the height of mutual antagonism.²⁵

In the 1950s, the Soviet Union helped China construct or equip more than 300 major industrial projects, ranging from military technology to power generation and chemical engineering, laying the foundation for China's industrial infrastructure for decades to come. It sent thousands of Soviet scientists and engineers to China as technical advisors, and trained tens of thousands of Chinese engineers and scientists in the Soviet Union.²⁶ It helped China formulate the Long-Term Plan for the Development of Science and Technology (1956–1967), which served as a blueprint for its nuclear and space programs as well as general scientific and technological developments. Indeed, it was V. A. Kovda, a Soviet soil scientist and chief advisor to the Chinese Academy of Sciences in 1954–55, who suggested that such a plan be drawn up in the first place.²⁷ In a reversal of the Americanization of the pre-1949 period, almost all Chinese universities were restructured in the direction of narrow technical training, and almost all Chinese scientists were required to learn Russian and follow Soviet scientific literature. In the elite Chinese Academy of Sciences, for example, a survey taken in 1954 found that 93.2 percent of all the staff, including the scientists, were learning Russian, 73.5 percent could already read Russian scientific literature, and 26.8 percent were able to translate Russian papers into Chinese.²⁸

Did the Cold War-inspired Sovietization transform the content of science in China? The most notorious candidate for a confirmation of this effect was the introduction of Lysenkoism and the effective banning of Western genetics in the teaching and research in biology in China in the first half of the 1950s. Close examination of this history indicates that Chinese Lysenkoism had elements that could be traced back to Communist science policy debate in the pre-1949 period, with the resultant emphasis on applied research, practical learning, and anti-Westernism, and thus not an entirely Cold War phenomenon.²⁹ Nevertheless, Sino-Soviet geopolitical alliance played an important part in the establishment of Lysenkoism as an orthodox biological doctrine.

An illustration for this point came in the case of Hu Xiansu, an outspoken American-trained botanist who, in a 1955 textbook, criticized Lysenkoism as pseudo-science propped up by political forces. The book drew protests from Soviet advisors in the Chinese Ministry of Education, and the controversy escalated into an international political problem. At a high-level meeting of the Chinese party-state leadership on April 27, 1956, Lu Dingyi, the party's propaganda chief, acknowledged that Hu was right scientifically but explained "what we focused on was his political problem. He attacked the Soviet Union at the time, which made us very mad."³⁰ Hu's book was banned, but fortunately political changes both at home and in the Soviet Union and

Eastern Europe soon led to the implementation of a liberal “Hundred Flowers” campaign that helped bring back modern genetics.³¹

Yet even in the heyday of the Sino-Soviet alliance, Sovietization had its limits. As a Chinese nationalist, Mao never had an easy relationship with Stalin. His relationship with Stalin’s successor Khrushchev was even more uneasy. At one point in 1958, Mao told the Soviet ambassador to China “You say that Europeans look down upon the Russians. I believe that some Russians look down upon the Chinese.”³² Political and ideological divisions eventually widened, resulting in a souring of bilateral relations, an end to Soviet technical assistance (including assistance in China’s atomic bomb project), and an end to the sending of large number of Chinese students to the Soviet Union to study science and engineering by the early 1960s.

In the same period, the West continued to influence science in China, if only in subtle and unheralded ways. For one, even at the height of Chinese isolation from the West, it was impossible to cut off all scientific and technological connections. Strict export controls didn’t, for example, prevent a small number of scientific instruments being smuggled from the US into China, often through Hong Kong.³³ Likewise, transnational scientific networking demonstrated remarkable durability. For example, the prominent marine botanist Zeng Chengkui (C. K. Tseng), who had been trained in the United States and had returned to China in 1947, was able to communicate with his former colleagues at Scripps Institution of Oceanography in San Diego in 1951, amidst the Korean War. He requested that they send him scientific reprints and help him realize his dream of building “an equivalent of the Scripps Institution plus Woods Hole Marine Biological Laboratory” in Qingdao. Indeed, in the 1950s and the early 1960s, Zeng could still receive scientific papers from his American colleagues at Scripps and elsewhere, while they themselves tried to keep abreast of Zeng’s scientific publications through Russian translations.³⁴

Perhaps more important, the 1950s witnessed the return of about a thousand Chinese scientists from the United States to mainland China. Even though both the Chinese government and the US government harbored suspicions of the American-trained Chinese scientists (the former because of their Western educational background, the latter because some of them were thought to be loyal to Communist China, especially during the Korean War), each side sought to recruit them in order to use their technical talents, to deny them to the other side, and to show the superiority of their side’s political system. The US government, in a move that echoed elements of its Project Paperclip to capture German scientists and engineers before they fell into the Soviet hands after World War II, not only encouraged but in some cases forced Chinese scientists and engineers who had been “stranded” in the US after the Communist revolution and Korean War to stay in the US. Yet many in this group were determined to return to China, often driven by a strong sense of Chinese nationalism, by political sympathy toward the Chinese Communists, and by a desire

to reunite with their families. Eventually, though about 4,000 of the estimated 5,000 Chinese students and scientists remained in the US (including Chen Ning Yang and Tsung Dao Lee, who would win the Nobel Prize in physics in 1957), about 1,200 fought the policy and returned to China in the 1950s.³⁵ They were joined in China by several hundred others who returned from Europe and Japan. According to an internal report, 1,954 Chinese students and scientists returned to mainland China in 1949–1958, of whom 1,244 (about 64 percent) returned from the United States.³⁶ (See table 11.2.) Of the 1,954, the number who specialized in natural sciences (presumably including engineering) was 1,117 (57 percent); the other two categories were “social sciences” and “unknown.”³⁷ (See table 11.3.)

Table 11.2

Chinese students and scientists who returned from abroad in 1949–1958, by country of training.

	Number	Percentage
US	1244	75.2
UK	221	11.3
France	103	3.8
Japan	198	10.1
Other Countries	128	6.6
Unknown Countries	60	3.1
Total	1954	100

Source: Beijing Municipal Archives, Beijing, file no. 002–020–339 “Guojia keweì zhuanjiaju 1959.3.5 tongzhi” (circular from the Bureau on Experts of the National Science and Technology Commission dated March 5, 1959), attachment 1.

Table 11.3

Chinese students and scientists who returned from abroad in 1949–1958, by field of training.

	Number	Percentage
Natural Sciences	1117	57.2
Social Sciences	716	36.6
Unknown Fields	121	6.2
Total	1954	100

Source: Beijing Municipal Archives, Beijing, file no. 002–020–339 “Guojia keweì zhuanjiaju 1959.3.5 tongzhi” (circular from the Bureau on Experts of the National Science and Technology Commission dated March 5, 1959), attachment 1.

Among those who returned to China from the US was Qian Xuesen (Hsue Shen Tsien). His case exemplified the difficulties that faced transnational Chinese scientists who were caught up in the international politics of the Cold War. Qian was born in 1911 in China and studied railroad engineering at Jiaotong University in Shanghai in the 1930s. He then went to the United States to study aeronautics on a Boxer fellowship. During and after World War II, he had a fast-rising reputation as a research scientist at Caltech and in national defense circles. His phenomenal ascent in the United States ended abruptly in June of 1950, when the government revoked his security clearance on suspicion of his past membership in the US Communist Party. It was the time of the Korean War, McCarthyism, and persistent racial discrimination. At one point Qian was both to be deported as a subversive (by the Immigration and Naturalization Service) and detained as a denial to Communist China (by the Pentagon and the State Department). After several years of virtual house arrest, Qian and dozens of other Chinese scientists who wanted to return to China eventually were exchanged for American prisoners of war and civilians held in China. Tsien went on to direct the Chinese missile program.³⁸

Qian's case illustrates not only how the Cold War affected science and scientists, but also the reverse. It is reported that Qian turned out to be so valuable to China that Premier Zhou Enlai commented at one point that the long negotiations with the United States at Geneva were worthwhile if only to get Qian back.³⁹ One can also make the argument that the return of the hundreds of Chinese scientists from the West in the early 1950s gave the Chinese party-state leadership the self-confidence to pursue a path that was increasingly independent of the Soviet Union. Zhang Jinfu, the party chief of the Chinese Academy of Sciences during the late 1950s, recalled that "Qian Xuesen knew that the key to missiles was the boosters, and so after he came back from the US, the Academy of Sciences decided to work on [its own] new boosters. We quickly succeeded because we walked on two legs. If we had not walked on two legs, we would have been at a dead end when the Soviets reneged on their agreements with us and stopped their assistance to us."⁴⁰

The return of these Chinese students and scientists from the United States and Europe in the 1950s helped to counterbalance Sovietization by reinforcing a strong sense of Chinese nationalism and, at the same time, by discreetly seeking inspirations from the Western model that they had become familiar. Qian, for example, reportedly voiced his shock at "seeing so many Soviet experts" at the famed Institute of Military Engineering (Hajungong) of the People's Liberation Army in the northern city of Harbin up on his return in 1955. "Don't we Chinese know how to teach? What are all these foreigners invited here to do?" he asked, to the delight of General Chen Geng, the president of the institute, who praised his patriotism.⁴¹ Apparently motivated by an unspoken attachment to his American alma mater and a dissatisfaction with the

Soviet-inspired separation of science and engineering in Chinese universities in the early 1950s, Qian subsequently helped establish the University of Science and Technology of China in the Chinese Academy of Sciences on the model of Caltech.⁴²

These post-1949 returnees further heightened the prominence of American-educated scientists among the leadership of the Chinese scientific community. In the late 1980s, the Chinese historian of science Li Peishan examined information on the 877 prominent Chinese scientists included in a contemporary biographical dictionary and found that 662—that is, 75.5 percent—had received advanced education abroad. Those who had received such education in the United States numbered 393 (59 percent)—more than four times as many as had received in the next favorite destination, Great Britain (91, or 14 percent). Li’s data also revealed that surprisingly few Japanese-trained and Soviet-trained scientists were listed—only 34 (5.1 percent) and 28 (4.2 percent), respectively.⁴³ (See table 11.4.) Even though Japan was a popular destination for Chinese students studying abroad in the early twentieth century, few of those who went there chose to specialize in science and technology. Most of those sent to the Soviet Union studied engineering, not science; those few who did study science would become prominent in their fields in large numbers only after the mid 1980s.

The dominance and the high quality of Western-trained Chinese scientists and engineers in Chinese science and technology didn’t escape the attention of the Soviet scientific leadership involved in Sino-Soviet interactions. As early as 1956, when a

Table 11.4

Countries of training for leading Chinese scientists, engineers, and physicians included in a biographical dictionary in 1986.

	No. of Chinese scientists trained in country	Percentage of all (877)	Percentage of all who studied abroad (662)
US	393	44.8	59.4
China	215	24.5	n/a
UK	91	10.4	13.7
Germany	54	6.2	8.2
France	35	4.0	5.3
Japan	34	3.9	5.1
Soviet Union	28	3.2	4.2
Other Countries	27	3.1	4.1
Total	877	100	100

Source: Li Peishan, “The Status and Roles of Returned Students in Scientific and Technological Developments in Post-1949 China,” *Journal of the Dialectics of Nature* 11, no. 4 (1989): 28–36.

high-level delegation of the Soviet Academy of Sciences visited China to assist in the making of its Twelve-Year Plan for Science and Technology, it became clear to many in the group that, owing to the return of eminent scientists from abroad, the Soviet side needed to send to China truly world-class experts to serve as advisors. Otherwise, inferior Soviet advisors would quickly expose their limits and bring embarrassment to themselves and to the Soviet Union. At a debriefing for the Presidium of the Soviet Academy of Sciences in Moscow in July 1956, Academician Aleksandr Mikhailov, a member of the delegation, explained:

It should be noted that in the last two or three years many prominent [Chinese] scientists have returned home from abroad. Based on our encounters with these scholars in China, their abilities are undoubtedly equal to those of our own Soviet scientists and their academic works are familiar to our scientists. We can point to the example of the visit of the aerodynamicist Qian [Xuesen] in our country. Returning to China from the US about seven or eight months ago, he is now visiting the Soviet Union by invitation. He has delivered a series of lectures and visited many research institutes. He is a well-educated scientist with a broad vision. Such scientists are growing in number in China. ... [Thus] I believe that if we could not send high-level personnel in some fields [to China], it's best that we do not send anyone.⁴⁴

As further evidence of the disparity between Soviet-trained and Western-trained scientists in China, Mikhailov noted that among researchers at the highest level in China 339 had been trained in "capitalist countries," 164 of them in the United States; only five had studied in the Soviet Union. "Obviously the influence on them mainly came from the capitalist countries," he lamented, "our influence is negligible."⁴⁵

Comparing Western-trained and Soviet-trained scientists was complicated by the little-known fact that at least a few of those who had been sent to the Soviet Union in the 1950s had previously returned to China from the United States. For example, Tu Guangchi, a geochemist, received his PhD from the University of Minnesota in 1949, returned to China in 1950, then was sent to Moscow University for another degree (which he earned in 1954). Likewise, Zhang Li, who had returned to China after studying physics at Cornell University in 1948–49, was sent to Leningrad University to study with Vladimir Fock. And Yang Guanghua had returned to China in 1951 after receiving a PhD in chemical engineering from the University of Wisconsin before going to the Moscow Institute of Petroleum in 1956 for additional training (though not another degree). In all three of these cases, the returnees' advanced technical preparations enabled him to take advantage of further Soviet training, but political reliability probably was another factor: all three had joined the Communist Party before going to the Soviet Union. Zhang was allowed to continue studying theoretical physics, but Tu switched from his postdoc basic research on titanium dioxide at the University of Pennsylvania to the more applied subject of mineral deposit geology in Moscow. In any case, such double exposure made this select group of scientists truly transnational hybrids during the Cold War.⁴⁶

One could argue, of course, that in many ways the Cold War hindered Chinese scientific development. If there had been no Sino-US conflicts, especially the Korea War, perhaps more of the Chinese students and scientists would have returned home from the US. The ban on scientific contact and the embargo on sales of scientific and technical equipment between the two countries hampered scientific development in China, and arguably in the US. One could also point to China's participation in and withdrawal from the International Geophysical Year (1957–58) as evidence of the negative effects of Cold War international politics on Chinese scientific development. In the early 1950s, when invited by the organizers to participate in the IGY, the Chinese Academy of Sciences agreed to join the global effort only after the Soviet Union said that it would do so and after receiving assurance from the organizers that Taiwan would not take part. Seeing an opportunity to benefit from the international collaboration and also to showcase China's scientific achievements, the Chinese academy and the national government poured resources into preparing for China's participation in the IGY, including the acquisition of advanced instrumentation and standards from the Soviet Union, which greatly helped to promote geophysical research in China. But only a few months before the IGY was to begin, Taiwan entered into the IGY with instigation by the US Department of State. That led mainland China to withdraw at the last minute in order to avoid the creation of a "Two Chinas" problem. The planned measurements and observations were apparently carried out, but follow-up collection and processing of data suffered, partly as a result of the lack of the pressure of international participation.⁴⁷

Yet it is doubtful that, in the absence of geopolitical rivalry with the United States, the Soviet Union would have provided the kind and the amount of technological assistance to China that it did provide.⁴⁸ It was within the framework and on the basis of this Soviet-style technical and industrial infrastructure that many of the most notable achievements of China's Western-trained scientists and engineers were produced. As Chen Mengxiong, a prominent geologist who never went abroad to study but who had been trained by Western-educated Chinese geologists in the 1940s, observed later:

The biggest difference between American and Soviet styles of engineering geology was that the American way was more open and focused more on innovation, which were reflected in their flexible practices, while the Soviets put more emphasis on applications. ... I think that it was right to learn from the Soviet Union at the time, because its approach was easier to follow. The advantage of the Soviets was that they had a set of comprehensive procedures, which we did not have in the past.⁴⁹

Chen hastened to add that "of course the Soviet approach was not supposed to be copied mechanically." "Indeed, after the end of the Cultural Revolution," he continued, "we carefully revised those old procedures in accordance with the actual

conditions in China.”⁵⁰ What resulted in China was an interesting transnational hybrid science and technology that reflected both Soviet and Western influences, which often were both conflicting and complementary.

Self-Reliance in the 1960s

After the breakup between China and the Soviet Union in the early 1960s, the Cold War turned a new chapter and China, as elaborated by Sigrid Schmalzer in her contribution to this collection, entered into an era during which self-reliance, especially in the areas of science and technology, took on a new prominence.⁵¹ The crowning achievement in this period in this regard was the successful testing of China’s first atomic bomb in 1964. Although the bomb was built with no formal participation by any foreigner, it nevertheless had many transnational characteristics: much of the infrastructure for it, including the uranium-separation facilities, was built with Soviet technical assistance. Most of the leading scientists involved in the project had been trained in the United States and in Western Europe, and a number of them had returned to China after 1949.⁵² Likewise, most of the senior scientists involved in the successful artificial synthesis of crystalline bovine insulin, another example of self-reliant science in this period, had received training in the West, and the final (though unsuccessful) official Chinese nominee for the Nobel Prize for this work, Niu Jingyi, had returned to China in 1956 with a PhD from the University of Texas.⁵³

The breakdown of the Sino-Soviet alliance and the continued Sino-American hostility led to the formation of self-reliance science and technology policy, but also to greater attention to the possibility of scientific communications with Europe, Japan, and other parts of the world. Even before the breakup with the Soviet Union, the Chinese government had hedged its Soviet bet with backup technical connections with Europe. In August of 1957, for example, Liang Sili, who had received a PhD in engineering from the University of Cincinnati in 1949 and had returned to China the same year, was sent by the Chinese government to Switzerland as a member of a trade mission with the purpose of purchasing missiles and related equipment in the black market. Liang’s group succeeded in buying theodolites and was on the verge of acquiring missiles when news came that the Soviet government had agreed to provide prototypes to China. Liang’s group was then turned into a trade delegation to West Germany, where they visited Siemens factories.⁵⁴

China extended its scientific contacts with other parts of Europe and the world. In 1962, the Chinese Academy of Sciences invited the Danish nuclear physicist Aage Bohr for a five-week visit and lecture tour, which in turn led China to send several physicists to Bohr’s Institute of Theoretical Physics in Copenhagen for one-year and two-year visits in the years 1963–1967.⁵⁵ In 1964, a Beijing Science Symposium attracted 367

scientists from 44 countries in Asia, Africa, Latin America, and the Pacific. Formally sponsored by the left-leaning Association of Scientific Workers and its Beijing branch, the conference was used by the Chinese government as a way to learn of new scientific developments and also to boost its claim as a leader of the anti-colonial cause. Two years later, Beijing hosted a Summer Symposium in Physics.⁵⁶ In 1964–65, the Chinese Academy of Sciences sent 49 graduate students to study in Great Britain, France, Sweden, Australia, Denmark, and Switzerland.⁵⁷

As the principal organizer of China's modernization drive, Premier Zhou Enlai was the main advocate for international scientific and technological contact. In early 1966, on the eve of the Cultural Revolution, Zhou urged Chinese diplomats to learn enough about science and technology to be able to coordinate the process of absorbing scientific and technological information from the countries where they were stationed.⁵⁸ Thanks in part to Zhou's protection, a number of prominent Western-trained scientists survived the Cultural Revolution, and some of them (including Zhu Kezhen, vice president of the Chinese Academy of Sciences) were able to keep abreast of international scientific developments by reading the journals *Science* and *Nature*. Thus, they were ready to plan for a resumption of scientific research and education under Zhou once the worst of the chaos was over, in the early 1970s.⁵⁹

Post-Nixon Transformations

Sino-US transnational movement of scientists benefited greatly from the Nixonian exchange of the 1970s. The Shanghai Communiqué, signed during Nixon's first trip to China in 1972, included these sentences:

The two sides agreed that it is desirable to broaden the understanding between the two peoples. To this end, they discussed specific areas in such fields as science, technology, culture, sports, and journalism, in which people-to-people contacts and exchanges would be mutually beneficial. Each side undertakes to facilitate the further development of such contacts and exchange.

Of course, Nixon's trip to China in 1972 was a calculated move by both sides in reshaping the geopolitical balance in the US-Soviet-China triangular relationship in the context of the Cold War. As with most other state-sponsored scientific international exchanges, the primary purpose for the states involved was politics, not science.⁶⁰ Yet it wasn't an accident that science and technology featured prominently in the list of areas for initial contacts. The United States had long used its strength in science and technology as a diplomatic tool and as a way to demonstrate the superiority of the American system and way of life.⁶¹ The US government sought to increase its appeal in Asia by equating science and technology, especially Americanized versions of them, with modernity. The US government was not unaware of the military

implications of scientific exchanges and technological transfers; its counterintelligence officials would always keep a close watch on the visiting Chinese scientists conducted under governmental agreements.⁶² Policy makers decided, however, that the benefit to American national interest was worth the risk.

Even though they knew that scientific exchanges formed only part of the overall new Sino-American relations, most Chinese scientists in China and Chinese American scientists in the US were heartened by the new developments, and indeed they capitalized on them in their continued pursuit of professionalism and Chinese cultural nationalism. For American-trained Chinese scientists who were still undergoing humiliating physical reeducation, the Nixon visit brought relief overnight. Many Chinese scientists saw a decisive improvement in their political fortunes when a visiting American scientist proposed meetings with them. For example, after the American marine biologist and deep-sea diver Sylvia Earle was allowed to meet with him, Zeng was able to return to research. In 1975, he was even chosen as vice chairman of a major Chinese scientific delegation to visit the United States, where he met with his fellow Michigan alumnus Gerald Ford in the White House.⁶³

For Chinese American scientists, the Nixon overture opened a new world of possibilities. The thousands of “stranded” students and scientists who decided to stay in the United States in the 1950s had been motivated by a confluence of factors, including fear of and uncertainty about the Chinese communists, disappointment with the Nationalists, the prospect for a better life in the US (especially with the repeal of the Chinese Exclusion Act during World War II), and plentiful job opportunities for scientists and engineers. Yet most of them also suffered, to varying degrees, McCarthyist political harassment, persistent racial discrimination, and a feeling of being isolated and marginalized professionally and socially. In the late 1950s and the 1960s their sense of identity crisis grew as they began to sink roots in America by becoming citizens and raising their American children. Chen Ning Yang, for example, worried that his father would never forgive him for giving up his Chinese citizenship. The act of finally becoming Americans also prompted them to seek to understand the bitter history of Chinese in the US.

Some Chinese American scientists became political activists, supporting the Civil Rights movement, joining protests against the Vietnam War in the 1960s, and leading the Defend Diaoyu movement in the early 1970s. The latter was an effort to protest against the US government for returning control of the disputed Diaoyu Islands to Japan rather than to China (or Taiwan), which had ceded them to Japan after the 1895 Sino-Japanese war and had expected to gain them back as part of the settlement after World War II. Many Chinese American scientists of the generation that saw China ravaged by Japanese invaders hoped to see their nation of origin emerge as a strong, prosperous, and modernized country. As long as China and the United States remained

isolated Cold War rivals, it was dangerous to express such attachment to China. The Nixon trip changed everything. It promised a future in which Chinese Americans in general, and Chinese American scientists in particular, could become transnational agents of exchange, legitimately serving the interests of both countries and healing the schism in their identity and political loyalty.⁶⁴

Chen Ning Yang, the first well-known Chinese American scientist to take advantage of the Nixon administration's relaxation of travel restriction, paid a visit to China in the summer of 1971. Yang had been able to keep in touch with his family in China throughout his years in the US, and had met with his parents in 1957 and 1960 in Geneva and in 1962 in Hong Kong. His father, Yang Wuzhi, a mathematics professor in Shanghai, had tried, with the tacit encouragement of the Chinese government, to convince his son to return to China, but his mother disagreed, citing the poor living conditions. ("I had to wait in a queue for two or three hours in the night to just buy some pieces of tofu.") Chen Ning Yang never seriously considered returning permanently to China once he was offered a permanent position by the Institute for Advanced Study at Princeton, but he had heeded his father's advice to avoid visiting Taiwan. During his trip in 1971, he met with Zhou Enlai and with many of his old teachers and classmates. He was carefully shielded from the dark side of the Cultural Revolution, and what he saw impressed him greatly. And he claimed to have been moved to tears when Deng Jiaxian, his childhood friend and fellow Boxer student in the US who returned to China in 1950 and who went on to play a prominent role in China's nuclear weapons program, confirmed to him that no foreigner had participated in that program.⁶⁵

However, Chen Ning Yang's meeting with another old friend, Huang Kun, and his brother Huang Wan, a heart specialist, touched a sensitive spot. When Yang mentioned the desirability of sending Chinese students to the US for training, Huang Wan said that there was a question of "who would they serve" after they finished. Taking the comment personally,

Yang responded immediately that he had wondered whether people in China might think that it was selfish for him to stay abroad. He said that yes, it was most selfish [for him to do so], but matters were not that simple. While many [Chinese] people in the US never cared for China, he thought of the country a lot. Huang Kun expressed to him [Yang] that he was especially delighted that he could overcome the many obstacles to be the first to return for this tour.⁶⁶

The sense of guilt felt by Yang and many other Chinese American scientists reinforced their Chinese cultural nationalism and motivated them to become active participants in US-China scientific exchanges. They introduced recent scientific advances to their Chinese colleagues who had been largely isolated from the international scientific community during the Cultural Revolution, established programs and institutional connections to bring Chinese scientists to the United States as visitors, and

advised the Chinese government on specific scientific problems and on major issues of science policy. Chinese science and scientists reaped benefits from US-China scientific exchanges, especially those promoted by Chinese American scientists.

The resumption of formal diplomatic relations between China and the United States in the late 1970s marked another milestone in transnational Chinese science. It came in the aftermath of the death of Mao, the end of the Cultural Revolution, and the coming to power of Deng Xiaoping, who remained the pragmatic national leader for the next two decades, pushing aggressively for the Zhou-initiated modernization drive and market-oriented economic reform for China. The normalization of relations with the US in 1979 made Chinese science even more transnational, bringing numerous bilateral cooperative scientific and technological projects into existence and further enlarging the influence of Chinese American scientists on China's science and education policy.

Yet perhaps the most significant result of formal diplomatic relations was that they opened the way for Chinese students to study in the United States, something that had proved politically impossible even after Nixon's trip. The size of the new wave of Chinese students studying in the US, which still shows no sign of abating, has been unprecedented, as was the speed with which it developed. The impact of those students is still unfolding. A large portion of them have stayed in the US after completing their studies, especially since the Tiananmen Square incident of 1989, and a growing number of them have become true transnationals by holding academic positions on both sides of the Pacific or by playing the role of facilitators in the rapid transnational development of the booming Chinese economy.⁶⁷ Those who did return also began to rise in leadership positions in Chinese science and other areas.⁶⁸ According to a 2003 Xinhua News Agency report commemorating the thirtieth anniversary of the Nixon trip, about 10,000 researchers from the Chinese Academy of Sciences alone had studied or worked in the United States in the previous 20 years, and "most of the CAS's leading scientists had a US education background."⁶⁹

The beginning of the Cold War had made a dramatic difference to science, scientists, and science policy in China and the United States in the late 1940s and the early 1950s. The end of the Cold War, which the 1989 Tiananmen Square incident may well have precipitated, didn't seem to have nearly as large an effect, at least not immediately. After a short post-Tiananmen hiatus of scientific and educational exchanges between China and the West (especially the US), both scientific and educational exchanges resumed and then accelerated in the early 1990s. The number of Chinese students coming to the US dropped again when the US government tightened visa requirements after the terrorist attacks of September 11, 2001, but the restriction was later relaxed after protests by American scientists. In 2010, Chinese students once again constituted the largest group of foreign students (127,628) in the United States.⁷⁰

Conclusion

Did the Cold War transform science in China and make it more transnational? It certainly brought about a massive Sovietization of Chinese science, technology, and education in the 1950s, within the Cold War framework of a geopolitical alliance. With the continuation of earlier American influence, reinforced by the return of about 2,000 Western-trained scientists from the United States and Europe in the 1950s, the era of Sovietization saw the emergence of what might be called a transnational hybridization of science and technology in China. Various foreign elements encountered, clashed, and merged with local ones within a highly politicized local environment. A fundamental character of science and technology in China during the Cold War was the combination of a Soviet-style scientific, technological, and industrial infrastructure built on the Nationalist legacy and a scientific and engineering workforce that was dominated by people educated in United States and Europe. This hybridization continued even during the subsequent decade of self-reliance, when both Soviet and American contacts were officially cut off. Transnational exchanges resumed in the 1970s as Westernization once again gained momentum, especially after the end of the Cultural Revolution in 1976.

Indeed, transnational science became so entrenched in China that its scientific and educational exchanges with the West, especially the US, withstood major potential countercurrents such as the 1989 Tiananmen Square tragedy and even the end of the Cold War in the late 1980s and the early 1990s when many commentators saw an increased possibility of Sino-US hostility as China rose as a major power. Today, science in China is more transnational than ever, marked by especially strong scientific and technological ties with the US, which in turn has been stimulated by booming trade and fostered by a new generation of American-educated Chinese scientists. In a 2007 speech on the importance of international scientific cooperation, Bai Chunli, who had done postdoctoral work at Caltech in 1985–1987, said: “As illustrated by the development of the Chinese Academy of Sciences in the last half century, almost all major scientific and technological achievements contained contributions from international collaboration.”⁷¹

Yet an emphasis on the transnational transformations of science and technology in China during the Cold War doesn't, as mentioned above, mean that nationalism disappeared from the scene. In fact, nationalism played a big part in the transnational dynamics. China's decision to “lean toward” the Soviet Union during the Cold War was driven at least as much by concerns about national security and sovereignty as by ideological commonality. It was the former that would later lead to the Sino-Soviet breakup. Similarly, a form of cultural nationalism that had derived from a deep awareness of China's long-time international humiliations powerfully motivated many American-educated Chinese scientists to return home in the 1950s against US policy

and to persist in their pursuit of modernization through science and technology despite political persecutions under Mao. Even those who had decided to stay in the US in the 1950s shared this sense of Chinese cultural nationalism, which was reflected in a widespread guilty feeling of having abandoned one's homeland and which drove many of them to engage actively in promoting US-China scientific exchange in the post-Nixon period and even in playing prominent roles in Chinese science, technology, and education policy.

In the end, a set of dualities shaped and reshaped the development of science and technology in China during the Cold War: a political context that reflected both the Cold War and developmental aspirations of the Chinese Communist party-state; a scientific community dominated by people trained in the West, especially the United States, working on the foundation of a technical and industrial infrastructure built with Soviet assistance and guidance; and finally, a strong sense of Chinese cultural nationalism both contrasted and underlined Chinese scientists' international scientific ideals, diverse transnational scientific training and influences, and shifting political environments. Some of these factors and dynamics arose from the Cold War; others did not. But in the case of the latter, such as Chinese scientists' sense of nationalism, the Cold War certainly sharpened it in many ways. Thus, to the extent that the Cold War helped to frame the development of transnational scientific institutions, practices, and interactions, we might say that it transformed science in China.

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Notes

1. Richard M. Nixon, "Asia after Viet Nam," *Foreign Affairs* 46, no. 1 (1967): 111–125, on 121.
2. There was much more to the Cold War than the actions and interactions of the United States, the Soviet Union, and China, of course. The so-called Third World in Asia, Africa, and Latin America, for example, played a key part in the Cold War. See Odd Arne Westad, *The Global Cold War: Third World Interventions and the Making of Our Times* (Cambridge University Press, 2005).

3. For some recent examples of transnational approaches to the history of science and technology, see Erik van der Vleuten, "Toward a Transnational History of Technology: Meanings, Promises, Pitfalls," *Technology and Culture* 49 (2008): 974–994; Zuoyue Wang, "Transnational Science during the Cold War: The Case of Chinese/American Scientists," *Isis* 101, no. 2 (2010): 367–377; John Krige, "Building the Arsenal of Knowledge," *Centaurus* 52 (2010): 280–296.
4. For more on the issue of foreign technological aid and self-reliance, see Sigrid Schmalzer's chapter in this volume.
5. See, e.g., William C. Kirby, "Technocratic Organization and Technological Development in China: The Nationalist Experience and Legacy, 1928–1953," in *Science and Technology in Post-Mao China*, ed. Denis Fred Simon and Merle Goldman (Harvard University Council on East Asian Studies, 1989); Izabella Goikhman, "Soviet-Chinese Academic Interactions in the 1950s: Questioning the 'Impact-Response' Approach," in *China Learns from the Soviet Union, 1949–Present*, ed. Thomas P. Bernstein and Hua-Yu Li (Lexington Books, 2010).
6. See, e.g., Zuoyue Wang, "Saving China through Science: The Science Society of China, Scientific Nationalism, and Civil Society in Republican China," *Osiris* 17, (2002): 291–322; Grace Yen Shen, "Taking to the Field: Geological Fieldwork and National Identity in Republican China," *Osiris* 24 (2009): 231–252.
7. On a broad survey of international influences in China in this period, see William C. Kirby, "The Internationalization of China: Foreign Relations at Home and Abroad in the Republican Era," *China Quarterly*, June 1997: 433–458. See also Benjamin Elman, *A Cultural History of Modern Science in China* (Harvard University Press, 2006).
8. Michael H. Hunt, "The American Remission of the Boxer Indemnity: A Reappraisal," *Journal of Asian Studies* 31, no. 3 (1972): 539–559.
9. Hunt, "The American Remission," 550. On the establishment of the Boxer fellowships, see also Stacey Bieler, "Patriots" or "Traitors"? *A History of American-Educated Chinese Students* (Sharpe, 2004), 42–51. Liang Shiqiu, a well-known Chinese writer who had studied English literature in the US in the 1920s as a Boxer fellow himself, first read James' letter in 1977 and commented: "How can we not react to these statements with alarm, bitterness, and shame?" Quoted in Cheng Xinguo, *Gengkuang liuxue bainian* (a century of Boxer indemnity funds for studying abroad) (East Publishing Center, 2005), 17.
10. Theodore Roosevelt, "Seventh Annual Message," December 3, 1907, in Public Papers of the Presidents (available at www.presidency.ucsb.edu).
11. The "Regulations," undated, were attached to a letter from William W. Rockhill, American minister in China, to the US Secretary of State, October 31, 1908, in US State Department, *Papers Relating to the Foreign Relations of the United States with the Annual Message of the President to Congress*, December 8, 1908 (available at <http://images.library.wisc.edu>). It is not clear who mandated the emphasis on science and technology in the fellowship program, but such a pattern was consistent with the advocacy of Zhang Zhidong, head of the Ministry of Education, that "Chinese learning should remain the essence while Western learning serve to bring utility." He

also insisted that Boxer candidates be tested primarily in Chinese, not Western subjects during the selection process. Hunt, "The American Remission," 557.

12. Cheng Xinguo, *Gengkuan*, 19–25.

13. According to Y. C. Wang (*Chinese Intellectuals and the West, 1872–1949*, University of North Carolina Press, 1966, 111), in addition to the 180 sent in 1909–1911, a total of 1,268 Tsinghua students had studied in the US with Boxer fellowships from 1912 to 1929, so the total for 1909–1929 was 1,448. Note, however, that Bieler ("*Patriots*," 381) listed only 1,119 students in the US as having come from Tsinghua from the beginning to 1953.

14. Zhu Junpeng, "Qinghua yuan nei diyipi ruxiao nusheng" (the first group of resident women students at Tsinghua), April 20, 2009 (<http://xs.tsinghua.edu.cn/docinfo/board/boarddetail.jsp?columnId=00302&parentColumnId=003&itemSeq=5602>). See also Cheng Xinguo, *Gengkuan*, 35; Wang, *Chinese Intellectuals*, 112.

15. Cheng Xinguo, *Gengkuan*.

16. Bieler, 79–81; Wang, "Saving China through Science."

17. On the Rockefeller Foundation in China, see Mary Brown Bullock, *An American Transplant: The Rockefeller Foundation and Peking Union Medical College* (University of California Press, 1980); William J. Hass, *China Voyager: Gist Gee's Life in Science* (Sharpe, 1996).

18. Ma Zusheng (T. S. Ma), *Linian chuguo/huiguo keji renyuan zonglan (1840–1949)* (a comprehensive survey of scientific and technical personnel studying abroad and back to China, 1840–1949) (Social Sciences Academic Press, 2007). Ma was a Tsinghua graduate who received his PhD in chemistry from the University of Chicago in 1938, and after teaching stints in China and New Zealand in the late 1940s, spent much of his career at the City University of New York. See Cheng Xiankang, "Daonian guoji zhuming huaxuejia Ma Zusheng xuezhang [in memory of Ma Zusheng, a senior alumnus and internationally renowned chemist]," June 24, 2008 (<http://www.tsinghua.org.cn/alumni/infoSingleArticle.do?articleId=10015446&columnId=10015367>).

19. Cheng Xinguo, *Gengkuan*, 72–88.

20. Yu Hao and Huang Yanfu, *Zhongguo keji de jishi: Ye Qisun he kexue dashimen [The Cornerstones of Chinese Science and Technology: Ye Qisun and Scientific Masters]* (Fudan University Press, 2000), 100–112.

21. Fan Dainian and Qi Fang, "Wang Ganchang xiansheng zhuanlue [A Biographical Sketch of Mr. Wang Ganchang]," in *Wang Ganchang he tade kexue gongxian [Wang Ganchang and His Scientific Contributions]*, ed. Hu Jimin et al. (Science Press, 1987), 228.

22. Norbert Wiener, *I Am a Mathematician* (MIT Press, 1964), 186.

23. Wang, "Saving China."

24. See Baichun Zhang, Jiuchun Zhang, and Fang Yao, "Technology Transfer from the Soviet Union to the People's Republic of China, 1949–1966," *Comparative Technology Transfer and Society* 4, no. 2 (2006): 105–171; Zhang Baichun, Yao Fang, Zhang Jiuchun, and Jiang Long, *Sulian*

jishu xiang zhongguo de zhuan yi, 1949–1966 [Technology Transfer from the Soviet Union to the People's Republic of China, 1949–1966] (Shandong Education Press, 2004).

25. Wang, "Transnational Science."

26. Zhang et al., *Sulian jishu*. See also Wu Yan, ed., *Zhongsu liangguo kexueyuan kexue hezuo ziliao xuanji* [A Selected Collection of Documents on the Scientific Cooperation between the Academies of Sciences OF China and the Soviet Union] (Shandong Education Press, 2008). On the sending of Soviet technical advisors to China, see Shen Zhihua, *Sulian zhuanjia zai zhongguo, 1948–1960* [Soviet Specialists in China, 1948–1960] (Xinhua Press, 2009).

27. See Wu Yan, *Zhongsu liangguo*.

28. Zhang et al., *Sulian jishu*, 162.

29. See Laurence Schneider, *Biology and Revolution in Twentieth-Century China* (Rowman and Littlefield, 2003), 155–159, and Schmalzer's chapter in this collection.

30. Hu Zonggang, *Bugai yiwang de Hu Xiansu* [The Hu Xiansu That Should Not Be Forgotten] (Changjiang Wenyi Press, 2005), 166.

31. Schneider, *Biology and Revolution*, 155–159.

32. Mao Zedong, "Tong sulian zhuhua dashi youjin de tanhua [Talks with Yudin, Soviet Ambassador]," July 22, 1958 (<http://www.mzx.cn/theory/html/mx07385.htm>).

33. Tao Wenzhao, "Jinyun yu fan jinyun: wushi niandai zhongmei guanxi zhong de yichang yanzhong douzheng [Embargo and Anti-Embargo: A Serious Struggle in China-US Relations in the 1950s]," *Zhongguo shehui kexue* [China Social Science] 3 (1997): 179–193.

34. Peter Neushul and Zuoyue Wang, "Between the Devil and the Deep Sea: C. K. Tseng, Mariculture, and the Politics of Science in Modern China," *Isis* 91, no. 1 (2000): 59–88, on 74.

35. Wang, "Transnational Science."

36. Beijing Municipal Archives, Beijing, file no. 002–020–339 "Guojia keweizhuanjiaju 1959.3.5 tongzhi [Circular from the Bureau on Experts of the National Science and Technology Commission dated March 5, 1959]," attachment 1.

37. Beijing Municipal Archives, Beijing, file no. 002–020–339. The report didn't give specific breakdowns of disciplinary distributions within each country of education.

38. See Iris Chang, *Thread of the Silkworm* (Basic Books, 1995).

39. See *ibid.*, 190.

40. Zhang is quoted in Jin Chongjin et al., *Zhou Enlai zhuan, 1949–1976* [A Biography of Zhou Enlai] (Central Documentation Press, 1998), volume 1, 235.

41. Zhu Zhaoxiang, "Qian Xuesen xiansheng zai lixuesuo chuangjian de rizili [Mr. Qian Xuesen in the founding period of the Institute of Mechanics]," *Kexue shibao* [Science Times], December 7, 2005, as quoted in Ye Yonglie, *Qian Xuesen* (Shanghai Jiaotong University Press, 2010), 205.

42. Wang, “Transnational Science.”

43. Li Peishan, “Guiguo lixuesheng 1949 nian yihou zai zhongguo kexue jishuyfazhan zhong de diwei yu zuoyong [The Status and Roles of Returned Students in Scientific and Technological Developments in Post-1949 China],” *Ziran biezhengfa tongxun [Journal of the Dialectics of Nature]* 11, no. 4 (1989): 26–34. These statistics didn’t include those Chinese scientists who remained abroad after they finished their studies but later played active roles in facilitating Sino-foreign scientific exchange. The dictionary Li used, *Zhongguo kexuejia cidian [Dictionary Of Chinese Scientists]* (Shandong Science and Technology Press, 1982–1986), included engineers under “technological science.”

44. For a Chinese translation of selections of the Russian transcript of a session of the Presidium of the Soviet Academy of Sciences on July 6, 1956, see Wu Yan, *Zhongsu liangguo*, 224. The English translation from the Chinese presented here is my own.

45. Wu Yan, *Zhongsu liangguo*, 223. Several delegation members also made the point that in two or three years, with the return of Western-trained scientists and with China’s growing research capabilities, Soviet advisors in China probably wouldn’t be in a position to provide guidance in many fields. At this point it is not clear whether this belief figured into Khrushchev’s decision to withdraw all Soviet advisors in 1960.

46. On Tu, see Tu Guangchi et al., *Tu Guangchi huiyi yu huiyi Tu Guangchi [Recollections by and of Tu Guanzhi]* (Hunan Education Press, 2010), 45–49. On Zhang Li, see interview with Zhang Li, Tsinghua University, Beijing, by Zuoyue Wang and Yin Xiaodong, December 17, 2011. On Yang, see “Yang Guanghua xiansheng shengping [Obituary of Mr. Yang Guanghua]” (<http://www.cup.edu.cn/heavyoil/Bulletin/37957.htm>). Tu had joined the Chinese Communist Party in 1949 while still in the US (*Tu Guangchi huiyi*, 55–56). Zhang joined in 1949 after his return to China. Yang joined in 1956.

47. Zuoyue Wang and Jiuchen Zhang, “China and the International Geophysical Year,” in *Globalizing Polar Science: Reconsidering the Social and Intellectual Implications of the International Polar and Geophysical Years*, ed. Roger D. Launius, James R. Fleming, and David H. Devorkin (Palgrave Macmillan, 2010).

48. See, e.g., Shen Zhihua, *Sulian*.

49. Zhang Jiuchen (interviewer), “Wo suo jiechu de sulian zhuanjia—Chen Mengxiong fangtan [The Soviet Experts I Encountered—An Interview with Chen Mengxiong],” *Zhongguo keji shi zazhi [Chinese Journal for the History of Science and Technology]* 32, no. 2 (2011): 154–165, on 162.

50. Zhang Jiuchen, “Wo suo jiechu de sulian zhuanjia,” 162.

51. Schmalzer, “Self-Reliant Science.”

52. Wang, “Transnational Science,” 373–374.

53. Xiong Weimin and Wang Kedi, *Hecheng yi ge danbaizhi: Jiejing niu yidaosu de rengong quan hecheng [Synthesize a Protein: The Story of the Total Synthesis of Crystalline Insulin Project in China]*

(Shandong Education Press, 2005), 17 and 121. On this project, see also Schmalzer's chapter in this book.

54. Guo Mei and Pang Ru, *Liang Sili zhuan [a biography of Liang Sili]* (Jiangsu People's Press, 2009), 41–42; Zuoyue Wang interview with Liang Sili, Beijing, July 14, 2011. See also Zhou Bolun, ed., *Nie Rongzhen nianpu [A Chronicle of the Life of Nie Rongzhen]* (People's Press, 1999), volume 1, 592 and 624. Marshal Nie was in charge of Chinese missile and atomic bomb programs in this period.

55. See Yin Xiaodong, "Danmai wulixuejia aoge boer laihua fangwen shimo jiqi yingxiang [Danish Physicist Aage Bohr's Visit to China and Its Impact]," *Ziran kexueshi yanjiu* 31, no. 3 (2012): 329–342. See also John Krige, "The Ford Foundation, European Physics, and the Cold War," *Historical Studies in the Physical and Biological Sciences* 29, no. 2 (1999): 333–361.

56. Xiong Weimin, "Zai kexue yu zhengzhi zhijian: 1964 nian de Beijing kexue taolunhui [Between Science and Politics: The 1964 Beijing Scientific Symposium—An Oral History Interview with Mr. Xue Pangao]," in *Xue Pangao wenji [Collected Papers of Xue Pangao]* (Division for the History of the Chinese Academy of Sciences of the Institute for the History of Natural Science, Chinese Academy of Sciences, 2008).

57. Qian Linzhao and Gu Yu, eds., *Zhongguo kexueyua* (Contemporary China Press, 1994), volume 1, 137.

58. Zuoyue Wang, "US-China Scientific Exchange: A Case Study of State-Sponsored Scientific Internationalism during the Cold War and Beyond," *Historical Studies in the Physical and Biological Sciences* 30, part. 1 (1999): 249–277.

59. See, e.g., Zhu Kezhen and Wu Youxun to Zhou Enlai (draft), September 26, 1968, in *Zhu Kezhen quanji [Complete Works of Coching Chu]* (Shanghai Science, Technology, and Education Press, 2004–), volume 4, 391–393.

60. Wang, "US-China Scientific Exchange."

61. Examples include Nixon's kitchen debate with Khrushchev, Eisenhower's giving Polaroid cameras as gifts to foreign leaders, and Johnson's present to the visiting president of South Korea—the Korean Institute of Science and Technology. On the last, see Kim Dong-Won and Stuart W. Leslie, "Winning Market or Winning Nobel Prizes? KAIST and the Challenges of Late Industrialization," in *Osiris* 13 (1998): 154–185. See also John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe* (MIT Press, 2006); John Krige and Kai-Henrik Barth, eds., *Global Power Knowledge: Science and Technology in International Affairs* (*Osiris* 21, 2006).

62. In the 1980s, for example, the FBI recruited Sylvia Lee, a staff member at the Los Alamos weapons laboratory, to keep track of Chinese scientists visiting the laboratory. In 1999, Lee's husband, Wen Ho Lee, was accused of nuclear espionage for China; he was later acquitted of all charges except for one of mishandling nuclear secrets. Dan Stober and Ian Hoffman, *A Convenient Spy: Wen Ho Lee and the Politics of Nuclear Espionage* (Simon and Schuster, 2001).

63. Neushul and Wang, "Between the Devil and the Deep Sea."

64. Wang, "US-China Scientific Exchange."
65. Wang, "US-China Scientific Exchange"; Yang Zhenning (C. N. Yang), "Deng Jiaxian," in *Yang Zhenning wenji [Writings of C. N. Yang]* (Central China Normal University Press, 1998), volume 2, 797–804; C. N. Yang, interview with Zuoyue Wang, July 21, 2011, Beijing.
66. "Yang Zhenning zhuanjuan 1971 nian (san zhi yi) [Special Files on C. N. Yang]," file 72-4-61, in Archives of the Chinese Academy of Sciences, Beijing.
67. On the history of Chinese students in the US since the late 1970s, see Zuoyue Wang, "'Xuehao shulihua ... ': 1978 nian hou dalu liumei kexuejia yanjiu [If You Learn Your Math, Physics, and Chemistry ... ': A Historical Study of Chinese Scientists in the US since 1978]," in *Beimei huaqiao huaren xin shijiao* (Overseas Chinese Press, 2008). In turn, the infusion from China (and Asia in general) was in large part responsible for an up surge in the number of science PhDs, especially physics PhDs, awarded in the US in the 1980s. See the graphs of "Physics PhD's and all PhD's conferred in the US, 1900 through 2007" and "Citizenship of Physics PhD's 1967 through 2007" at <http://www.aip.org>. Thanks to David Kaiser for information regarding these trends.
68. Zuoyue Wang, "Chinese American Scientists and US-China Scientific Relations: From Richard Nixon to Wen Ho Lee," in *The Expanding Roles of Chinese Americans in US-China Relations: Transnational Networks and Trans-Pacific Interactions*, ed. Peter H. Koehn and Xiao-huang Yin (Sharpe, 2002).
69. Xinhua News Agency, "Sci-tech Cooperation Promotes Sino-US Relations," February 7, 2002 (<http://www.china.org.cn/english/26753.htm>).
70. Tamar Lewin, "China Surges Past India as Top Home of Foreign Students," *New York Times*, November 15, 2010.
71. Bai Chunli, "Keji chuangxin xuyao quanqiu de shiye he yishi," *Keji ribao*, September 4, 2007 (scitech.people.com.cn/GB/6211876.html). (Bai, who at the time he gave the speech quoted was vice president of the CAS, became president of that body in 2011.)