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## PHYSICS IN CHINA IN THE CONTEXT OF THE COLD WAR, 1949–1976

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In April 1952, just days after he was appointed the associate director of the Institute of Modern Physics of the Chinese Academy of Sciences in Beijing, the Chinese nuclear physicist Wang Ganchang was called into the headquarters of the academy. A secret mission awaited him at the battle front of the Korean War: The Chinese forces suspected the US had used “atomic shells” and wanted Wang to investigate the matter. Wang, a physicist who had gone to Berlin University to study with Hans Geiger but ended up receiving his Ph.D. with Lise Meitner at the Kaiser Wilhelm Institute in 1933, was well-qualified for the job. With a primitive but effective Geiger counter, Wang checked fragments of the suspect shells and found that there was no increase in radioactivity. He concluded that they were not mini atomic bombs, but perhaps a new type of conventional weapon.<sup>1</sup> A relatively minor incident in the Korean War, it nevertheless marked a milestone toward the beginning of an era when the Cold War and nuclear weapons increasingly and decisively shaped the context within which physics was practiced in the People’s Republic of China under Mao Zedong. A decade later, Wang emerged as a major architect of the Chinese nuclear weapons project and his whole institute and most of the leading Chinese physicists devoted themselves to it.

In recent decades historians of science have become increasingly interested in the interactions of science and state during the Cold War. In his influential paper on quantum electronics Paul Forman, for example, has asked us to examine to what extent the needs of the national security state drove the development of American physics. Other scholars have since painted a picture of the science/state relationship where American scientists embraced the national security state, with its objective of containing Soviet expansionism, much more readily than previously thought. All, however, seem to agree that the Cold War transformed American science, especially American physics. While this debate has generated fruitful discussions on the interactions between science and state during the Cold War in the US and, to a lesser extent, in Europe and the Soviet Union, little has been known about the experiences of Chinese scientists.<sup>2</sup>

What drove the dynamics of the relationship between scientists and the state in the Chinese context during the Cold War? To what extent was the science-state

<sup>1</sup> Li et al., *He wulixuejia*, pp. 108–112. Wang later recognized that if it had been an atomic bomb, there would not have been fragments left.

<sup>2</sup> Forman, *Behind Quantum Electronics*; Kevles, *Cold War*; Forman/Sánchez-Ron, *National Military Establishments*.

interaction mediated by the particular political and social environment of Maoist China? In this paper, I explore the forces and circumstances, especially their sense of nationalism, that led Chinese physicists and other scientists to cast their lot with the Communists, to survive the harsh political and ideological purges, and eventually to participate in the nuclear weapons program. As in Stalinist Russia, Mao and other Communist leaders needed to soften their mistrust of western-trained scientists for their service to the Chinese national security state. The Cold War, especially the pursuit of nuclear weapons and the accompanying political confrontations between China, the Soviet Union, and the United States, profoundly affected the funding and direction of Chinese science, especially physics. Ultimately, the experiences of Wang Ganchang and other Chinese physicists indicate that a complex web of interactions that was built on Chinese nationalism, scientific professional autonomy, Communist ideology, and the geopolitical strategies of the Chinese party-state shaped the social/political environment for the practice of physics during the Cold War.

#### WAITING FOR MAO

In order to understand the experience of Chinese physicists during the Cold War, it is necessary to examine the background of modern science in China. Perhaps more than their counterparts in other countries, a sense of scientific nationalism motivated most of the first generation of modern Chinese scientists to pursue science and technology in the early twentieth century. Their aim was not so much to make China into a leader in world science as to use science to help make China a prosperous and strong country, or "saving China through science." Born in the late 19th and early 20th century, many of these first generation of modern Chinese scientists were trained in the West, especially in the US, in the 1910s and 1920s, and went back to China to establish its earliest educational, research, and industrial institutions in science.

Organizationally, the Chinese scientific community cohered around two main groups during the Republican period (1911–1949): the older and privately-run Science Society of China and the newer, official Academia Sinica. Prominent Chinese physicists played an active role in both institutions. Founded by Chinese students at Cornell University in 1914, the Science Society can be seen in many ways as an attempt by Chinese scientists to build a civil society and public sphere, especially through their publication of the influential *Kexue* (science) magazine, in China. Together the society and the journal provided Chinese scientists with a forum where they could both critique the government's public policy and, as a departure from civil society institutions in the West in general but in some ways analogous to the German Research Foundation (*Deutsche Forschungsgemeinschaft*, DFG), collaborate with the government in furthering a form of scientific nationalism that sought to strengthen Chinese national development through science and technology. Receiving funding from private donations, local governments, and the semi-public China Foundation for the Promotion of Education

and Culture, the society in turn supported research at its own institutes as well as that carried out by scientists elsewhere. In contrast, the Academia Sinica was established by the new Nationalist government under Jiang Jieshi (Chiang Kai-shek) in 1927 as an official entity to help unify the country politically as well as scientifically. As a step forward in the struggle for Chinese scientific nationalism, the Academia, modeled after the Soviet and French academies, won overwhelming support of the leaders of the Science Society of China. Indeed, many of them became directors of institutes in the new academy.<sup>3</sup>

Given such close ties between the scientific leaders and the Nationalists and the West, it was striking that few of them moved with the US-backed government to Taiwan when it lost the civil war to the Communists in 1949, one of the signal events of the Cold War. The estrangement between the scientists and the Nationalist regime derived largely from the latter's reputation for corruption, but also partly from a resentment over a perceived American and European indifference toward Japanese aggression in China before the Pearl Harbor attack in 1941. For example, Zhu Kezhen, a Harvard-trained meteorologist who was a leader in both Academia Sinica and the Science Society and, in 1936, hand-picked by Jiang as president of Zhejiang University, grew critical of the Nationalist and US policy in the late 1930s. In 1938, while leading the university on a perilous journey inland to evade the advancing Japanese army, which eventually claimed the lives of his wife and a son, Zhu indignantly wrote in his diary that "the Americans, the British, and the French were all helping the [Japanese] invaders [by refusing to cut off its oil supplies]."<sup>4</sup> Two years later, he added angrily that the Japanese used newly-designed airplanes purchased from the US to shoot down Chinese airplanes.<sup>5</sup> Another entry, in 1944, expressed his dissatisfaction with the Nationalists:

I am not opposed to the Nationalists per se, but was extremely reluctant toward joining the party. As to the various behaviors of the Nationalists, I view them with complete disgust and abhorrence. Recently, I have become even more horrified and outraged by individuals within the party who became followers of the German Nazis ... If we are forbidden from criticizing those embezzling officials such as Kong [one of the Jiang's brothers-in-law], where is the freedom of speech?<sup>6</sup>

Wang Ganchang, likewise, quickly became disillusioned with the Nationalists when he returned to China from Germany and was recruited by Zhu Kezhen to Zhejiang University. He sympathized with his students, such as Xu Liangying, who had joined the underground Communist Party in opposition to the Nationalist policy. He openly approved, for example, of Xu's couplet "Science Is Supreme; Physics Comes First" on his (Wang's) make-shift laboratory, which was a direct challenge to Jiang Jieshi's edict that "The State is Supreme; The Military Comes

<sup>3</sup> Wang, *Saving China*.

<sup>4</sup> Zhu Kezhen diary for April 29, 1938, in: Zhu, *Zhu Kezhen riji*, vol. 1, p. 227.

<sup>5</sup> Zhu Kezhen diary for October 18, 1940, *ibid.*, p. 461. Two years later, his wife and one of his sons died from disease contracted on the road while escaping from the Japanese army.

<sup>6</sup> Zhu Kezhen diary for July 13, 1944, in Zhu, *Zhu Kezhen riji*, vol. 2, p. 768.

First.”<sup>7</sup> Qian Sanqiang, another leading Chinese physicist who was trained in the labs of Irene and Frédéric Joliet-Curie in Paris in the 1940s, returned to China in 1948 with the hope of setting up a government-sponsored nuclear research center in Beijing under his leadership. Unbeknownst to Qian, however, intervention from the US embassy led to a cancellation of the center.<sup>8</sup> The American action likely derived from its Cold War concerns: Beijing was on the verge of being overtaken by the Communists and Qian had been closely associated with Frédéric Joliet-Curie, one of the best known French Communists. The apparent sudden change of plans left Qian frustrated; he became disappointed with what he interpreted as a sign of the Nationalists’ lack of interest in science. Thus when the government sent for him to retreat to Taiwan, he declined and instead waited for the Communists to take over the city.<sup>9</sup>

Despair with the Nationalist and a hope, though an uneasy one, for the Communists made Qian, Wang, Zhu, and most other scientists decide to ride out the coming storm by remaining on the mainland. As Zhu told Wu Youxun, a physicist trained in the US with Arthur Compton in the 1920s and another leader of the Science Society:

when the Nationalists launched the Northern Expedition [to defeat the warlords in 1927], the people rejoiced as much as they do today. But the Nationalists did not capitalize on the opportunity; they instead covered up embezzlements, failed to adhere to clear rules of rewards and punishments, and ended up being overthrown today. The people have welcomed the Liberation Army as they do clouds amidst a severe draught. [I] hope that [the Communists] can work hard to the end and do not turn out to be as corrupt as the Nationalists. Science is extremely important to construction, and [I] hope the Communists could pay close attention to it.<sup>10</sup>

Despite their unease, most Chinese scientists seemed genuinely impressed by the strong support the new government provided science. Shortly after the transfer of power, Zhu, Wu, Wang, Qian, and about 200 other prominent scientists in the country were invited by the new government to participate in the making of a new science policy in Beijing.<sup>11</sup> While in Beijing, Zhu took part in the making of a provisional Constitution for China and was apparently responsible for the inclusion of Article No. 43: “[The government] will strive to develop natural sciences, [make them] serve industrial, agricultural, and defense construction, reward scientific discoveries and inventions, and popularize scientific knowledge.”<sup>12</sup> On October 1, 1949, Zhu climbed on top the Tiananmen gate to witness Mao Zedong’s declaration of the founding of the People’s Republic of China. Two weeks later,

<sup>7</sup> Xu, Enshi Wang Ganchang. Xu himself later became a translator of Albert Einstein’s works and an outspoken human rights advocate in China. See Overbye, *Einstein’s Man*.

<sup>8</sup> Ge, Qian Sanqiang he zaoqi.

<sup>9</sup> Ren, *Bochunzhe*, pp. 44–45.

<sup>10</sup> Zhu Kezhen diary entries for May 25–27, 1949, in: Zhu, *Zhu Kezhen riji*, vol. 2, pp. 1255–1256.

<sup>11</sup> Zhu Kezhen diary entry for June 24, 1949, in: Zhu, *Zhu Kezhen riji*, vol. 2, p. 1265.

<sup>12</sup> Xie, Zhu, p. 537. Zhu Kezhen diary entry for September 1, 1949, in: Zhu, *Zhu Kezhen riji*, vol. 2, p. 1285.

he was appointed vice-president of the new Chinese Academy of Sciences, as was Wu a year later.<sup>13</sup> The Academy established a new Institute of Modern Physics on the basis of two older physics institutes, one under the Academia Sinica in Shanghai and the other under the Peking Academy in Beijing. Qian was appointed the institute's director and Wang a division leader (later associate director).

Ultimately, most Chinese scientists' enthusiastically received the Chinese Communists because they believed that the Communists shared their nationalist drive, and that a stable government would support the development of science and reconstruction of the country. After all, Mao had declared poetically on June 15, 1949, that:

China must be independent, China must be liberated, China's affairs must be decided and run by the Chinese people themselves, and no further interference, not even the slightest, will be tolerated from any imperialist country ... The Chinese people will see that, once China's destiny is in the hands of the people, China, like the sun rising in the east, will illuminate every corner of the land with a brilliant flame, swiftly clean up the mire left by the reactionary government, heal the wounds of war and build a new, powerful and prosperous people's republic worthy of the name.<sup>14</sup>

Identifying with these announced nationalist goals of the Communists, Chinese scientists enthusiastically supported the government's decision to establish the Chinese Academy of Sciences (CAS) as the new center of national scientific research. Like the Academia Sinica it replaced, the CAS was a state-sponsored scientific institution, which marked a continuity between the Nationalist and the Communist eras and helped explain the ease with which Chinese scientists embraced the new academy. To many of them, a strong central government willing to both use and support science formed a key part of their nationalist program for a modern China. Their initial, positive interactions with the Communists affirmed their decision to give the benefit of the doubt to the new regime, with hope for a better and more efficient party state to set China on the road to modernization through the application of science and technology. Thus, like their counterparts in two earlier revolutions – the French Revolution and the Russian Bolshevik revolution – they not only made accommodations to the new regime, but actually welcomed it with substantial, if not complete, enthusiasm.

#### MAO ON SCIENCE AND SCIENTISTS

For their part, Mao and other Chinese leaders both shared and differed from the scientists' view on the role of scientists and science in the Communist party state. On the one hand, Mao agreed with the scientists that natural science was crucial for economic development in general, and for industrialization in particular. On the other hand, Mao, a firm believer in class struggle as a driving force in his-

<sup>13</sup> Xie, Zhu, pp. 539–541.

<sup>14</sup> Mao, Address to the Preparatory Meeting.

tory, regarded scientists, especially those trained in the West, as belonging to the reactionary bourgeois or, not much better, petty bourgeois class. Therefore, in his view, bourgeois scientists were to be used, but not completely trusted politically until they were thoroughly reformed ideologically. Reinforcing his ambivalent attitude toward the scientists was an inherent tension in his attempt to combine and reconcile two potentially conflicting paradigms of Chinese nationalism: revolution and modernization. Was revolution a means toward the end of modernization or vice versa? In many ways, Mao's attitudes toward scientists, which in turn helped shape national science policy, often depended on the manner he tried to solve the tension of the revolution-modernization matrix.

Mao's essentially negative political assessment of Chinese scientists also paralleled his decision to seek and rely on Soviet political, strategic, and technical support during the Cold War. Mao and Josef Stalin had not enjoyed a close working relationship during the Chinese revolution. Even after the Chinese Communist victory, Stalin suspected that Mao and his colleagues might be tempted to align with the United States. "This problem was only solved when we began to fight the Americans in the Korean War," according to Zhou Enlai, a leader of the Chinese Communist Party and premier of China from 1949 to 1976.<sup>15</sup> Yet, despite such clashes, there was little doubt in Mao's mind that he needed Soviet nuclear protection in order to secure the revolution at home and to deter a possible American military intervention. In June 1949 he announced a foreign policy of "leaning toward one side," signaling that China would form a political alliance with the Soviet Union. In late 1949 and early 1950, Mao made a humble pilgrimage to Moscow, during which he asked Stalin for a formal friendship treaty between the two countries. When Stalin initially demurred, citing his Yalta agreement with the Nationalists and the US, Mao stubbornly persisted in his request. Finally, new developments, especially a softening of Western attitude toward China, apparently led Stalin to relent. The new treaty was signed, along with agreements on financial and technical assistance to China.<sup>16</sup>

The outbreak of the Korean War in the summer of 1950 and Mao's decision for China to enter the war later that year dramatically increased China's strategic importance to Stalin. They also led to a large increase in Soviet military-technical aid to China. Indeed Mao's decision to enter the war in the first place may have been influenced by the promise of this assistance.<sup>17</sup> In 1950–1951, the two countries signed agreements to set up four joint companies in the areas of civil aviation, petroleum, metallurgy, and shipbuilding. By the time Stalin had died in 1953, the Soviets had promised to help China build 141 major technological projects in military and civilian industries.<sup>18</sup> The massive scale of Soviet technological transfer was unprecedented in history and greatly accelerated the pace of

<sup>15</sup> Chinese Communist Party Central Documentation Research Office, Zhou Enlai nianpu, vol. 1, pp. 620–621.

<sup>16</sup> Jiang/Jin, Mao Zedong zhuan, vol. 1, pp. 28–58; Zhang et al., Sulian jishu, p. 14.

<sup>17</sup> See, e.g. Holloway, Stalin, p. 280.

<sup>18</sup> Mao, Tong Sulian, p. 387; Xie, Dangdai, vol. 1, pp. 14–15.

Chinese industrialization in the 1950s. Like the American Marshall Plan, it was calculated to solidify a strategic alliance. Yet, the Soviet technical aid was not without its hidden cost to the Chinese, as Mao himself soon realized: reliance on Soviet technical assistance encouraged the Chinese government to follow Stalin's model of economic development through emphasis on heavy industries at the neglect of agriculture and consumer industries. The reliance on the Soviets also lessened the importance of indigenous technical resources, including the Chinese scientists themselves, in the eyes of the Chinese Communist party state. Thus it was not surprising that during this period, the government saw only a minimal role for the Chinese Academy of Sciences in national defense, directing it instead to focus on thought reform of the scientists and solving practical problems in industrial production.<sup>19</sup>

The Korean War also dramatically changed the domestic political dynamics with a profound impact on the scientists. Just as the war helped fan the McCarthyist red-scare in the US, it intensified the Chinese campaign to purge domestic enemies. Partly to help pay for the Korean War, Mao started an anti-embezzlement, anti-waste, and anti-bureaucratism campaign. Soon thereafter, targeting the intellectuals and scientists more specifically, Mao and the party launched a Thought Reform movement to remold their thinking along the lines of Marxist ideology and to build up their loyalty to the Communist Party. At the local level, these national movements were widely used by party branch organizations to humiliate and persecute scientists. Without the protection of due process, scientists were often falsely accused of embezzlement or forced to confess crimes that they never committed. Those scientists who had returned from the US faced especially harsh harassment in this period. The movement was the first, but certainly not the last, of the national ideological campaigns in the Mao years from which no scientist or intellectual could escape.<sup>20</sup>

#### THE BOMB AND TECHNO-NATIONALISM

To many Chinese scientists these ideological campaigns certainly put a damper on their idealistic vision of science under the Communists, but, encouraged by moderates such as Zhou Enlai, they maintained faith in the possibility of using their talent for national reconstruction. In 1956, their moment seemed to have finally arrived. On January 21 of that year, Zhu Kezhen, Wu Youxun, and other leaders of the Chinese Academy of Sciences went to Zhongnanhai, seat of the Chinese Communist Party (CCP) headquarters within the Forbidden City, to give reports on the state of science and technology in China and the world. They were surprised by the attention they received:

<sup>19</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 14, 50–65.

<sup>20</sup> *Ibid.*, pp. 26–30.



Chairman Mao himself was present, as well as President of the People's Congress Liu Shaoqi, Premier Zhou Enlai, and vice premiers Chen Yun, Chen Yi, Li Fuchun, Deng Xiaoping, and others. The audiences consisted of the party chiefs in various provinces and various ministries, totaling between 1,300–1,400, filling the whole auditorium ... Today's conference was extremely solemn and grand. [I] did not expect that the people's government would attach so much significance to science.<sup>21</sup>

What accounted for the Chinese government's unexpected surge in interest in Chinese science and what did this interest portend for the relationship between the Chinese scientists and the party state?

The urgent need to develop China's own nuclear weapons made Mao and the party pay attention to Chinese science, especially Chinese physics. Even though Mao had famously called the atomic bomb a "paper tiger," he was enough a realist to realize that the weapon did change the strategic balance in international politics. That thinking was part of the reason he insisted on the signing of the China-Soviet friendship treaty in 1950. In 1953, he also felt the pressure of President Dwight D. Eisenhower's threat of the use of nuclear weapons to force the Chinese and North Koreans to end the war. The next year, Eisenhower again threatened the use of nuclear weapons when Mao ordered the shelling of Nationalist-controlled Jinmen (Quemoy) and Mazu (Matsu) islands off the Chinese coast. Initially Mao sought Soviet help to develop China's own nuclear weapons. However, when he made such a request to the visiting Nikita Khrushchev in Beijing in October 1954, the Soviet leader balked. He tried to convince Mao to give up his nuclear dream because China did not have the industrial infrastructure or financial capability and should instead be content to stay under the Soviet nuclear umbrella. Rebuffed, Mao and Zhou came to recognize that the Soviets would not share all its advanced technologies and that China still had to build its own scientific and technological ability if it was to fend off the American nuclear threat again in the future.<sup>22</sup>

This encounter reinforced a Chinese determination to pursue a techno-nationalist program to enhance China's national strength and international prestige through the building of its own strategic weapons.<sup>23</sup> Two weeks after his meeting with Khrushchev, Mao spoke at a meeting with the National Defense Commission about the need to modernize the Chinese military:

Our industry, agriculture, culture, and military are still not strong. Imperialists dare to bully us because they figure that we don't have much strength. They say: "How many atomic bombs do you have?" But they are mistaken in their evaluation of us in at least one aspect, i. e., the potential power of China at the present will be stunning when it's released.<sup>24</sup>

<sup>21</sup> Zhu Kezhen diary entry for January 21, 1956, in: Zhu, Zhu Kezhen riji, vol. 3, p. 641.

<sup>22</sup> Shi, Zai lishi, pp. 571–573. See also Niu, Mao, esp. p. 55.

<sup>23</sup> See Lewis/Xue, China, and Feigenbaum, China's Techno-Warriors.

<sup>24</sup> Mao, Zai guofang.

For the next few weeks and months, the atomic bomb was constantly on Mao's mind even when he met delegations from several Asian countries.<sup>25</sup>

While continuing to call the atomic bomb a paper tiger, Mao and Zhou wasted no time in planning for a Chinese nuclear weapons project, with the expectation that the Chinese scientists would build the bomb with major Soviet technical assistance. On January 14, 1955, Zhou met Qian and Li Siguang, a well-known Chinese geologist and vice president of the Chinese Academy of Sciences, to plan for a major presentation to the top party state leadership. The next day, just about everybody in the Chinese leadership from Mao on down showed up for the scientists' briefing on atomic energy, complete with uranium samples from a uranium mine that had just been discovered in southern China. At the end of the session, Mao spoke of the decision to go forward with the program:

We now know that our country has uranium mines. After further exploration, we will certainly find even more uranium mines. In addition, we have trained a number of people, laid some foundation in scientific research, and created some favorable conditions [for the nuclear program]. In the past several years, preoccupation with many other things have led to a neglect of this matter. But it has to be taken seriously. Now it's the time to go at it. As soon as we put it on our agenda, focusing on it steadily, we will definitely achieve our goal ... Now, with the Soviet assistance, we should make it work. [Even if] we have to do it on our own, we can also definitely get it to work. As long as we have the people and the resources, we can create miracles at will.<sup>26</sup>

A decision was made right at the meeting to pool the country's resources to solve the various technical problems of an atomic energy program. A Department of Technical Physics was established at Beijing University and a Department of Engineering Physics at Qinghua University to work on nuclear physics and engineering. In the Chinese Academy of Sciences, a Bureau of New Technologies was established to handle nuclear, rocket, and satellite projects. Qian and Wang's institute became the center of nuclear research and development.<sup>27</sup> Two days after the big meeting in Zhongnanhai, the Chinese government received a formal notice from the Soviet Union that the Soviets, in an effort to compete with the American Atoms for Peace program, had launched its own initiative to help countries in the Eastern bloc in the development of peaceful nuclear energy.<sup>28</sup> The Chinese Academy of Sciences utilized the Soviet Atoms for Peace offer to build a heavy water reactor (7 megawatt) and a 1.2 meter (2.5 MeV) cyclotron in 1958.<sup>29</sup>

The return in the early and mid-1950s of a large number of Chinese scientists from abroad, mainly the US, but also from Europe, bringing with them cutting-edge science and technology from the West, also contributed to the increasing

<sup>25</sup> See, e.g. Mao, *Tong Yindu*; Mao, *Tong Riben guohui*.

<sup>26</sup> Qian, *Shenmi*.

<sup>27</sup> Chinese Communist Party Central Documentation Research Office, *Zhou Enlai nianpu*, vol. 1, pp. 440–441; Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 366–370; Zhang, *Qing lishi*.

<sup>28</sup> Chinese Communist Party Central Documentation Research Office, *Zhou Enlai nianpu*, vol. 1, p. 445.

<sup>29</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 368–370.

confidence of the Chinese party state to launch the atomic bomb project. These included some of the future chief designers of the Chinese atomic bombs, such as Deng Jiaxian who received his Ph. D. in physics from Purdue University in 1950. Shortly after the outbreak of the Korean War, the US government implemented a policy of forbidding the roughly 5,000 Chinese students, especially in science and engineering, from returning to China. But many of these scientists nevertheless managed to find their way home, often by traveling to a third country first.<sup>30</sup>

Once the US and China started direct bilateral negotiations as a result of the Geneva Conference of 1954, more Chinese students and scientists in the US were able to return to China. Among the most famous of these was the aerodynamicist Qian Xuesen (H. S. Tsien) who had been detained by the US as a suspected Communist. Altogether, one estimate puts the number of scientists who returned to China from abroad from 1949 to 1956 at 2,000. Once they arrived in China, the Chinese Academy of Sciences, at Zhou Enlai's direction, had priority in recruiting them, especially for the nuclear weapons program.<sup>31</sup> Thus, from 1949 to 1956, 129 of these returned students went to work in the CAS, and 109 of them achieved the senior status of associate research fellows (equivalent to associate professor), accounting for one quarter of all such positions in the academy.<sup>32</sup> Both individually and as a group, it is difficult to overestimate the importance of these returned students to the Chinese strategic weapons programs, including the atomic and hydrogen bombs, the missiles, submarines, and the satellites.<sup>33</sup> In fact, the Chinese government decided to launch its missile program in large part due to the return of Qian Xuesen, who quickly became its major architect.<sup>34</sup>

Together with the atomic bomb project, the initiation of the first Five Year Plan toward industrialization in 1953 also brought to the attention of the top party state leaders the need for more and better trained technical personnel. In his major Report on the Work of the Government at the First Session of First People's Congress on September 23, 1954, Zhou Enlai called for the building of a strong, socialist, modernized industrial country. "One major problem," he pointed out, was the lack of technical personnel and the imperfection of technical management.<sup>35</sup> Shortly afterward, Mao called attention to the same problem in a speech to the Supreme National Council.<sup>36</sup>

Recognizing that science and technology were the bottleneck for Chinese modernization, Mao, Zhou, and the party state leadership launched several initiatives in 1956. One was the holding of a major national conference on the issue of intellectuals in January. After an extensive survey of the working and living conditions of intellectuals, and discussions within the party, Zhou supervised the

<sup>30</sup> Wang, *Technical aliens*.

<sup>31</sup> Chinese Communist Party Central Documentation Research Office, *Zhou Enlai nianpu*, vol. 1, p. 445.

<sup>32</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, p. 63.

<sup>33</sup> *Ibid.*, pp. 361, 369.

<sup>34</sup> Zhou, *Nie Rongzhen nianpu*, vol. 2, p. 765. On Qian, see also Chang, *Thread*.

<sup>35</sup> Zhou Enlai, *Ba woguo*.

<sup>36</sup> Mao, *Shehui*.

drafting of a major policy speech on intellectuals, which he delivered on January 14, 1956, at the CCP Conference on Intellectuals attended by hundreds of national and regional leaders. Zhou detailed the numerous cases where a severe shortage of technical experts had hindered economic and defense programs. He also pointed out the many ways that the party had failed to make optimum use of the existing intellectuals because of political distrust. To scientists, perhaps the most heartening statement in Zhou's speech was his assertion that "most of them [intellectuals] have already become state employees, have been serving socialism, and have been part of the working class."<sup>37</sup>

Even though Mao seemed to agree with Zhou's points in general, in his own shorter speech at the conference, he did not specifically endorse Zhou's assessment of the political standing of the intellectuals. His emphasis was still much more utilitarian: "Now we are carrying out a technological revolution, a cultural revolution. It's a revolution against stupidity and ignorance. For this we can no longer do without the intellectuals and depend only on the uneducated masses [dalaocu]."<sup>38</sup> In another talk he even acknowledged that there need to be more intellectuals and scientists within the party leadership:

In my view our central committee is still a political central committee, not a scientific central committee. Therefore it is rather reasonable for some to doubt that our party can command scientific work, can command the work in public health, because you simply don't know, don't understand [work in those areas]. Our current central committee is indeed defective in this respect: we don't have many scientists, or specialists.<sup>39</sup>

Although Mao was by no means calling for a technocracy, he was certainly welcoming technocrats who could help speed up Chinese industrialization.

Despite the subtle and still hidden difference between Mao and Zhou in their assessment of the political status of the intellectuals at this point, there appeared to be a remarkable consensus among the party state leadership that the revolutionary paradigm, in the form of socialist reform, and modernization paradigm, in the form of industrialization, reinforced each other in this period, which lasted from 1949 to 1956.<sup>40</sup> As Mao put it, in a speech at the Supreme National Council a few days after the Conference on Intellectuals, "the purpose of socialist revolution is the liberation of the productive force."<sup>41</sup> In this atmosphere, Zhou's speech resulted not only in elevated political status for scientists – in contrast to the recruitment of only one senior scientist into the party, the party conferred such political recognition to ten, including Zhu Kezhen, in 1956 alone – it also led to better living and working conditions for scientists.<sup>42</sup> The conference with

<sup>37</sup> Zhou Enlai, Guanyu.

<sup>38</sup> See Chinese Communist Party Central Documentation Research Office, Zhou Enlai nianpu, vol. 1, pp. 518–525, 538–541.

<sup>39</sup> Mao, Guanyu di ba.

<sup>40</sup> Jiang/Jin, Mao Zedong zhuan, vol. 1, p. 467.

<sup>41</sup> Mao, Shehui.

<sup>42</sup> Yao et al., Zhongguo kexueyuan, vol. 1, p. 69.

the scientists in Zhongnanhai that Zhu Kezhen mentioned above took place the day after the conference on intellectuals had ended.

The next major initiative was the making of a Twelve-Year Plan for Science and Technology. Planning, following the Soviet model, became a key word as China launched its first five-year plan in 1953. The concept of scientific research according to a politically determined master plan had always been part of the new science policy from the beginning of the People's Republic of China, but until then it had remained general and vague. The making of the twelve-year plan under Zhou Enlai involved 787 scientists, engineers, and administrators from the Chinese Academy of Sciences, universities, and other sectors of Chinese science and technology.

Soon a Science Planning Commission was established in the State Council under Marshall Nie Rongzhen to coordinate the making of the science plan. Nie, as vice-premier and head of the CCP science group, was in charge of science and technology in both the party and government; he also headed the newly established nuclear weapons project.<sup>43</sup> Perhaps more than anyone else, Nie not only linked Chinese science with the national security state but also articulated a vision of technonationalism that placed the achievement of sophisticated military technologies at the core of Chinese national independence and modernization drive.<sup>44</sup> Accordingly, the goal of the twelve-year plan was to introduce the state-of-the-art science and technology into China, especially those most urgently needed in defense, and to "approach the level of the Soviet Union and other powers in the world in twelve years." Not surprisingly, nuclear energy, rockets and missiles, wireless electronics, automation, semiconductors, computers, and airplanes were at the top of the list, followed by natural resource survey and utilization, earthquake, ocean, power generation, metallurgy, fuel chemistry, agriculture, and antibiotics. Soviet advisors were also heavily involved in the making of the plan.<sup>45</sup>

Interestingly, in contrast to American scientists' resistance to planning in the US, Chinese scientists seemed to have welcomed the step. At the inaugural meeting in 1955 of the CAS Departmental Committees, whose memberships represented the highest scientific honor in the country, scientists urged the government to make a science plan as soon as possible.<sup>46</sup> Many of these scientists participated in the making of the plan, although the party administrators seemed to dominate the process. The scientists' only complaints, after the formulation of a preliminary list of 55 key tasks, was that it emphasized too much developmental goals at the expense of basic research. Zhou responded by adding a no. 56, on "Key Theoretical Problems," and by asking for the making of plans for the development of each basic science field.<sup>47</sup> As a result of the twelve-year plan, the

<sup>43</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 66-79.

<sup>44</sup> Feigenbaum, *China's Techno-Warriors*, pp. 25-31, 37-39.

<sup>45</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 72-74.

<sup>46</sup> *Ibid.*, pp. 43-44.

<sup>47</sup> *Ibid.*, p. 73.

Chinese and Soviet governments reached 122 cooperative agreements in science and technology in 1957–1958.<sup>48</sup>

The structure of Chinese science and technology was also adjusted as a result of the twelve-year plan. By 1956, as the production ministries and universities established their own research programs, the CAS sought to focus on major problems in basic research, state-of-the-art science and technology, establishing new institutes on electronics, automation, semiconductor, and computers, and tasks that required interdisciplinary and cross-departmental efforts, or “Gong Guan,” meaning literally “storming strategic passes.” The effectiveness of “Gong Guan,” the marshalling of scientists, engineers, equipments, and other resources from all over the country to solve key scientific and technological problems, became a key part of the Chinese science policy, and has been widely claimed to be one of the advantages of socialist planned system. It was not unique to socialism, as the US Manhattan Project, penicillin project, and the postwar missile and Apollo projects also mobilized large numbers of manpower and resources from many different sectors of the country. Yet, it is probably true that in peacetime such coordinated attack was more prevalent in socialist countries than in the West.<sup>49</sup>

A third major initiative in 1956 to promote the development of science and technology was the implementation of the so-called “double-hundred” policy. To guide the party and the nation through the ideological confusion caused by Khrushchev’s recent denunciation of Stalinism in the Soviet Union, and to help people vent any discontent that had built up by then, Mao proposed a policy of pluralism in literature (“Let A Hundred Flowers Bloom”) and non-interference in science (“Let One Hundred Schools Contend”). To exemplify the new policy, the Propaganda Department of the CCP sponsored a conference on genetics in Qingdao in August 1956 where both Lysenkoists and modern geneticists were allowed to speak and a measure of rehabilitation of the Morgan genetics implicitly took place.<sup>50</sup> Following the example of the Qingdao conference on genetics, scientists in other fields where political ideology had reined also came out to speak for their points of view. For now, politics seemed to retreat from science.<sup>51</sup>

Thus the 1955–1956 period started with a note of high promise for a socialist construction program that could link the revolutionary and modernizational paradigms harmoniously. The launching of the atomic bomb project not only enhanced the practical value of both domestic and returning scientists, but also dramatically improved their political and social capital in the eyes of the party state, resulting in both enhanced political standing and improved living and working conditions. The double-hundred policy even created some space for academic dissent and debate. But this new partnership was built on a shaky, utilitarian foundation. The enhanced status of the scientists did not derive from a recognition of the fundamental principles of academic freedom, freedom of speech, or

<sup>48</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, p. 75.

<sup>49</sup> *Ibid.*, pp. 77–78.

<sup>50</sup> See Schneider, *Biology*, pp. 165–177.

<sup>51</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, p. 82.

individual rights. It was bestowed on the scientists because of their new-found utility to the party state; it could be taken away just as easily without institutional guarantees for such rights. As events unfolded in China during the tumultuous post-1956 period, Chinese intellectuals in general and scientists in particular found themselves time and again drawn into the political storms.

### PHYSICS AND THE NATIONAL SECURITY STATE

As the Chinese leadership launched the nuclear weapons projects in 1955–1956, national security became the basis for the state support of science, especially physics, in China just as it did in the US and the Soviet Union. At this point, the so-called “advanced” (*jianduan*) military technologies focused on the atomic bomb and guided missiles, with initial emphasis actually on the latter. The success of both, however, depended on the availability of manpower in the physical sciences, and their initiation fundamentally reshaped physical science research in China, especially nuclear physics. The impact of the atomic bomb project on Chinese physics can be best seen in the evolution of what was initially called the Institute of Modern Physics of the Chinese Academy of Sciences. Its origin can be traced to the Communist Party’s first grant in support of nuclear physics – \$ 50,000 in cash in US dollars – for Qian Sanqiang to purchase nuclear equipments during a planned trip to Paris in April 1949.<sup>52</sup> Soon thereafter the Chinese Academy of Sciences was founded on November 1, 1949, which established two institutes in physics, the Institutes of Modern Physics (IMP) and the Institute of Applied Physics. During 1950, its first year, the IMP, located in inner Beijing, was headed by Wu Youxiu, with Qian as deputy director, but a year later Wu became a vice president of the CAS, and Qian became director. Qian’s wife, He Zehui, who had also received her Ph.D. with the Joliot-Curies, worked on nuclear emulsions at the institute.<sup>53</sup>

As the only Chinese institution in nuclear physics, the IMP soon gathered some of the leading physicists from all over China, including Wang Ganchang and Peng Huanwu who became its deputy directors. A theoretical physicist, Peng had received his Ph.D. in physics with Max Born at Edinburgh in 1940 and returned to China in 1947. In 1950, Zhao Zhongyao, a Caltech-trained experimental nuclear physicist, returned from the US with components for a van de Graff accelerator after having been detained by US forces in Japan for more than a month.<sup>54</sup> He joined the IMP as another deputy director. During the next seven years, about two dozen nuclear physicists returned from the US and Europe to join the IMP, which was renamed the Institute of Physics (IP) in 1952. They not only strengthened the manpower at the institute, but also brought state-of-the-art knowledge and skills from the west back with them. Before the party’s decision

<sup>52</sup> Ge, *Qian Sanqiang nianpu*, pp. 69–72.

<sup>53</sup> *Ibid.*, pp. 124–125.

<sup>54</sup> Zhao, *Wo de huiyi*.

to embark on the atomic bomb project in 1955, the institute carried out research in experimental physics, with emphasis on building accelerators and detectors, radiochemistry, cosmic rays, theoretical particle physics, reactor designs, and electronics. It trained a number of young physicists on its own as well as by sending them to the Soviet Union. By the end of 1954, the institute had moved to a larger site in Zhongguancun, a suburban in northwestern Beijing, and its scientific staff had grown from about 37 in 1951 to 90.<sup>55</sup>

Following the party leadership's decision to launch China's atomic bomb project in 1955, the Institute of Physics experienced even more rapid growth. It opened a new division in Tuoli, a suburban area in southwestern Beijing, as the site for the Soviet-provided reactor and cyclotron. In September 1956, the Tuoli division was put under dual control by the CAS and the Third Ministry of Machine Building, which was established in November 1956 to focus on nuclear energy, including the building of the atomic bomb, with Qian Sanqiang as one of the deputy ministers. It was renamed the Second Ministry of Machine Building during a restructuring of the government in February 1958.<sup>56</sup> In March 1956, China joined the consortium of Socialist countries that ran the particle physics center at Dubna in the Soviet Union, contributing about 20% of its operating cost (about 15 million Chinese yuan). In 1956, the Institute of Physics sent Wang Ganchang to Dubna, where he eventually became deputy director and led a group of physicists from China and other countries to discover a new anti-hyperon particle in 1959.<sup>57</sup> By the end of 1957, the institute's scientific staff grew to 560, with about 20 senior researchers and its expenditure for 1957 (2,786,000 yuan), nearly tripling that for 1954 (992,436 yuan). By contrast, the expenditure for the more civilian-oriented Institute for Applied Physics, which stood at about the same level in 1952 (287,876 yuan for the IMP and 284,279 yuan for the IAP) and which also experienced rapid growth, consistently lagged behind the IP's in both 1954 (632,883 yuan) and in 1957 (2,037,000 yuan).<sup>58</sup>

Even though the IP's connections with the bomb project did not spare the institute from the political purges during the Anti-Rightist Movement in 1957 and the Great Leap Forward in 1958, scientists there seemed to have suffered less than elsewhere in the Chinese Academy of Sciences. The "rightists," which eventually numbered around 300,000, were branded enemies of the people and were treated harshly.<sup>59</sup> Under the pretense that without employment they could not survive, the government forced many of the rightists into inhuman labor reform

<sup>55</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 359–365; Ge, *Qian Sanqiang nianpu*, pp. 81, 114.

<sup>56</sup> Zhou, *Nie Rongzhen nianpu*, vol. 1, pp. 596, and vol. 2, p. 634.

<sup>57</sup> Li et al., *He wulixuejia*, pp. 123–156.

<sup>58</sup> On the IP staff, see Ge, *Qian Sanqiang nianpu*, p. 136. On the expenditures for 1952, see Appendix 3, "Statistical Table of the Expenditures of the Chinese Academy of Sciences in 1952," in: Xue/Ji, *Zhongguo kexueyuan shishi huiyao 1952 nian*. For 1954, see Appendix 3 in: Wang/Wang, *Zhongguo kexueyuan shishi huiyao 1954 nian*. For 1957, see Appendix 8 in: Xue/Ji, *Zhongguo kexueyuan shishi huiyao 1957 nian*.

<sup>59</sup> Spence, *Search*, p. 572.



camps. For some of them, it was the first time that they recognized that there was no more corners of civil society outside of the harsh control by the state. In the words of Shu Xingbei, one of the best known physicist-rightists and one-time colleague of Wang Ganchang at Zhejiang University, only then did he realize that "the party could do whatever it pleased with me after all."<sup>60</sup> As a result of the campaign, many of the brightest, most outspoken scientists were taken away from science and education and sent to perform physical labor for many years. All suffered grave physical and mental persecution. In the CAS alone, 167 scientists were purged as "rightists," including 11 members of the departmental committees.<sup>61</sup>

Yet, against such a grim background for scientists, the Chinese atomic bomb and missile projects kicked into high gear when the Soviets promised to provide technical assistance in these areas, including prototype bombs and missiles, in an Accord on New Technologies in Defense signed in Moscow between the two countries on October 15, 1957, a week after the Soviet launch of Sputnik. Apparently Khrushchev, like Stalin before him, relented to China's demands in order to maintain China's support in both international and domestic politics.<sup>62</sup> In early 1958, a number of other technical accords ensued to help China implement its twelve-year science plan. Nominally civilian, many of these areas, such as minerals, oceanography, radio electronics, metallurgy, and precision equipments were clearly relevant to military technology.<sup>63</sup> Meanwhile, the Chinese Academy of Sciences, inspired by Sputnik, received approval from the top party-state leadership to launch China's own satellite project under the leadership of the geophysicist Zhao Jiuzhang. It eventually joined the atomic bomb and missiles in the top priority list of advanced technologies.

The mobilization for the bomb took advantage of a centrally planned system that prevailed under the Chinese Communist party state. It made possible, for example, a swift restructuring of Chinese scientific, educational, administrative, and military institutions to facilitate the launching of the bomb and missile projects. Within a year of the signing of the October 1957 agreement, new bureaus were established in the Ministry of Defense for missiles and in the Third (soon Second) Ministry of Machine Building for the atomic bomb. The latter ministry also created a Nuclear Weapons Institute (NWI) to prepare for the reception of the expected bomb and accompanying technical materials. Upon Qian Sanqiang's recommendation, Deng Jiaxian from the Institute of Physics was put in charge of the NWI's technical preparatory work.<sup>64</sup> The Institute of Physics itself was renamed the Institute of Atomic Energy and put under the dual control of the Second Ministry and the Chinese Academy of Sciences. Over the

<sup>60</sup> See Liu, Shu Xingbei, esp. pp. 154–181, 240.

<sup>61</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 86–89.

<sup>62</sup> See Zhang et al., Sulian, p. 183.

<sup>63</sup> For a list of 122 areas covered in one major agreement, see Zhang et al., Sulian, pp. 184–204.

<sup>64</sup> Xie, *Dangdai*, vol. 1, p. 36; Ge, Qian Sanqiang nianpu, p. 139.

next several years, more than a thousand of scientists and technicians from the institute moved over to the NWI. In general, the CAS served as a reservoir of scientists and engineers from which the military R&D system drew its technical manpower in this period. In addition, the CAS created in 1958 a university of its own, the elite University of Science and Technology of China (USTC) in Beijing, to train middle- and lower-level technical manpower for fields relevant to the bomb and missile projects. Zhao Zhongyao added chairmanship of the USTC's Department of Technical (nuclear) Physics to his responsibilities. Continuing to oversee the rapidly expanding nuclear weapons complex on behalf of Mao and Zhou was Marshal Nie Rongzhen, who now directed the vast advanced technologies enterprise from his chairmanship of the powerful National Defense Science and Technology Commission (NDSTC) that was reconstituted out of an earlier, narrower group on aviation and missiles in 1958.<sup>65</sup>

In the highly centralized Chinese military R&D system, state support was central to the success of any project but money was not everything, sometimes not even the primary currency. For one, as the leaders of the Chinese Academy of Sciences recognized, personal relations mattered. In this regard, their ace card was Gu Yu, an administrator in the academy who happened to be married to Hu Qiaomu, one of Mao's political secretaries, and therefore enjoyed easy access to the top leadership. Gu was soon put in charge of the academy's Office for New Technologies to manage its mushrooming satellite project. In 1958, it was she who helped the academy find a suitable site for its new USTC by pulling some strings. That year the academy also received a huge special budget allocation of 200 million yuan for work on the satellite but waited in vain for the money to come in until Gu used her connections to bring in the funds. Of course Gu Yu succeeded not merely because of her personal connections; the leadership recognized the key role that the academy would play in the advanced projects. But the right connections did give the academy an significant edge in the intensified inter-departmental rivalry over not only funds, but also the distribution of manpower, raw materials, and precision equipments. Thus the academy breathed a heavy sigh of relief in 1960 when Gu Yu won it a spot among the top four agencies with the highest national security priorities in the national allocation of materials.<sup>66</sup>

By then the Chinese Academy of Sciences and its scientists had taken on even greater importance to the Chinese advanced technology program. In the summer of 1958, the post-Sputnik Sino-Soviet honeymoon began to end when Mao Zedong refused Khrushchev's request for a joint long-wave-length radio station and a joint nuclear submarine fleet as impinging on Chinese national sovereignty. Ideological cleavage also developed between the two sides over Mao's Great Leap Forward movement and Khrushchev's proposal for peaceful co-existence with the West. A turning point in Sino-Soviet relations came in June 1959 when the Soviets, citing their ongoing negotiations with the US and Britain

<sup>65</sup> Feigenbaum, *China's Techno-Warriors*, pp. 54–57.

<sup>66</sup> Pei/Lu, *Liangdan*.

toward a nuclear test ban, postponed indefinitely the shipping of the promised atomic bomb prototype to China and began to withdraw their technical advisers. Undaunted, the Chinese leadership decided to go ahead with the project on its own. Another blow to China's advanced technologies program came a year later when the Soviet Union withdrew all its scientific and technical advisers from China.<sup>67</sup>

With these turns of events, the primary role of Chinese scientists changed from that of playing second fiddle to Soviet technical advisers to that of chief designers of the advanced weapons projects themselves. Understandably, this experience of working with the Soviets did not lessen but actually intensified a sense of Chinese nationalism not only on the part of the party state leadership but the scientists as well, putting an interesting twist to the Chinese experience of the Cold War. Increasingly, the Chinese national security policy was re-oriented from a possible conflict with the US to that with the Soviet Union, which quickly affected not only international politics but also Chinese science and technology policy. Among the first Chinese reactions to the Soviet withdrawal was to move a number of senior Chinese physicists, including Wang Ganchang, Peng Huanwu, and Zhu Guangya, whose sense of national and professional pride was once again stimulated by the Soviet actions, fulltime into the bomb project.<sup>68</sup>

In fact, much of the Chinese Academy of Sciences was now devoted to the bomb/missile/satellite projects. In 1960, Gu's Office of New Technologies (ONT) was enlarged into a bureau with 34 institutes under its control, which grew to 47 by 1966, with 11,328 scientists and engineers, comprising nearly half (46%) of all such personnel of the CAS, under their command. Even those institutes not formally turned over to the ONT conducted significant amount of research for the defense programs. Altogether, about half to two thirds of all the scientists and engineers in the academy worked on national security-related projects in this period.<sup>69</sup>

The necessity of relying on Chinese scientists for the making of the bomb and missiles created a protective political effect for them not unlike what happened to their Soviet counterparts under Stalin.<sup>70</sup> In a crucial conference on the political assessment of scientists at the Fifth Academy on missiles, Nie directed the party committee to trust Chinese scientists both politically and technically and also to improve their working and living conditions. "If you ask them to do the work you have to trust them. We have to rely on our own experts."<sup>71</sup> He lost sleep when he heard scientists' complaints that they were not trusted by the power-holding local party committees and that they were treated like technicians and even ordered to do physical labor in the countryside. Further investigations soon

<sup>67</sup> See, e.g. Lewis/Xue, *China*, pp. 60-65.

<sup>68</sup> Ge, *Qian Sanqiang nianpu*, pp. 146-149, 152-161; Yao et al., *Zhongguo kexueyuan*, vol. 1, p. 374.

<sup>69</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, p. 116; Zhang, *Qing lishi*.

<sup>70</sup> Holloway, *Stalin*.

<sup>71</sup> Zhou, *Nie Rongzhen nianpu*, p. 737.

revealed that such treatment of scientists was not restricted to the Fifth Academy but widespread in the Chinese Academy of Sciences and elsewhere. Nie, who had himself sought to “save China via science” in his youth and who tended to trust the scientists more than most in the party did, then drafted a CCP policy paper to correct the misuse and mistreatment of scientists, with fourteen specific directives – it became known as the Fourteen Points.<sup>72</sup>

Issued by the CCP in July 1961, the Fourteen Points directed that the party should trust scientists politically and do everything to help them fulfill their scientific and technological missions. It specifically demanded that scientists and engineers should be protected from political and other interferences and guaranteed five full days devoted to their work out of a six-day working week. Called the “Constitution of Science,” the policy codified scientific professionalism and stabilized the environment of scientific research.<sup>73</sup> In the same vein was the Gunagzhou conference in 1962 where Zhou and Vice Premier Chen Yi announced that intellectuals were part of the working class, a political edict that was of paramount importance to the scientists in a politicized society.<sup>74</sup> Most scientists also received increased pay and promotions in this period.<sup>75</sup> Thus the improvement in scientists’ political and living conditions came less from any ideological relaxation than from concerns for the strengthening of the national security state, which culminated in the successful testing of China’s first atomic bomb in October 1964.

#### PARADIGM SHIFT

As China embarked on its long march toward a nuclear deterrent, Mao’s thinking about the proper relations between revolution and modernization actually underwent a radical shift that had a profound impact on Chinese science and scientists. The Khrushchev denunciation of Stalin in February and the Hungarian uprising in October 1956 caused Mao to seriously rethink the strategy of revolutionary modernization not only from the point of view of what was best for the nation, for the Communist party state, but also increasingly for his own political standing. As a result of this rethinking, Mao came to increasingly question the possibility of integrating revolution and modernization harmoniously; in weighing the options, he seemed to have come to the conclusion that the earlier, Soviet model of development would inevitably lead to an abandonment of the revolutionary paradigm and to a Chinese version of revisionism that threatened not only the revolutionary course he had shaped for China but also his own position within the Chinese party state.

<sup>72</sup> Zhou, Nie Rongzhen nianpu, pp. 739–740, 784.

<sup>73</sup> Suttmeier, *Research and Revolution*, pp. 93–100.

<sup>74</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 99–114.

<sup>75</sup> *Ibid.*, p. 113.

As a response to these developments, Mao first tried a strategy that he thought could build the revolutionary paradigm so much into the modernization program that when modernization did succeed it would not automatically lead to revisionism. This strategy resulted in the Great Leap Forward (GLF) of 1958, which sought to industrialize China overnight via mass mobilization. Zhou Enlai and Liu Shaoqi initially opposed this policy as dangerous “adventurism” but fell in line when Mao attacked them as aligning with the rightists. As the official biographers of Mao later acknowledged, the debate over “adventurism” on the eve of the GLF “marked the beginning of the breakdown of the party’s principle of collective leadership and system of democratic centralization, with perilous negative implications for later historical developments.”<sup>76</sup> The GLF failed miserably and as a result China fell into a horrible famine as well as a dire economic situation that threatened the bomb and missile projects. It was Nie who fought for their continuation and his argument, that they would not only provide a nuclear deterrent for China but also offer spin-offs in conventional weaponry, prevailed with Mao’s crucial support.<sup>77</sup>

Following the disastrous GLF, Mao retired to the “second front” and pragmatists represented by Liu Shaoqi and Deng Xiaoping came to power. Mao’s resentment of their liberal policy grew in the early 1960s. The tension between Mao, on the one hand, and Liu and Deng, on the other, finally broke in 1966 when Mao launched the country into a chaotic, destructive Cultural Revolution to remove the latter from power and to correct what he perceived as a revisionist direction for the country. As with other intellectuals, scientists again were branded as basically bourgeois, and not to be trusted, rather to be cleansed and reformed. Many of them suffered horribly during the decade of unrest. Targeted were not only scientists, but also many of the modern scientific theories, including, as it turned out, Albert Einstein’s relativity theories.<sup>78</sup> The seminal circular of May 16, 1966, called for the attack on “the reactionary bourgeois stands of the so-called ‘academic authorities’”, and the criticism of reactionary viewpoints in the theoretical front in natural sciences.<sup>79</sup>

As with other institutions, the CAS was turned upside down during the first few months of the Cultural Revolution, when Red Guards and other rebels seized power from the leadership and stopped virtually all research. Scientists, especially those in the leadership, were criticized and persecuted. Among the 170 senior CAS scientists in the Beijing area, 131 were attacked, including the vice president Wu Youxiu. Altogether 106 scientists of different levels of seniority in the CAS, including the geophysicist Zhao Jiuzhang, died during the Cultural Revolution due to political repression. In Shanghai, hundreds of scientists were beaten, tortured, and some killed, for dredged-up charge of anti-communist conspiracy during the Nationalist years. By 1969, many scientists who survived the ordeal were

<sup>76</sup> Jiang/Jin, *Mao Zedong zhuan*, p. 789.

<sup>77</sup> See Feigenbaum, *China’s Techno-Warriors*.

<sup>78</sup> See, e.g. Hu, *China and Albert Einstein*.

<sup>79</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 141–142.

sent to the countryside to do physical labor.<sup>80</sup> The only member of the scientific community spared the worst of the violence were those who worked on the nuclear weapons projects. Zhou and Nie had taken those institutes of the CAS covered by the Bureau of New Technologies out of the academy and put them under the control of the NDSTC for protection.<sup>81</sup> Even there they were not safe as the Cultural Revolution soon spread to the military as well. Following the beating death of Yao Tongbin, a metallurgist with a Ph.D. from the University of Birmingham who returned to China in 1957 to direct its space materials program, in June 1968, Zhou ordered that several hundreds of scientists and engineers in the advanced technology system to be put under the protection by armed guards.<sup>82</sup>

In 1967–1969, Nie himself came under attack by Maoist “rebels” for his role in the formulation of the liberal “Fourteen Points” science policy, his “blind trust” in the experts, and allegedly cultivating his own authority at the expense of Mao’s in the NDSTC.<sup>83</sup> In a self-criticism report to Mao, Nie asserted that he “had followed the strategic intent” of the party state leadership, but acknowledged “deficiency” in his dealing with scientists and intellectuals: “I have done more to unite with them and to encourage them than to educate and criticize them.”<sup>84</sup> In a second such report, Nie was again forced to reflect on his “serious errors”: “In my thinking, I had been single-mindedly pursuing the development of our science and technology, the modernization of industry, agriculture, science and technology, and national defense, so as to accelerate the socialist construction of our country. But I failed to recognize the correct relationship between modernization and revolutionization [geminghua] and failed to let revolutionization take command over modernization.”<sup>85</sup>

A turning point of the Cultural Revolution came in 1971 when Lin Biao, Mao’s designated successor, fled and died in a plane crash following a failed coupe against Mao. By then, Mao had realized that the revolutionary program he had pursued once again failed to deliver for him the hoped-for results. Instead, the national economy was brought to the edge of collapse. Even though he still worried about the danger of a revisionist cancellation of his revolutionary achievements, his dominance in the party was established and he switched gear yet again: he personally made the decision to open up relations with the United States and supported Zhou Enlai to get the country back on the modernization track. For a brief period, Zhou was able to relax ideological control over science.

Taking advantage of the US-China rapprochement and the recommendation on basic research by some of the visiting Chinese American scientists, Zhou managed to re-legitimate scientific research in the CAS as necessary work on “theory.” A conference was held in May 1972 which contradicted the current Maoist or-

<sup>80</sup> Ibid., pp. 154–157.

<sup>81</sup> Zhou, Nie Rongzhen nianpu, pp. 1056–1057.

<sup>82</sup> Chinese Communist Party Central Documentation Research Office, Zhou Enlai nianpu, vol. 3, pp. 313–314. On Yao, see Song, Liangdan.

<sup>83</sup> Zhou, Nie Rongzhen nianpu, pp. 1047, 1097, 1100–1101.

<sup>84</sup> Ibid., pp. 1100–1101.

<sup>85</sup> Ibid., pp. 1102–1103.

thodoxy by affirming pre-Cultural Revolution science policies. Mao's wife Jiang Qing and her influential radical group Gang of Four, however, soon made it impossible for any substantial restoration of the scientific planning, policy, or institutions. When Deng Xiaoping returned to high positions briefly in the early 1970s he also tried to restore order and used the CAS as a starting point. Soon, however, Zhou died and Deng was purged again by Mao in 1976. Only after Mao himself died and after the old guards allied with Mao's designated successor Hua Guofeng crushed the Gang of Four later that year was it possible for a full-scale restoration of pragmatic policy emphasizing the modernization paradigm under the leadership of Deng Xiaoping after 1976.<sup>86</sup> By the 1980s and 1990s, a drive for market-oriented reform began to reshape Chinese science and technology, even though the domination of the state remained. In this regard, the establishment in 1986 of the National Natural Science Foundation, which allowed scientists to make individual proposals outside of the rigid planning system, led the way toward a pluralistic system of science funding that by the early twenty-first century included science funding from private donations and transnational corporations as well.<sup>87</sup>

## CONCLUSION

What conclusions can we draw from this examination of the experiences of Chinese scientists under Mao during the Cold War? First, the Chinese case exhibited striking similarities and differences with American and Soviet cases. The willingness of Chinese scientists to join the atomic bomb project recalled similar attitudes of Russian scientists in the Soviet nuclear program and American scientists in both the Manhattan Project and, after the outbreak of the Korean War, in the hydrogen bomb project. Either out of a sense of patriotic nationalism, or a belief that nuclear deterrence was vital to world peace, or a recognition that their professional and personal success depended on their service to the national security state, few Chinese scientists refused the call from the government. As in both the US and the Soviet Union, national security dominated Chinese science and technology policy, in the funding structure and in the allocation of manpower and materials, during much of the Cold War. Likewise, the overwhelming demand for real, "hard" results in the nuclear weapons projects often softened the political and ideological interferences with scientific research in China under Mao as it did in McCarthyist US and Stalinist Soviet Union.

It should be noted that even though the decision to launch the strategic weapons in 1955–1956 was based on widespread consensus within the party-state leadership, even though there was a vigorous debate within a small circle of policy makers over its continuation in the early 1960s in the aftermath of the Soviet withdrawal and the GLF disaster, and even though the bomb test in 1964 and the

<sup>86</sup> Yao et al., *Zhongguo kexueyuan*, vol. 1, pp. 141–171.

<sup>87</sup> On the foundation, see its website at [www.nsf.gov.cn](http://www.nsf.gov.cn).

satellite launching in 1970 enjoyed overwhelming public support, there was never any open, public, thoroughgoing national debate over these matters. Scientists such as Qian Sanqiang and Qian Xuesen did participate in some high-level discussions over strategic weapons, but their involvement was by and large limited to technical questions, rarely policy issues. Then, of course, China was not alone in the shroud of secrecy around its nuclear weapons policy-making. Such was largely the case with the Soviet Union under both Stalin and Khrushchev. Even in the US, where debates over nuclear policy was much more open than in either China or the Soviet Union and where scientists did participate in policy discussions, strategic weapons policy was often determined more by the policy elite in the Executive Branch than by public sentiment or the Congress.

There were striking differences as well. To a much greater extent than was the case with their counterparts in the US or even the Soviet Union, Chinese scientists suffered political persecution and ideological harassment despite the recognized need for their service to the Chinese national security state. The nuclear weapons projects did provide the scientists, especially physicists, some protection, and were certainly responsible for the immense state support for physics and other relevant disciplines in this period. But even the bomb could not shield the scientists completely from the various political movements that swept the country under Mao. The fact that all Chinese scientists worked for the government meant that there was much less freedom of action when faced with political and ideological pressure than in a more pluralistic science-funding structure that existed, e. g. in the US and Germany during the Cold War. There were no such philanthropic sources of science funding as the Ford and Rockefeller Foundations in the US, or the self-governing DFG in Germany, or even a place like the US National Science Foundation for support of self-generated research.

Of course, a plural system of science funding does not by itself guarantee freedom from politicization of science just as a formally democratic political system did not prevent such abuses of individual rights as the McCarthyist attacks on American dissident scientists. As the historian John Krige has demonstrated, private foundations could often be doing the bidding for the national security state in the US and Europe.<sup>88</sup> But the possibility of getting funding or employment outside of the government did make it easier for scientists and others to take unpopular or politically incorrect stands. Thus, in contrast to the miseries experienced by Chinese scientists purged during the 1957 Anti-Rightist Movement, many of the faculty members of the University of California who refused to sign the anti-Communist state loyalty oaths in the 1950s found employment in other, especially private, universities. The highly centralized funding structure left little room for maneuver by Chinese scientists in terms of their research interests or preference for civilian or military orientations. Happily for at least those Chinese scientists involved in the nuclear weapons projects, their scientific nationalism fit into the national security strategy of the Chinese Communist party state during much of the Mao era, but that changed radically when his political

<sup>88</sup> See, e. g. Krige, Ford.



and ideological considerations led to an overturning of the consensus during the destructive Cultural Revolution.

This study also points to both the strengths and weaknesses of techno-nationalism that had been pursued by Chinese scientists, especially physicists, and pragmatists among the Chinese Communist party state leadership such as Wang, Qian, Zhou, and Nie both during and beyond the Cold War. Scientists' sense of nationalism made them to decide to stay and cast their lot with the Communists in the late 1940s and early 1950s. It also drew scientists to return from the US and other countries. Nationalism likewise fueled scientists' devotion to advancing science and technology to achieve either economic benefits, or higher national prestige, as in basic research, or most important of all, a vision of techno-nationalism in the case of the atomic bomb. The new Chinese Academy of Sciences provided crucial institutional and ideological support for much of the scientific research carried out in the Mao years. Thus the success of the Chinese nuclear weapons and other advanced scientific/technological projects during the Cold War shows nationalism could play a powerful mediating role in bringing the Chinese scientists and national security state together and that science and technology could survive and even prosper under an authoritarian regime.<sup>89</sup> Yet, the abuse of the scientists and other intellectuals during the Anti-Rightist campaign and the disastrous consequences of both the Great Leap Forward movement and the Cultural Revolution also demonstrate that techno-nationalism alone could not make for a prosperous and strong China that the scientists and their political allies had dreamed.

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<sup>89</sup> For comparison with the case of another field, mariculture, in China in this period, see Neushul/Wang, *Between the devil and the deep sea*.

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