A Place for One's Mat: China's Space Program, 1956–2003

Gregory Kulacki and Jeffrey G. Lewis

AMERICAN ACADEMY OF ARTS & SCIENCES

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Acknowledgments

This paper is part of the American Academy's Reconsidering the Rules of Space project, which is guided by the Academy's Committee on International Security Studies. The project examines the implications of U.S. space policy from a variety of perspectives, and considers the international rules and principles needed for promoting a long-term balance of commercial, military, and scientific activities in space. The Reconsidering the Rules of Space project is supported by a generous grant from the Carnegie Corporation of New York. We thank the Carnegie Corporation for its support and Patricia Nicholas for her continued interest, advice, and perceptive comments.

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Preface

Space has long been the setting of especially intricate encounters between human aspirations and the implacable laws of the physical universe. It is a natural laboratory of fundamental science, at once the source of seminal conceptual achievements and bewildering mysteries. It has been the venue for both spectacular feats of engineering and tragic accidents. It has been the locus of uplifting collaboration among nations as well as ominous confrontation. It is an ever-compelling template on which popular imagination plays out.

The resulting array of interests, attitudes, and emotions engaged in the practical utilization of space has made that topic an especially demanding problem of public policy. Because of the risks and expense involved in space operations, the burden so far has been borne primarily by the major national governments. And those governments have been driven primarily by national security considerations, the legacy of confrontations between the two global alliances that dominated the latter half of the twentieth century. The passing of that era and the progressive expansion of commercial utilization of space have clearly created a new situation but not as yet the decisive reformulation of basic purpose and operational policy that the change of circumstance can be expected to require.

There has in fact been an argument about the basic character of the appropriate adjustment. An impulse emerging from within the U.S. government to dominate the utilization of space for national military advantage has been resisted by a nearly universal coalition of other countries defending the principle of equitable utilization for common benefit. If the outcome were to be directly decided by simple majority sentiment, the argument would have long since been settled. Most people when asked opt for collaboration and the pursuit of common interest; redirecting the inertia of established policy is anything but simple, however. The underlying argument involves a collision of intense convictions, and casual endorsement of common interest is often mixed with the residual fear of imperial aggression that is an enduring product of historical experience.

The appropriate balance between collaboration and confrontation in the era of globalization is an unsettled question, and the implications for space policy have not been worked out in the necessary detail. The effort to do so is demanding, and will undoubtedly take some time.

To stimulate the broad discussion that must accompany any fundamental redirection of policy, the American Academy of Arts and Sciences initiated the Reconsidering the Rules of Space project in 2002. Four occasional papers have been published dealing with, respectively, the basic laws of physics that apply to all space activity (*The Physics of Space Security: A Reference Manual*, by David Wright, Laura Grego, and Lisbeth Gronlund, 2005); the fundamental issues of security policy (*Reconsidering the Rules for Space Security*, by Nancy Gallagher and John Steinbruner, 2008); and the policies of the principal national governments (*United States Space Policy: Challenges and Opportunities*, by George Abbey and Neal Lane, 2005, and *Russian and Chinese Responses to U.S. Military Plans in Space*, by Pavel Podvig and Hui Zhang, 2008).

A Place for One's Mat: China's Space Program, 1956–2003 is the fifth paper of the project series. Using Chinese-language sources, Gregory Kulacki and Jeffrey G. Lewis examine three formative events in the development of China's utilization of space: the launch of the first satellite in 1970, the launch of the first communications satellite in 1984, and the first human spaceflight in 2003. They trace the origins and basic purposes of each of these efforts and set them in the context of China's internal history. Their central observation is that China understood each of these efforts to be a measure of national accomplishment necessary to qualify for inclusion among the major spacefaring countries that set the rules. Equity appears to have been the principal concern of China's political leadership.

That motive is more legitimate and less belligerent than those typically attributed by foreign observers—the U.S. intelligence community in particular. The authors do not claim to provide a comprehensive account of China's space program or an indisputable interpretation of its fundamental purposes. They do, however, provide evidence to be considered in any fair-minded assessment of the program's global significance.

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A Place for One's Mat: China's Space Program, 1956–2003

Gregory Kulacki and Jeffrey G. Lewis

On October 2, 2008, CCTV-9—the English-language broadcast for China's Central Television network—announced that something had gone awry during China's *Shenzhou-7* spaceflight. A "small satellite accompanying the Shenzhou 7" had begun "drifting away from its intended trajectory" before the Beijing Aerospace Control Center brought the satellite back "under control."[1]

Critics pointed to the fact that the Shenzhou capsule and the small satellite had passed within a few kilometers of the International Space Station (ISS) as evidence that China's activities in space were reckless or irresponsible. "Either the Chinese knew that their Shenzhou would close to a fair distance of the ISS, and their picosat would get even closer, or they did not," one American commented. He continued:

> Neither should be reassuring. If they did not, why not, especially since the ISS' orbit is known and they could easily have obtained this information simply by asking. If they did, then the question becomes why they did such a close approach . . . what political and perhaps even military messages does this portend?[2]

One option, of course, was simply to ask the Chinese. What is interesting about the entire episode is the manner in which the debate in the United States played out, with no participation from the Chinese side. In searching

1. "Shenzhou 7 Satellite Back Under Control," CCTV.com, October 2, 2008, http://www.cctv.com/english/20081002/100344.shtml.

2. Leonard David, "China's Shenzhou-7–Debate over Mission Messages," LiveScience, October 16, 2008, http://www.livescience.com/blogs/2008/10/16/chinas-shenzhou-7-debate-over-mission-messages/. See also, Richard Fisher, "Closer Look: Shenzhou-7's Close Pass by the International Space Station" (International Assessment and Strategy Center, October 9, 2008); http://www.strategycenter.net/research/pubID.191/pub_detail.asp.

for messages from the Chinese, few Americans had the inspiration to ask Zhu Zhencai, the Chinese lead designer of the *BX-1* satellite, or other responsible Chinese officials. Nor did many American analysts watch the interviews that Zhu or Shen Xuemin, head of the research institute that designed the *BX-1*, gave in Chinese explaining the mission.[3]

Had they done so, they might have been disappointed. The entire episode was the result of a poor translation by the nontechnical CCTV staff: the *BX-1* was never out of control. Unguided release is a standard method to place small satellites in orbit. Neither *Shenzhou-7* nor the *BX-1* was at risk of colliding with the ISS. Orbital space, especially at the altitudes used for human missions like Shenzhou and the ISS, is relatively crowded, with objects often passing by one another. But *Shenzhou* and the *BX-1* were at different altitudes than the ISS. The chance of collision was nil.[4]

The episode of the *BX-1* illustrates the continued lack of understanding within the United States about one of the world's most important space programs. Although China has become only the third country to place a human being in orbit, little of the history of the Chinese space program has been written in English. Of the handful of books on the subject, two slim volumes stand out: *The Chinese Space Program,* by Joan Johnson-Freese; and *China's Space Program,* by Brian Harvey.[5] These books are important, early efforts to document the history of China's space program by focusing on things we can observe from afar—namely, the satellites China has placed in orbit. These books provide a solid background on the technical realities of China's program, particularly in a comparative context. Although they are therefore necessary to understand the Chinese space program, they are not sufficient.

What they lack is an explanation from the Chinese themselves about the decisions that they made and their motivations for becoming a spacefaring nation. As the BX-1 story illustrates, inferring motives from afar is difficult.

Fortunately, we now have available a significant amount of Chinese-language historical material that documents the decisions that shaped China's space program and provides an explanation—from a Chinese perspective—of

3. The authors have made the interview with Shen Xuemin available on YouTube. See "Shen Xuemin Interview," October 18, 2008, http://www.youtube.com/watch?v= ko6xvbo1oEE. In the lower right-hand corner of the screen is a mission clock that confirms that the interview with Shen—in which he discusses the release and planned drift of the BX-1—occurred before the satellite was released.

4. Two technically informed accounts that make use of Chinese sources are David Wright and Gregory Kulacki, "Chinese Shenzhou 7 'Companion Satellite' (BX-1)" (Union of Concerned Scientists, October 21, 2008); http://www.ucsusa.org/assets/documents/nwgs /UCS-Shenzhou7-CompanionSat-10-21-08.pdf. Also, Brian Weeden, "China's BX-1 Microsatellite: A Litmus Test for Space Weaponization," *The Space Review* (October 20, 2008); http://www .thespacereview.com/article/1235/1.

5. Brian Harvey, *China's Space Program—From Conception to Manned Spaceflight* (New York: Springer-Verlag, 2004); and Joan Johnson-Freese, *The Chinese Space Program: A Mystery within a Maze* (New York: Krieger Publishing Co., 1998).

their motivations.[6] Where Harvey and Johnson-Freese had to make do with the occasional article by a Chinese scientist in an obscure publication like the *Journal of the British Interplanetary Society*, scholars now have access to many Chinese-language histories of the program as well as access to the participants themselves.

Scholarly experience with the published histories of the Russian space program suggests some caution in assessing the veracity or objectivity of the new Chinese-language histories.[7] One important similarity is that, like early Russian histories of the Russian space program, China's histories are vetted by political authorities for political reasons. This type of oversight unquestionably influences the selection of information that is contained in these works and how it is presented. Such oversight does not, however, necessarily mean the information is unreliable or uninteresting; but it does strongly suggest the stories told are incomplete. We are likely to learn much more about the history of the program in years to come, especially if the Chinese government exercises less control over Chinese academic publications.

The sources we selected are only a small slice of the total number of publications on China's space program, most of which are transparently self-serving pieces of personal, institutional, or national propaganda. We selected works by scholars who, while associated with some of the institutions and individuals involved in the Chinese space program, nevertheless make a serious attempt to be detailed, objective, and comprehensive in their treatment of the subject. The information contained in these sources is broadly similar, and in some cases the description of particular events is almost identical, suggesting an agreed-upon narrative imposed by their editors.

Differences in emphasis, style, and content also appear, suggesting independent scholarship and honest inquiry. Despite their limitations and lack of independence, these sources nevertheless contribute much to what is known about the Chinese space program outside of China and are deserving of our attention. Where possible we checked the content of the sources by interviewing senior figures in China's space programs.

Chinese scientists and engineers use a particular phrase to describe why China made such significant investments in space programs. They explain their motivation to make China a spacefaring nation with the phrase *yi xi zhi di*: "a place for one's mat." The English analog is "a seat at the table," the difference explained by the fact that people in ancient China sat on mats on the

6. We have included a bibliography for Chinese-language readers with approximate English translations of the titles. We have not translated the titles within the footnotes if the materials are not available in English.

7. At the same time, one should not make the mistake, made in so many areas of Chinese studies, of inferring Chinese behavior or motivations from the history of the Soviet Union. The similarities between the organizational and ideological underpinnings of their modern political and economic experiences pale in comparison to the weight of the differences between the historical, cultural, academic, and literary traditions of the two nations.

floor, not in chairs. The fundamental idea is that China deserves a place among spacefaring nations. Throughout the history of the Chinese space program that has meant taking technical cues from the leading space programs—usually the United States.

Chinese efforts have been shaped by political, bureaucratic, and technical realities. In particular, the political turmoil of the Mao era and subsequent efforts to restore stability to the Chinese economy deferred many of their objectives to the present day.

We do not for a moment believe that we have written a definitive history of China's space program. We do not present the complete chronologies of every space program and piece of technology discussed in the original Chinese sources, but instead have selected as case studies three important decisions and accomplishments: (1) the launch of China's first satellite in 1970, (2) the launch of China's first communications satellite in 1984, and (3) China's first human spaceflight in 2003. A comprehensive history should address many other issues and events, such as the influence and the role of Soviet assistance and China's military space programs, but a comprehensive history is not our objective. We aim to demonstrate how the available history can help foreign observers better understand Chinese intentions. These three difficult efforts to establish China as a major spacefaring nation demonstrate strong philosophical and political aspirations that go beyond the acquisition of instrumental military or technical capabilities. Although the motivations in the Chinese space community conflict and overlap, all parties appear to have a sense of the importance of space to China's view of itself and its place among nations.

THE EAST IS RED: CHINA'S FIRST SATELLITE[8]

China launched its first satellite on April 24, 1970, becoming the fifth nation to do so, following the Soviet Union, the United States, France, and Japan. Yet China's desire to be able to place a satellite in orbit dates to the beginning of the space age. The story of China's twelve-year quest to launch a satellite reveals the economic and technical constraints on China's early space efforts and the political and social influences that shaped the bureaucratic structures that mark China's modern space industry.

Sputnik Impresses the Great Helmsman

The Soviet Union launched *Sputnik*, the first man-made satellite, into orbit around the earth on October 4, 1957.

8. The principal source of information for the events described in this case study is 巩小华. 中国航天决策内幕. 中国文史出版社, 2005, 139–195. Dates, documents, and quotations in the first case study were obtained from this source unless otherwise specified.

When Chairman Mao Zedong stepped off a plane twenty-eight days later in Moscow, for his second and final trip to the Soviet Union, he congratulated the Soviets on "a great accomplishment that exemplifies the beginning of a new era of humankind's progressive conquest of nature." Mao was not reading from a prepared text or attempting to flatter the new Soviet leader; he detested Soviet premier Nikita Khrushchev, in fact. *Sputnik* made quite an impression on the Great Helmsman.

Mao was in Moscow to attend a gathering of Communist leaders to celebrate the fortieth anniversary of the Bolshevik Revolution. Historians remember Mao's November 1957 visit to the Soviet Union as the beginning of the Sino-Soviet split, but at the time, Khrushchev had very different hopes. Khrushchev needed Mao to help repair the rifts in the international Communist movement caused by his denunciation of Joseph Stalin and the uprisings it precipitated in Poland and Hungary. Mao, who felt slighted after Stalin's mistreatment during his first visit to the Soviet Union in 1949, repeatedly insulted Khrushchev. At the time, Khrushchev's efforts to win over Mao included promising substantial technical assistance that would form the foundation of China's nascent space industry. In advance of Mao's visit, the Soviet Union and China signed the October 1957 New Defense Technical Accord, to provide assistance in the development of nuclear weapons, missiles, and aircraft.

In China during the months following the launch of *Sputnik*, the core of China's tiny scientific and technical community—scientists such as Qian Xuesen, Zhao Jiuzhang, Qian Sanqiang, Chen Fangyun, and Cai Xiang—published numerous articles explaining the potential uses of satellites and their future significance. Zhang Qinfu, the party secretary and vice director of the Chinese Academy of Science (CAS), had held a series of meetings to discuss the relevance of satellites to national scientific and technical development and the question of how China might proceed with a satellite research and development program.

Mao formally decided that China would have its own *Sputnik* after listening to a working paper on the satellite question during the Second Plenary Meeting of the Eighth Party Congress on May 17, 1958. Displaying the same crude approach to satellites that he applied to most policy matters, Mao exclaimed: "If we're going to throw one up there then throw a big one, one that weighs two tons. Of course we start throwing small, but with one that is at least two tons. Something like that chicken egg of the Americans, I won't do it!"

After Mao's pronouncement, the CAS made the satellite program its number one priority for 1958 and formed a special group—group 581—to carry out a three-phase plan beginning with the development of a sounding rocket, the launch of a 200-kilogram satellite, and finally, the launch of a satellite of several thousand kilograms. Qian Xuesen was the group leader, with Zhao Jiuzhang and Wei Yiqing as assistant group leaders. They established three design academies under the CAS to carry out the plan. The First Design Academy, under

Guo Yanghuai and Yang Nansheng, would be responsible for the overall design of the rocket and the satellite. The Second Design Academy, under Lu Qiang and Chen Yuanjiu, would be responsible for the control system. The Third Design Academy, under Zhao Jiuzhang and Qian Ji, would be responsible for developing satellite instrument packages that would study the space environment.

Politics Intrudes: The Great Leap Forward

Almost immediately, politics began to intrude. In January 1958, Mao launched the "Great Leap Forward," a massive experiment in economic and social engineering designed to propel China into the ranks of the advanced industrial nations within fifteen years. The experiment, famous for the "backyard furnaces" in which peasants smelted their cookery to overtake England in steel production, ended in one of the greatest famines in human history.

The somewhat measured approach outlined by the CAS was disrupted by the Great Leap, whose purpose was to upend the bureaucratic planning processes Mao felt were leading to the reestablishment of class hierarchies in China just as they had in the Soviet Union.

Although the unrealistic expectations about Chinese technical accomplishments initially created the atmosphere needed to inaugurate an ambitious space program at a time when China was mired in poverty, the enthusiasm quickly created uncontrollable forces that proved destructive. The slogan "launch a satellite" became a popular metaphor for ambitious efforts in disparate fields, from grain production to factory construction.

People were launching metaphorical satellites all over China,[9] creating pressure on CAS to accelerate their effort to place a real one in orbit. At a CAS meeting in mid-June 1958, Qian Xuesen, a U.S.-educated engineer who had worked on the U.S. rocket program and was one of the founding fathers of the Chinese space effort, was the first to speak. He set an overly enthusiastic tone in his remarks on the satellite program. As the deputy director of the Fifth Academy of the Chinese Ministry of Defense, his words carried a lot of weight. Chen Yuanjiu, another senior scientist, not wanting to be outdone, exclaimed, "If you dare to send up a satellite, then I'll collect it back!" Things quickly got out of control. Twenty days later, at the second meeting of the Chinese Communist Party (CCP) delegation at CAS, 43 different work units proposed 972 different projects, claiming 102 of them would "surpass advanced international standards." In this politically charged and wholly unscientific context, the leadership of CAS collectively set the incredibly unrealistic goal of launching a satellite in fifteen months, in October 1959—in time for the tenth anniversary of the founding of the People's Republic of China (PRC). This date was a popular goal for many projects during

9. 人民日报. "卫星" 行行可放. August 26, 1958.

the Great Leap Forward, including the huge government buildings that still rim Tiananmen Square in downtown Beijing. Despite the popular and political enthusiasm, China's scientists knew they were not ready to launch a satellite anytime soon, much less in a little more than a year.

CAS organized a trip to the Soviet Union, setting off to seek technical assistance in Moscow on October 16, 1958. The political climate was considerably different than it had been the year before; Mao's calculated insults to Khrushchev had fed the growing Sino-Soviet split. Fearing that Moscow would reject their inquires, CAS described the purpose of the delegation as studying the "physics of the upper atmosphere," scrupulously avoiding the words *rocket* and *satellite* in their proposal. The Soviets refused Chinese requests, made through the Chinese Embassy in Moscow, to visit the Soviet satellite design research institute and the launch site. The only potentially instructive thing on the agenda was a glimpse at a sounding rocket in the atrium of the Central Meteorological Bureau, but even there the Soviets ordered the Chinese to keep a distance. When a member of the delegation strayed within the three-meter boundary set by the Soviets, the guide sternly chastised the group. The next day, the head of the Technical Department of the Soviet Academy of Sciences subjected the Chinese delegation to a patronizing lecture on the difficulties of launching a satellite and advised them to forget about it.

China's Scientists Regroup: The Development of Sounding Rockets

China's scientists did not forget about launching a satellite. When they returned home, the four CAS scientists who went to Moscow—Zhao Jiuzhang, Yang Jiahui, Qian Ji, and Wei Yiqing—wrote a report asking for more resources and time, noting that China's satellite effort suffered from a general lack of resources, equipment, and personnel.

The party organization within the CAS, led by Deputy Director Zhang Qinfu, set out to solve those problems by joining together with the municipality of Shanghai, which had money and a strong industrial base, to establish the CAS-Shanghai Mechanical and Electronics Institute in November 1958. The new institute consolidated scientists, engineers, students, workers, and managerial personnel from CAS in Beijing; the CAS branch institutes in Hebei, Huanan, and Sichuan; Shanghai Jiao Tong University; the Harbin Polytechnic University and other educational institutions; as well as engineers from Jiangnan Shipyards, the Radio Electronics Factory, and the Textile Machinery Factory.[10] They were put under the direction of a 37-year-old Virginia Tech-educated engineer named Wang Xiji, another of the founding fathers of China's space program. Wang would go on to play a key role in the development of China's space-launch vehicles, the design of their recoverable remote sensing satellite program, the production of the *Shenzhou* human spaceflight capsule, and the establishment of China's experimental microsatellite program.

10. 李鸣生. 中国火箭卫星发射纪录. 中共中央党校出版社, 2005, 39.

As China's political leaders began to accept the reality that the Great Leap had been a catastrophe, early enthusiasm for racing past advanced nations like the United Kingdom gave way to more pragmatic approaches to industrial and technical development. In January 1959, Deng Xiaoping, then general-secretary of the CCP, told group 581 that they should formulate a realistic plan to take China step by step to where it needed to be, directing CAS to begin with sounding rockets.

Wang was starting the sounding rocket program from scratch, in a new institution under significant political pressure and without the foreign expertise, instructors, and equipment that kick-started the military missile program at Qian Xuesen's Fifth Academy. The initial design for a sounding rocket was too ambitious. The T-5, with an engine produced by the Shanghai Diesel Fuel Equipment Factory and tested in a mosquito-infested air force repair hangar in the wetlands of Shanghai's Songjiang County, never got off the test stand. Wang set his sights on a smaller, easier design, the T-7M. They began work just after the tenth anniversary of the PRC in October 1959. The T-7M was a two-stage rocket with no control system that combined liquid and solid fuels; it weighed 190 kilograms, was 5.3 meters tall, and could reach an altitude of 8 to 10 kilometers.

The first launch was on February 19, 1960. Key engine parts were handcrafted by a pair of young women, and the rocket was fueled with a bicycle pump. The launch was a success, and although the rocket reached an altitude of only 8 kilometers, it was China's first indigenously designed liquid-fueled rocket. To this day it is considered the first step on China's long road to putting a satellite in space. A few months later, Mao visited the hangar where they were working on the T-7M to congratulate Wang and his team. As he left, he stood next to a model of the rocket on display and gave it a few slaps with his hand. An observer later wrote that the look on Mao's face was like that of a father patting his infant son on the bottom.[11]

After the successful launch of the T-7M sounding rocket on September 13, 1960, cooperation between three CAS institutes—the Geophysical Institute, the Biophysical Institute, and the Shanghai Mechanical and Electronics Institute—produced a series of experimental missions including environmental sensing missions in the upper atmosphere and the launch and recovery of guinea pigs and dogs. CAS also started research and development programs in space medicine, aerodynamics, orbital mechanics, rocket engines and propellants, attitude control technology, and many other space-related fields.[12]

A key figure in the design and implementation of these experiments was CAS Geophysical Institute Director Zhao Jiuzhang, another foreign-educated founding father of the Chinese space program. After graduating in 1929 from Tsinghua University with a degree in physics, Zhao was awarded a

11. 李鸣生. 中国火箭卫星发射纪录. 中共中央党校出版社, 2005, 45.

12. 刘韩锋, 刘艳琼, 谢海燕. 两弹一星工程与大科学. 山东教育出版, 济南, 2004, 67.

scholarship and, together with Jiang Weiguo, the son of Nationalist China President Jiang Jieshi (Chiang Kai-shek), went to Germany to study. Zhao earned his doctorate in meteorology in 1936 and returned to China to a leadership position in the Central Meteorological Bureau. Zhao refused to leave China with the Nationalists in 1949 and turned over the Meteorological Bureau to the new Communist government. After Deng directed CAS to refocus the satellite program in January 1959, Zhao led the space science and technology research effort within CAS.

The Military Becomes Involved

Through the early 1960s, the advocates for China's satellite program were located within the civilian CAS, with its limited resources, equipment, and personnel. At the same time, China was developing ballistic missiles, initially with the help of the Soviet Union.[13] China's successful test of a medium-range ballistic missile, the DF-2, on June 29, 1964, created conditions for a change in policy and organization.

In mid-October, Zhao Jiuzhang and a small CAS delegation were invited to the launch site in Jiuquan to witness a test of the DF-2 ballistic missile. Zhao realized then that China had made significant progress, to a point where they could launch a satellite. Zhao called together the technical staff to discuss the possibility and was encouraged by their support.[14]

On December 21, 1964, Zhao attended the Third National People's Congress as chair of the science and technology delegation. Premier Zhou Enlai opened the meeting with some remarks focused on the so-called Four Modernizations that he believed China should undertake as a long-term objective: the modernization of agriculture, industry, national defense, and science and technology.[15] Zhao composed a several-thousand-character argument for reopening the question of launching a Chinese satellite that he gave to Zhou Enlai the next day. In his essay Zhao wrote, "I suggest we combine the tests of our ballistic missile program with launching a satellite, and get the benefit of hitting two birds with one stone." Zhou Enlai called Zhao aside during the congress and told him to submit a more detailed proposal.

Zhao and Lu Qiang, a colleague at CAS, quickly drafted a proposal and submitted it to Party Secretary Zhang Qinfu, who in turn passed it—with his approval—to the CAS Interplanetary Flight Committee, which took its title from a book called *Interplanetary Flight* written by Qian Xuesen and inspired by Yuri Gagarin's flight into space. The CAS had established the committee, with both Zhao and Qian as members, a year earlier under the direction of

13. For the history of China's ballistic missile programs, see John W. Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," *International Security* 17 (2) (Fall 1992): 5–40.

14. 李鸣生. 中国火箭卫星发射纪录. 中共中央党校出版社, 2005, 47.

15. The Four Modernizations would reappear as a theme in 1975.

the noted meteorologist Zhu Kezhen.[16] The CAS Interplanetary Flight Committee approved Zhao's proposal and sent it to the Party Central Committee.

Qian Xuesen took his own proposal to the Committee on Science and Technology for National Defense (CSTND). Securing CSTND's support was essential; after all, the committee was in charge of developing the ballistic missiles that Zhao hoped would put a satellite in orbit.

Originally called the Aeronautics Industry Committee, Zhou Enlai decided to create CSTND after listening to a report by Qian Xuesen at an expanded meeting of the Central Military Commission on March 14, 1956. The official CSTND history says it was established by the State Council in April 1956. Qian's report was based on a series of lecture tours he took to military installations around China organized by Defense Minister Peng Dehuai after Qian's return from the United States in October 1955. In his report, Qian called for the establishment of a special organization to oversee China's "defense aerospace industry."

General Nie Rongzhen, a veteran revolutionary who had joined the party as a student in Paris in the 1920s, served as director of the new committee and remained in charge after it became CSTND in October 1958, when its responsibilities expanded to include nuclear technology and the nuclear weapons program.

In his report to CSTND, Qian, like Zhao, argued that China's nascent intercontinental ballistic missile program could support an effort to place a satellite in orbit. Nie understood the military value. He told Qian: "Last year, before we detonated our atomic bomb, the Americans had already seen it with one of their satellites. Now that's something!" Nie asked Qian for a proposal, which Qian submitted to CSTND on January 8, two days after the Zhao's CAS proposal went to the Central Committee. Qian's proposal noted that "the planned intercontinental ballistic missile can also launch a satellite."

Other members of CSTND, however, were less certain about the new push to launch a satellite. General Nie tried to advance the effort by having General Zhang Aiping, a deputy in the General Staff Department and a deputy director of CSTND, convene a hearing with thirty technical experts, including Zhao Jiuzhang and the group from CAS, to discuss the military and scientific implications of what Nie described as Qian's recommendation.[17] The discussion began in early March, but CSTND was still undecided in mid-April, when Zhao Jiuzhang made his case for the satellite proposal in an ad hoc meeting with another CSTND deputy director, General Luo Wuchu, and several others, including CAS Party Secretary Zhang Qinfu and Qian Xuesen.

On April 29, 1965, CSTND finally signed off on a report to the Party Central Committee proposing to put a 100-kilogram satellite in orbit by 1971.

16. Zhu was a close friend of Joseph Needham, who posed "the Needham question" as to why China had been overtaken by the West in the fields of science and technology. Zhu was well known in China for his commentary on Needham's question.

17. 巩小华. 中国航天决策内幕. 中国文史出版社, 2005, 154.

The Central Committee sent the proposal to the Special Committee—set up to direct the nuclear weapons program but now a body guiding national science and technology policy—which during its twelfth meeting, held in Beijing on May 4–5, 1965, decided to put the satellite in the national plan. The Special Committee gave overall control of the satellite project to CAS and directed them to submit a plan for implementation in July.

CAS submitted its implementation plan in July, and the Special Committee reviewed it during their thirteenth meeting on August 2. The CAS plan went well beyond a single satellite. What CAS proposed was a long-term plan for the development of a comprehensive national satellite program. The Special Committee approved the plan with a stipulation: the project managers must consider the political aspects of a space program. The first satellite should be more advanced than the first satellites of the United States and the USSR, with a longer lifespan and more advanced technology.[18] In hindsight, the early focus on the political ramifications of technical details foreshadowed the difficulties that the satellite program would face in the coming years. The Special Committee also assigned the project a number, 651, in commemoration of the month and year it was submitted for consideration.

The next step on China's road to space was a now legendary 42-day meeting in the Friendship Hotel in the northwest suburbs of Beijing that lasted from October 20 to November 30.[19] The "Project 651 Meeting" established the process, personal relationships, and bureaucratic infrastructure for the development of the first satellite. The institutional framework established there continues to shape the Chinese space program, from its bureaucratic structures to its location in the northwest suburbs of Beijing, which continues to be the heart of the Chinese aerospace industry.

The meeting brought together representatives from all of the major institutions: the Committee on Science and Technology for National Defense; the Committee on Industry for National Defense (later merged with the former); the National Committee for Science and Technology; the general staff of the People's Liberation Army (PLA); the air force; the navy; the 2nd Artillery; the PLA Signal Corps; the 1st, 4th, and 7th Machinery Bureaus; the Ministry of Post and Communications; the Academy of Military Science; and thirteen other research institutes under the CAS. CAS Vice Director Pei Lishen chaired the meeting.

After the meeting ended, CAS formally established the 651 Design Institute, headed by Zhao Jiuzhang, and the 701 Project Bureau, which was a management agency for the ground stations that would be used to track the satellite. CAS also set up more than two hundred mission-supporting research projects spread across the country. The 7th Machinery Bureau's Eighth

18. 李鸣生. 中国火箭卫星发射纪录. 中共中央党校出版社, 2005, 52.

19. Zhu Yilin describes the meeting as "from October 20 through December 2, 1965, lasting for 64 [*sic*] days." Zhu's error is repeated in Harvey, *China's Space Program*, 49.

Design Institute started research on the launch vehicle. The Academy of Military Science and the Academy of Medical Science began research on space medicine and the space environment.

The mission for the first satellite was ambitious: an experimental instrument package to collect data to assist with the design and development of earth observation, weather, and communication satellites. The mission also had a basic public relations requirement summed up in a twelve-character phrase, roughly translated as "get it up, follow it around, make it seen, make it heard."

Politics Intrudes—Again: The Cultural Revolution

Once again, Mao's political ruminations would become obstacles for the space program. While the scientists, engineers, and generals were planning China's future in space, Mao was preparing to travel south to the remote hills of Jiangxi's Jinggangshan, to reminisce about the good old days of his peasant revolution. A few months later, in May 1966, as he was walking the mountain paths of his old revolutionary base camp, Mao decided to start another political movement aimed at smashing the entrenched bureaucracy he believed was sapping the strength from China's forward historical momentum. He called it the "Great Proletarian Cultural Revolution."

Intellectuals were a primary target during the Cultural Revolution, and institutions like CAS became the major battlefields. The Cultural Revolution was a mass movement, with no clear lines of authority. The high school and college students who made up the movement's "red guards" had little direction beyond the cryptic aphorisms in the now famous "Little Red Book."

Amid the chaos, Zhou Enlai tried unsuccessfully to protect the satellite program at CAS from the political and ideological struggles initiated by the movement. The satellite program was being destroyed in the chaos. One casualty of the Cultural Revolution was Zhao Jiuzhang, as responsible as anyone for pushing the satellite program since the late 1950s. Zhao was eventually removed from his positions at CAS. Later, in October 1968, he committed suicide.[20]

Zhou was more successful in protecting CSTND, where General Nie Rongzhen had managed with great difficulty to limit the impact of the Cultural Revolution on the nuclear weapons and ballistic missile programs, including the facilities associated with it that were under PLA control, such as the launch site in Jiuquan, the nuclear weapons test site in Xinjiang, and the nuclear weapons design base in Qinghai. The leadership at CAS and in the industrial bureaus asked Zhou Enlai to place their organizations under military protection. Nie and Zhou drafted the "Petition for Military Assumption of

20. His death was a significant setback for the satellite program. In 2007, on the occasion of the 100th anniversary of Zhao's birth, Wu Zhongliang, the director of the China Earthquake Administration at the China Geophysical Institute, which Zhao had directed, published an article that strongly suggested Zhao's death was not only the result of foul play, but a heroic sacrifice for the salvation of modern China that was "weightier than Mount Tai."
吴忠良. 百年生死赵九章. 国际地震动态, 第8期 2007年8月, 11–12, 22.

Management and Reorganization of National Defense Science and Technology Research Organizations" and sent it to Mao in March 1967. With his approval the entire Chinese space effort was brought under PLA control. One important result of the restructuring, among many others, was the creation of the Chinese Academy of Space Technology (CAST) in February 1968.

With the restructuring came personnel changes. Qian Xuesen became the director of CAST. Qian replaced Zhao Jiuzhang with a young ex-air force officer, Sun Jiadong. Sun had studied airplane engine design in Moscow, worked as a technical translator, and had worked as a designer on the missile program with the Fifth Academy under Qian since its founding.

The chaos of the Cultural Revolution slowed work on China's first satellite and eventually began to shape its objectives. Where the Special Committee had initially insisted the satellite be *more* advanced that early U.S. and Soviet satellites, the political climate now placed an emphasis on speed and propaganda. Sun decided Zhao's original design was too complicated for the initial launch and quickly won General Nie's support to strip the satellite down to a bare minimum. Instead of Zhao's vision of the project as a cornerstone for a long-term satellite development program, Sun's stripped down satellite was named *East Is Red 1,* after a collection of converted folk songs that told the story of the revolution. All the satellite could do was play the first few bars of the song.

The scientists who had worked on the satellite program before the onset of the Cultural Revolution strongly opposed Sun's proposal. Nevertheless, CSTND approved the proposal in October 1967—in large part because of support from Qian Xuesen—and set aside much of the work on the instrument packages and structural design that had been done in the two years since the Project 651 meeting.

The slogan—"get it up, follow it around, make it seen, make it heard"—soon shaped the program. Zhou Enlai, who took an unusually strong interest in the technical details of the satellite program,[21] wanted to make sure both friends and foes could see that China had been successful. Accurate tracking, in particular, was a priority because Zhou planned to notify other countries in advance when the satellite would be over their territory. Not only would observers be able to "hear" the satellite playing "The East Is Red," but they would be able to see it, too. The satellite was just visible to the naked eye, and designers gave the third stage of the rocket an "observation skirt," a shiny metal ring that would allow those on the ground to find the orbital track.

21. Qi Faren, who worked on the first satellite project and went on to become a leading figure in Chinese aerospace, recounts an evening a few days before the launch when, together with other members of the satellite design team, he and Zhou were sitting in front of schematics spread out on the carpet answering Zhou's questions about the technical parameters of the satellite and the mission, including details about battery life and orbital parameters. After each answer, Zhou would check off items in the notebook he kept on the progress of the project, occasionally even catching discrepancies in calculations. 李鸣生. 中国火箭卫星发射纪录. 中共中央党校出版社, 2005, 103.

China successfully launched the satellite on April 24, 1970. Although China's scientists "got it up there," the success was hardly the foundation for a robust space science program. In the end, politics trumped technology even in the selection of a launch date. The technicians wanted to wait a few days for clear skies, but Zhou—ever mindful of the politics—insisted the launch take place just before a scheduled April 25, 1970, meeting with the leaders of Laos, Cambodia, North Vietnam, and South Vietnam.

The PLA sent up an experimental satellite shortly after the success of the *East Is Red 1*.[22] China did not launch its next satellite until 1975, the first in a series of six experimental satellites that may have flown some of the instrument packages originally planned for the first satellite.[23] But the vision from the forty-two-day 651 meeting, for developing communication, earth observation, and weather satellites, did not come to pass until the 1990s. Institutions of higher learning were closed for a decade because of the anti-intellectual, anti-institutional ethos of the Cultural Revolution. An entire generation of potential scientific and technical talent was lost.

CHINA'S FIRST COMMUNICATIONS SATELLITE[24]

In April 1984, China placed its first communications satellite into geosynchronous orbit. The successful launch was the culmination of nearly a decade's worth of effort, which began with a decision during Mao's dying days. Mao's death in 1976 permitted the gradual reemergence of Deng Xiaoping, who became the organizing force behind an effort to reconstitute the bureaucratic structures the CCP had put in place in the early 1950s before the Great Leap, and again in the early 1960s before the Cultural Revolution. Deng's interest in education spurred China to seek a communications satellite and put China back on a solid path to space.

5-19 Commentary

Shortly before the end of the Cultural Revolution, the State Council and the Central Military Commission (CMC) approved and funded plans for a Chi-

22. The Chinese launched the *Shijian 1* on March 3, 1971; it carried an instrument package comprising a cosmic-ray detector, X-ray detector, magnetometer, field effect solid-state storage device, louver-type thermal control device, and a solar-cell experimental power supply system. This instrument package differed substantially from the initial suite of experiments planned for *DFH-1*.

23. China also started a recoverable satellite program under Wang Xizhi in the 7th Machinery Bureau's Eighth Design Institute. The progress of this program was also interrupted by the chaos of the Cultural Revolution. Its first successful launch and recovery was in 1975, on November 26. Two additional successful missions were launched in the 1970s, one on December 7, 1976, and another on January 26, 1978.

24. The principal source of information for the events described in this case study is 巩小华. 中国航天决策内幕. 中国文史出版社, 2005, 196–232. Dates, documents, and quotations in the second case study were obtained from this source unless otherwise specified.

nese communications satellite—for a rather earthly reason. Communications satellites are most effective when placed in a geosynchronous orbit (GEO). This unique orbit is at an altitude and in a plane where satellites move at the same speed and in the same direction as the earth's rotation; therefore they appear to stay in a fixed location relative to a point on the earth's surface, which allows them to be used for reliable and uninterrupted communications over as large an area as possible. By the mid-1970s, slots in GEO were scarce. Although the use of GEO is coordinated by the International Telecommunications Union (ITU), national access can be assured only by staking a claim to space in GEO and occupying it with an actual satellite. The longer China waited to put up their own satellites, the less space would be available.

Three young Chinese telegraph workers, Huang Zhongyu, Zhong Yixin, and Lin Keping, brought this arcane but important matter to the attention of a dying Zhou Enlai in a handwritten letter in March 1974.[25] Two months later, on May 19, Zhou sent the letter to four politburo members—Zhang Chunqiao, Ye Jianying, Wang Hongwen, and Li Xiannian—with a note in red pencil asking them to convene a meeting to discuss it. Chinese historians refer to the letter as the "5-19 Commentary."

Li Xiannian, also serving on the State Council as vice councilor, gave the letter to the director of the National Planning Commission, Yu Qiuli, who convened a meeting with the leaders of the Post & Telegraph Ministry, the Radio and Television Department, and CSTND on May 21. Four months later they sent a report to the Party Central Committee titled "On the Question of the Development of Our National Communications Satellite."

Six months after that, on March 31, 1975, General Ye Jianying put the proposal before the CMC. An intense debate ensued over whether reconnaissance or other types of satellites should take priority. Deng Xiaoping played a central role, acting as the chosen successor for the terminally ill Zhou. During the brief interlude that began with his rehabilitation by Zhou in 1974 and ended with his second purge after Zhou's death in April 1976, Deng urged the CMC to stop debating the issue and approve the report on the communications satellite. They did and sent their recommendation to the Party Central Committee, with a request to act quickly on their recommendation. (The Party Central Committee acted within two days.) Mao, himself dying, was preparing for surgery and generally unable to read. He looked at the document and drew a circle on the top of the first page, expressing his consent. China's communications satellite program then became known as Project 331 to mark the March 31 CMC meeting.

25. Huang was an ordinary technician working for the Planning Department of the Ministry of Post & Telegraph; Zhong was a lecturer at the Ministry's Beijing Institute of Post & Telegraph; Lin was a recent graduate of the Institute, who after graduation was doing secretarial work at the ministry and had an interest in computers. In their spare time, the three friends would dream up ways to improve the Ministry's technical infrastructure. 李鸣生. 中国火箭卫星发射纪录. 中共中央党校出版社, 2005, 160–161.

Deng Decides to Buy a Satellite from the Americans

China's scientists and engineers accomplished little in the two years following the March 1975 CMC meeting. China notified the ITU that they intended to place a satellite in GEO, which the ITU made public on March 3, 1977; but another six months would pass before the program actually got under way. Mao's death and the arrest of the infamous "Gang of Four" in 1976 ended the Cultural Revolution, but a struggle continued within the party between the designated successor, Hua Guofeng, and Deng Xiaoping.

Deng did not consolidate his position as the de facto leader of the country until the 11th Party Congress in August 1977. CSTND, now led by Deng's ally Zhang Aiping, made the communications satellite one of its three top priorities in September 1977.[26]

In the spring of 1978, Deng convened a meeting of the Special Committee at which the communications satellite program was discussed. Deng opened the discussion by observing, "If we invite a good teacher to give a lecture in the Great Hall of the People only 10,000 people can hear it, but if the same teacher were to give that lecture on television, and everyone had the equipment to receive it, that's a classroom of unlimited size." Deng then inquired about the progress of the communications satellite program. Those at the meeting recall that Deng felt the program was progressing too slowly.

Deng decided that rather than wait for China's fledgling space industry to recover, he would simply purchase a communications satellite from the Americans. At the time of the meeting, China was in secret negotiations with the Carter administration on normalizing relations. The United States was preparing a July 1978 visit to China, to be what National Security Advisor Zbigniew Brzezinski described as "the most high powered science/technology delegation ever sent by the United States to a foreign country." The delegation was led by Carter's science advisor, Frank Press, and included the head of NASA.[27] Deng informed the Special Committee that he personally would raise the issue of purchasing a communications satellite if Press came to China as planned.

Chinese sources recount that the Americans seemed interested, but the lengthy negotiations over the satellite purchase eventually left the Chinese feeling slighted. They wanted a new satellite that incorporated parts and equipment they could supply themselves. The Americans, on the other hand, offered to sell an existing satellite Hughes had made for another client who could not take delivery. The Chinese recall that both sides expressed a willingness to compromise, but the deal still fell through—though the details remain unclear.

26. Zhang Aiping first expressed his intention to make it a priority during a meeting of CAST in June 1975. 李鸣生. 中国火箭卫星发射纪录. 中共中央党校出版社, 2005, 151.

27. An account of the delegation can be found in Robert Ross, *Negotiating Cooperation: The United States and China, 1969–1989* (Stanford, Calif.: Stanford University Press, 1995), 159–160. The quotation is taken from Richard Masden, *China and the American Dream: A Moral Inquiry* (Berkeley: University of California Press, 1995), 134.

Part of the problem may have been financial issues on the Chinese side. On the eve of a NASA delegation visit to China in 1979, both sides were working toward a memorandum of understanding for the satellite purchase. The Ministry of Post & Telegraph suddenly realized that it did not have the funds to buy it. Upon learning of the situation, Deng called an emergency evening meeting in his residence with CSTND Director Zhang Aiping, Deputy Director Ma Jie, Vice Councilor and State Planning Commission Director Yu Qiuli, and Chief Negotiator Ren Xinmin. Deng told the group, "The Americans are coming. Yu Qiuli should take responsibility for receiving them." Deng wanted Yu to find the funds and close the deal. Nevertheless, at the end of the visit there was no memorandum.

China Moves On

Shortly afterward, during another briefing at Deng's private residence, this time with the negotiating team, Deng decided China had suffered enough indignity at the hands of the American negotiators, and he reinvigorated Project 331. Ren Xinmin, who earned his Ph.D. in engineering mechanics from the University of Michigan and briefly taught at the University of Buffalo before returning to China in 1949, was the chief designer of the communications satellite project as well as the lead negotiator with the Americans on the failed attempt to purchase one. He spoke for many when he said, "This is just as well, let's forget about this idea, quickly put together our own satellite, get up in the sky and win one for the Chinese people." Zhang Aiping put it a bit differently:

> In space there is this issue of a UN seat. The great nation of China can't go for long without a seat in GEO and the face of the Chinese people won't be lost in our hands! If we buy, we can buy one or two, but we can't go on buying indefinitely. So, we have to do this ourselves.

Success seemed to take priority over expediency after the Chinese scientific and technical leadership became convinced—in part because of the experience with the Americans—that China would never be able to acquire genuinely advanced space technology from abroad. In contrast to the first satellite project, China's leadership persisted in this long-term view despite Deng's evident interest in a short-term distance-education solution and an ITU filing with a launch date of 1980. In the end, China did not launch its first communications satellite until 1984.

One key reason China took so long was Ren Xinmin's insistence on developing a cryogenic engine for the third stage of the rocket they would use to place the satellite in GEO, the Long March 3 (LM-3). Facing opponents who argued—correctly—that easier and faster alternatives existed using technology China had already mastered, Ren persisted. He felt that if they abandoned the effort to develop cryogenic engines for this project, decades might pass before they tried again.

By August 1983, China had completed the five major systems needed for the project: the launch vehicle, the satellite, the launch site, the tracking and telemetry equipment, and the network of ground stations. CSTND held a meeting in mid-August. Their report designated the communications satellite the *East Is Red 2* and set a launch window of December 1983–April 1984. Moreover, they decided to prepare three rockets and three satellites to ensure that they could complete the mission. If the first launch failed, China's designers could try again as soon as they could determine the cause of the failure. The Party Central Committee, the State Council, and the CMC approved the CSTND report on October 9, 1983.

The first launch attempt took place on January 29, 1984, but the third stage of Ren's cryogenic engine failed to reignite; pressure in the engine chamber reached only 90 percent of what was necessary. After three seconds, the pressure collapsed, leaving the satellite in an elliptical orbit with a perigee of 321 kilometers and an apogee of 474 kilometers, short of what was required for the satellite's solid-fuel kick motors to place it in GEO. So the Chinese maneuvered the satellite into an orbit and an attitude where it could be maintained for use as an experimental satellite. This was no small feat. The satellite was not where it was supposed to be, and China's ability to find it, track it, and communicate with it was extremely limited.

The Chinese press described the launch as a success: what had been a communications satellite was now dubbed an "experimental" satellite. The disheartened team working on the project took a short vacation to celebrate the Chinese New Year after listening to an encouraging letter from former CSTND Director Nie Rongzhen and current Director Zhang Aiping.

Ren Xinmin immediately got to work on the cause of the failure. The data collected from the tracking stations—in particular the data from the *Yuanwang 1,* the ship built to track the launch of China's first ICBM in 1980—indicated that a turbine in the third stage overheated, melting an electrical cable. A remedy for the overheating problem was not immediately obvious. Some scientists began to wonder whether China really could produce a cryogenic engine and whether they should delay the second launch.

Ren gave a briefing on what he had learned from the data at a CSTND meeting shortly after the failed launch. Zhang Aiping pressured Ren for a decision on whether the problem could be quickly fixed and whether they should authorize a second launch. Ren was not sure, but he told Zhang and CSTND he could solve the problem. On the way back, on the flight from Beijing to Chengdu, Ren realized that the overheating was probably due to problems with the supply of liquid hydrogen to the turbine. He imagined that a secondary line to supplement the supply could solve the problem.[28] It did. After a few months of testing and modifications to the LM-3 rocket, CSTND authorized a launch on the evening of April 8, 1984.

28. Additional unspecified causes and remedies for the failure are suggested in 李鸣生. 中国火箭卫星发射纪录. 中共中央党校出版社, 2005, 165.

The second launch was successful in getting the satellite into GEO, but the satellite's power system experienced a serious problem. The batteries were recharging too fast, and if the Chinese did not quickly correct the problem, the heat being generated by the recharging process could permanently damage some of the other circuitry. The Chinese had not been able to learn of this problem from their experimental satellite because its orbit was not high enough, and therefore they did not realize how the solar cells would perform at the higher altitude. They solved the problem by adjusting the satellite's attitude to an angle that would reduce the amount of sunlight reaching the solar cells without compromising the ability to recharge the batteries enough to keep the satellite in good working order.

On April 16 at 6:27:57 p.m. Beijing time, the *East Is Red 2* was parked in its assigned slot in GEO. By the evening of April 17, tests on the transponders for radio, television, digital communications, and fax showed they were all functioning properly. The next morning Zhang Aiping used the new connection to call Wang Enmao, the CCP Party Secretary in the Autonomous Region of Xinjiang. Wang told Zhang that for the first time in history, the people of his remote western region were able to watch a CCTV newscast in real time.

HUMAN SPACEFLIGHT[29]

In October 2003, China became only the third country to place a human being in orbit. A story in the Chinese aerospace community claims that the Americans once offered to exchange a moon rock for one of the Qin emperor's terra-cotta soldiers but that China's leaders refused. They were confident that China's getting to the moon was only a matter of time. The story is almost certainly apocryphal: four decades after China first embarked on a human spaceflight program, the country still has no plans to send Chinese astronauts to the moon.[30] The United States, for its part, gave China a moon rock as a gesture of goodwill during the negotiations over the normalization of diplomatic relations.[31] More complex motivations lie behind the evolution of China's human spaceflight program.

29. The principal source of information for the events described in this case study is 邓宁丰. 天河圆梦. 中国宇航出版社, 2004. Specific references to dates and documents contained in this section were obtained from this source unless otherwise specified.

30. After NASA Administrator Michael Griffin said he personally believed China would put people on the moon before the United States returned, Chinese officials clearly stated that China has no such plans; "Lunar scientists: China has no timetable for manned moon landing," Xinhua News Service, October 25, 2007. See also, Jill Drew, "Space Inspires Passion and Practicality in China," *The Washington Post*, September 25, 2008. For Griffin's comment, see Ching-ching Ni and John Johnson, Jr., "A first for China in space; The nation's launch of a lunar orbiter lays the groundwork for the ultimate goal putting an astronaut on the moon," *Los Angeles Times*, October 25, 2007.

31. U.S. National Security Advisor Zbigniew Brzezinski gave a 1-gram moon rock to Chairman Hua Guofeng on May 28, 1978, along with a Chinese flag the United States had "flown" on the moon.

China's False Start

A secret meeting of the CSTND on March 4, 1966, marks the official beginning of China's quest to put people into space. Zhou Enlai's original goals were modest: a feasibility study funded by piggybacking on the first satellite program. The assignment went to the 7th Machinery Bureau's Eighth Design Institute in July 1967. By January 1968 they had developed a draft proposal and a name for the program: Shuguang, or "Dawn's Early Light."

Shortly before the launch of the first satellite, four hundred Chinese aerospace experts from more than eighty different work units were called to another large meeting in another hotel in the northwest suburbs of Beijing, to discuss the Shuguang proposal. After the successful launch of *East is Red 1* and an enthusiastic speech by Qian Xuesen, the assembled experts boldly proposed a plan to put a Chinese astronaut in space by the end of 1973.

A month later the Chinese Air Force began recruiting astronauts. The search officially began shortly after CSTND and the CMC approved a joint report on the Shuguang program drafted by the air force and the Defense Department's Fifth Academy.[32] Chairman Mao, Premier Zhao Enlai, and Defense Minister Lin Biao signed off on the report on July 14, 1970, and the human spaceflight effort was then referred to as "Project 714."

Eighty-eight candidates were selected from an initial pool of 1,840 air force pilots who had at least 500 hours flying time, were approximately 30 years of age, weighed between 65 and 80 kilograms, and were between 1.7 and 1.8 meters tall. After some initial training, twenty finalists were selected to enter the Chinese astronaut corps. They began a two-year training program in May 1971, putting them on schedule for the planned 1973 launch of *Shuguang 1.*

The Country Is Broke!

Four months later, on September 13, Defense Minister Lin Biao, who had close ties to the Chinese Air Force, was on a plane piloted by his son, an air force officer; the plane crashed in Inner Mongolia en route to the Soviet Union, killing all those aboard. Lin was Mao's designated successor and a major figure in the Cultural Revolution. He was the publisher of the "Little Red Book" of Mao's sayings. The circumstances of the flight and his death remain shrouded in mystery. But the official position of the Chinese government was that Lin had planned to murder Mao and seize control of the country. Shortly after the crash, Mao decided to disband the astronaut corps, saying, "We should take care of affairs here on earth first, and deal with extraterrestrial matters a little later." After several years at the astronaut training center, at a university in Beijing, the pilots were officially transferred back to their original air force squadrons.[33]

32. 巩小华. 中国航天决策内幕. 中国文史出版社, 2005, 260–261.

33. Ibid. The university is not identified in the original source.

In addition to the political intrigues, funding was another problem holding back progress on the human spaceflight program. Yang Guoning, the assistant director of the 7th Machinery Bureau, recalled:

> The country was broke! Human spaceflight requires frighteningly large sums of money. Everyone was asking for funds, and both my hands were empty. All I could do was go to the Special Committee. Zhou Enlai confessed in exasperation that he was taking money from one pocket to put in the other and sent me to Yu Qiuli at the National Planning Committee. Yu asked for a report. After the 7th Machinery Bureau approved it, Yu organized a meeting at the Friendship Hotel. Although Yu was in charge of finances, he was tight with his money. His position at the Planning Committee was a tough one. He was having meetings like this all the time. Everyone was asking for money. . . . Yu sent me back to Premier Zhou. Because even Qian Xuesen didn't have the nerve to plead with Premier Zhou for money, I wasn't about to do it.[34]

Project 714 maintained operation on a shoestring budget, but made little progress. One Chinese source claims the project was officially ended in 1975, but offers no details.[35] Chinese histories state that after six-and-a-half years of plodding along without funds, China's human spaceflight effort was officially cancelled by Deng Xiaoping shortly after the political chaos of the Cultural Revolution subsided and he became China's de facto leader. Deng made the decision in August 1978 in response to a grim progress report from the directors of Project 714. Deng concluded that China "should not participate in the space race" and instead should "focus our energies on urgently needed practical satellite applications."

The primary focus of China's space program during this period was the recoverable satellite program. China successfully launched nine satellites between 1975 and 1987.[36] The development of large, blunt-nosed capsules capable of surviving reentry allowed designers to work on technologies that would be relevant when China resumed its human spaceflight program.

Rumors of a Chinese human spaceflight program continued through the early 1980s, but Chinese sources show no indication that any activity on such a program actually took place. Qian Xuesen's published correspondence contains two letters, from January 1977 and March 1978, to Chen Xin, the director of the CSTND 507 Research Institute, which focused on medical science and was involved in the original astronaut training program. Qian asked for

34. Ibid, 261–262.

35. 邓宁丰. 天河圆梦, 2004, 13.

36. This does not include the failed launch of another recoverable satellite on November 5, 1974.

Chen's support for a crash program to get a person in space by 1985, suggesting that the earlier effort had indeed ended. No subsequent mention of a push for a human spaceflight program appears in Qian's correspondence with Chen after the March 1978 letter.[37]

Reagan's "Star Wars" Speech and Project 863

China's human space program would receive crucial impetus from an unlikely source. Ronald Reagan's March 23, 1983, speech announcing the Strategic Defense Initiative (SDI) did not mention space or China. But it began a debate within China about the role of science and technology in China's national development—a debate that would eventually lead to the resuscitation of the human spaceflight program.[38]

The immediate result of Reagan's speech was a series of meetings organized by the leaders of various related government agencies, industrial departments, and research institutes on how China should respond to the challenge implicit in what Senator Edward Kennedy, quoted the next day in the press, called "reckless Star Wars schemes."[39] Some Chinese scientists argued that missile defense "is not just a military program but a far-reaching political striving to preserve American superiority" and that the U.S. program's "real objective" was "to push forward new advanced technologies and national economic development."[40]

Reagan's speech triggered an intense debate between two camps of experts in the upper levels of the Chinese bureaucracy that went on for almost three years. One camp argued that in an era of rapidly advancing technology, China must respond with a high-tech initiative if it wanted to build its overall technology base. The other camp argued that China should maintain the status quo, continue to focus on modest technology projects that would yield more immediate results, and hold off on making large investments in cutting-edge technologies, especially human spaceflight, until its economy was stronger. In the absence of a consensus, the status quo held, but the debate continued.

Three years later, on March 3, 1986, four senior Chinese scientists who strongly believed that China must launch its own drive to acquire high technology made an end run around the bureaucracy. Wang Daheng, Chen Fangyun, Wang Ganchang, and Yang Jiachi, veterans of China's nuclear weapons program, drafted a formal proposal, "Recommendations Concerning Research to Keep Pace with Foreign Strategic High Technology Development." As veteran bureaucrats and senior scientists, the four decided to place the proposal

37. 钱学森. 钱学森书信选 1956.2–1991.12. 国防工业出版社, 2008, 0027–0028.

38. The context and history of the 863 effort is described in Evan A. Feigenbaum, *China's Techno-Warriors: National Security and Strategic Competition from the Nuclear to the Information Age* (Stanford: Stanford University Press, 2003), esp. 141–188.

39. Quoted in Terence Hunt, No title, The Associated Press, March 23, 1983.

40. 巩小华. 中国航天决策内幕. 中国文史出版社, 2005, 263.

directly in Deng Xiaoping's hands, and sidestepped a complacent bureaucracy. Wang Daheng asked a favor of an old office mate, Zhang Hong, who had courted (and later married) Deng Xiaoping's daughter during the Cultural Revolution.

In the single-paragraph cover letter, dated March 3, the four scientists referred directly to America's "Star Wars Plan" and the "reactions it would engender from every nation in the world." The cover letter provides some insight into the nature of their concerns, which centered on whether China's current emphasis on light industry, land reform, and basic economic development was enough to ensure the country's ability to continue to compete in a world where the advanced industrial nations were making a concerted effort toward new technological breakthroughs.[41]

That the four scientists focused on getting the letter to Deng personally is interesting. After all, Deng was responsible for the pragmatism behind the more modest development plans the four found wanting. Deng was nonetheless moved. Upon receiving the proposal, Deng—who was not formally head of state or party—wrote a commentary, dated March 5, asking his protégé, Premier Zhao Ziyang, to "hold a meeting with a few experts and the responsible comrades, discuss it, express opinions and make a decision." Deng added that the matter was "very important" and instructed Zhao not to delay.

Zhao responded immediately by directing the State Council to organize meetings to discuss the proposal and Deng's commentary. On March 8, the State Council ordered the head of China's State Science Commission, Song Jian, and the head of China's Commission on Science, Technology, and Industry for National Defense (CSTIND), Ding Henggao (son-in-law to the now-retired Nie Rongzhen) to take responsibility for organizing specific arrangements for a debate on China's high-technology development plans.[42] In April, Song and Ding—under the auspices of a State Council Science and Technology Working Group, the State Science Commission, and CSTIND—engaged two hundred experts from the relevant civilian and military departments in a four-month effort that eventually produced the document, "An Outline for National High Technology Planning."

Another split emerged during the first few days of the discussion, between experts who wanted any high-technology initiative to be focused on military capabilities and others who argued for a broader approach targeting the development of the civilian economy. Deng Xiaoping intervened on April 6, expressing his opinion that they should pursue dual-use technology, with civilian applications as the primary focus.

41. Yang Jiachi and Chen Fangyun publicly explained their reasoning and motivations in an article published in the *Journal of the Chinese Academy of Science* shortly after they transmitted their letter to Deng. 陈芳允, 杨嘉墀. 我国航天技术发展与技术科学. 中国科学院院刊1986年4期, in 杨嘉墀院士文集. 中国宇航出版社, 北京, 2006, 102–109.

42. The Chinese added the "I" after merging the Committee on Science and Technology for National Defense (CSTND) and the Committee on Industry for National Defense.

During the debate over the plan, one of the four scientists, Wang Ganchang, was called to the leadership compound in central Beijing and asked for an estimated budget. He suggested a figure of 10 million RMB. Zhang Jinfu, who had moved on from his position at CAS to become state councilor and the chair of the Committee on the Economy, immediately told Wang it would not be enough.[43]

The Standing Committee of the Politburo of the CCP approved the plan in October, followed by the State Council in November with an authorization for the expenditure of 10 billion RMB. All four scientists were stunned when the final number was announced; it was equivalent to about one-half of China's annual defense budget in 1986.

The outline now became known as "Plan 863," in reference to the date of the four scientists' letter and Deng's commentary. Plan 863 contained seven fields where China would try to "follow international developments, decrease the gap between China and more advanced nations, and look for advantages where China could make a breakthrough": the life sciences, information, energy, defense, automation, new materials, and aerospace.

In February 1987, a special committee was established to develop a detailed plan for the space sector (Plan 863-2). The Chinese aerospace experts on this committee decided that a space program organized around the operation of a space station in low earth orbit, which could be used for the long-term conduct of human scientific experiments, would be one of the hallmarks of a twenty-first-century great power. A country with the capability of claiming and holding a long-term place in space would signal international significance and national strength. Human spaceflight was back on China's agenda.

The Bureaucracy Stalls

Serious differences of opinion, both from within and outside of the aerospace community, held up the authorization of Plan 863-2 for more than five years. Advocates said the program would spur technological development, increase national power, raise China's international standing, and inspire national pride. Opponents said human spaceflight was risky and that the large sums of money needed to ensure success would be better spent elsewhere in a country where the basic needs of many were still unmet. Opponents also argued not only that repeating something the United States and the Soviets had accomplished decades ago would be politically meaningless at home and abroad, but that both U.S. and Soviet experts had admitted that neither country received the originally anticipated military or scientific returns from the massive sums they spent on their human spaceflight programs.

Whether China should develop a capsule, a space plane, or a space shuttle was another topic of extended debate. The inability of the 863-2 group to come to a decision bred some interesting processes, such as an anonymous ranking

43. 巩小华. 中国航天决策内幕. 中国文史出版社, 2005, 267.

exercise, which used a point system to assign value to the various attributes of each proposal. In a July 1988 meeting of the 863-2 special committee in Harbin, the space shuttle option narrowly defeated the capsule option by a score of 84 to 83.69. In the end, however, the group settled on a capsule in their "Summary Report of the Exploratory Work of the National High Technology Plan for Aerospace," which they completed and submitted to the State Council for approval in May 1990.

Seven months later, in January 1991, the State Council convened a meeting to discuss the report that included the Chinese Society of Astronautics (CSA) and the CAS. Li Qianming, Deng Xiaoping's brother-in-law and a deputy commander in the 2nd Artillery, attended the meeting under the auspices of the CSA. Knowing Li would be there, the deputy director of the Aerospace Ministry, Liu Jiyuan, drafted his own proposal for a piloted space program and had Zhang Hong, Deng's son-in-law and the same man who gave Deng the letter from the four scientists in 1986, secretly hand his proposal to Li Qianming at the meeting. In his proposal Liu wrote:

> Whether or not we go ahead with a human spaceflight program is a political policy, not purely a technical question, not something scientific and technical people can decide by themselves. Our space program is facing the danger of losing the international standing the old generation of proletarian revolutionaries achieved with considerable difficulty. I urge the Party Central to decide this issue quickly.

Six weeks later, Premier Li Peng asked Liu's boss, Ren Xinmin, for a briefing on the human spaceflight program. Reflecting on the controversy over the best use of resources and the importance of building up China's technology base, Li reportedly told Ren, "It can't be said that going ahead with a human space flight program is a wise decision, but it is a decision that must be made."

Liu Huaqing Intervenes

Deng, who by then had completely retired from even his advisory position in the party, seems to have cajoled his successors into going forward with the program. His agent in this case appears to have been Admiral Liu Huaqing, who at the time was a vice chair of the CMC and an advisor to the Party Central Committee. The admiral sent a letter to Premier Li Peng, Party Secretary Jiang Zemin, and President Yang Shangkun dated March 1 recommending they approve a human space program and cautioning that while funds were limited, the cost, if spread over several decades, was manageable.

Liu's comment on finances came in the middle of an economic downturn caused in part by disruptions related to the domestic political protests of 1989 and their bloody suppression. The admiral was also a strong and powerful advocate for the development of a blue-water navy, including aircraft carrier

groups. In his memoirs, Liu notes that he had always been in favor of a human spaceflight program,[44] but his expression of support at this critical moment, while dismissing the fiscal constraints, surely had a significant effect on the CCP leadership's final decision.

The Standing Committee of the Politburo finally gave the go-ahead for the space station plan on September 21, 1992, and despite numerous Western press accounts suggesting otherwise, the space station has to this day remained the Chinese human spaceflight program's ultimate objective. The Party Central Committee created a new office under the Special Committee, the "Human Spaceflight Project Office," which is responsible for coordinating and implementing what became known as Project 921, in commemoration of the date of the decision.[45]

During this period in the mid-1990s, China apparently considered purchasing a full-scale Soyuz spacecraft, complete with internal components. Russian experts have claimed that Beijing and Moscow did not reach a commercial agreement. As a result, the Chinese scientists and engineers only "got bits and pieces, here and there" from their Russian counterparts and, in the end, "had to do the bulk of the work themselves."[46] The Chinese histories make no mention of an effort to purchase Soyuz vehicles and technology from the Russians, but Chinese participants, in discussing cooperation with Moscow, broadly confirm both the early Chinese interest in a Soyuz spacecraft as well as ensuing dissatisfaction with what one senior Chinese aerospace engineer described as patronizing and opportunistic Russian behavior.

Shenzhou Orbits

Opponents continued to pressure the political leadership to cancel the project. The last major challenge came in 1997, when both supporters and opponents realized work on the capsule was eighteen months behind schedule. At the time Project 921 was approved there was an understanding that it would attempt an initial launch of the capsule by 1998 and would assure a launch by 1999. Not only was it clear they could not make good on that assurance, but there were serious problems with the capsule effort that caused critics to reopen the question of whether the program was worth the time and effort.

The launch vehicle, the Long March 2F (LM-2F), would be ready by 1999. Opponents wanted to use it to put up a satellite, but no domestic or international satellites were in the pipeline. At the time, the Party Central Committee was considering a proposal, which was eventually approved, for a robotic lunar exploration program. A formal request to use the LM-2F for an unmanned lunar launch did go to the State Council, but Premier Zhu Rongji

44. 刘华清. 刘华清回忆录. 解放军出版社, 2007, 679.

45. 巩小华. 中国航天决策内幕. 中国文史出版社, 2005, 277.

46. For an excellent summary of these efforts, see Anatoly Zak, "Chinese Bought Russian Technology to Aid Space Program," Space.com, November 22, 1999, http://www.space.com/news/china_russia_991122.html.

thought the risks of failure from such a hasty change of plans were too great. A third option was to adapt a test capsule, used for ground testing the electrical systems, for use as an experimental Shenzhou return module.[47]

Two assistant designers on the Shenzhou project, Wang Zhuang and Zhen Songhui, had successfully adapted test capsules before, during the course of the development of the recoverable satellite program. The principal advocate of the third option was Project 921 Deputy Administrator Lt. Gen. Shen Rongjun, a graduate of the CMC's Survey and Mapping Academy who spent his entire career working on tracking and telemetry issues for China's ballistic missile and space programs. Although converting the test capsule into an experimental Shenzhou return module was feasible, the Chinese would still need to mount it on the engine module of the spacecraft, which was being designed and produced at the Shanghai Academy of Space Technology (SAST). Shen visited SAST in late December 1997 to check on the progress and discovered that SAST could not complete a normal testing program for the engines in time to meet the 1999 deadline. Shen told the entire team at SAST, "I know you're having difficulties, but the story is, if we can't launch in 1999 then Project 921 will be in serious trouble, we will have failed to meet our obligations to the Central Committee. That's the big picture."

After a series of meetings to discuss Shen's warnings about the consequences, SAST Deputy Director and Project 921 Deputy Chief Designer Shi Jinmiao told Shen that they could accelerate their testing program, and that although the accelerated program would still fall considerably short of the normal requirements, they could make the 1999 deadline. On January 9, 1998, Project 921 General Administrator Gen. Cao Gangchuan convened a meeting of all project administrators and designers. They agreed to move forward with the plan to use a modified test capsule for the first launch and scheduled it for October 1999. Afterward, Cao and Chinese Aerospace Corporation Vice President Li Jiyuan sent a report on their decision to Premier Li Peng and the State Council.

The launch of the *Shenzhou 1* was one of the three major priorities of the Party Central Committee in 1999, along with the fiftieth anniversary of the PRC and the return of Macao from Portuguese control. Progress toward the launch did not go smoothly. The adapted test capsule cum experimental Shenzhou return module experienced an instrument failure in mid-August. In order to find the mistake, engineers would have to open the bottom of the capsule, something they did not want to do unless the problem was critical to the suc-

47. The Chinese sources downplay cooperation with Russia on the Shenzhou program, despite the obvious similarities between the Shenzhou Return Module and the Russian Soyuz TM Reentry Vehicle. The chief designer of the Shenzhou program, Wang Yongzhi, was a student of Vasily Mishin (Василий Мишин) and maintained close ties with his former teacher. In April 2001, on the fortieth anniversary of Yuri Gagarin's first spaceflight, Wang Yongzhi introduced the Shenzhou program to his alma mater, the Moscow Aviation Institute. Mishin, who was in the audience, is reported to have said, "See, as I said, the Shenzhou is not the Soyuz." 巩小华. 中国航天决策内幕. 中国文史出版社, 2005, 286.

cess of the mission because the risks of damage from opening the capsule might be greater than ignoring the instrument failure, which was connected to the astronaut system and not critical for the mission. Then one of the spacecraft's gyroscopes got stuck. A backup was in place, but a gyroscope failure would be catastrophic.[48]

After several meetings and more careful assessment of the risks, the engineers decided to open the capsule and fix the problems. In doing so they discovered another wiring problem; it was not only the cause of the failure in the astronaut system, but would have led to mission failure. Fixing the problem set the launch date back a month. Finally, at 6:30 a.m. on November 20, 1999, *Shenzhou 1* lifted off to a nearly flawless mission. There was a glitch transmitting the signal to fire the retrorockets for reentry from Qingdao. Engineers had five minutes to find the problem and try again from the *Yuanwang 3* tracking ship, or else the capsule would not land in the target area in Mongolia. The *Yuanwang 3* transmission was successful, and the craft landed on November 21 at 3:41 a.m.

Three test flights of the actual Shenzhou capsule were made before China was ready to send its first astronaut into space. The project managers experienced quite a few problems along the way, but with the success of the first mission, the opposition to the human spaceflight program finally subsided. Some key individuals closely associated with the program still question its value, but among the political leadership the question of whether China should continue the human spaceflight program has been settled.

The final opportunity for doubt might have been the tragic loss of the U.S. space shuttle *Columbia* and its seven astronauts in February 2003. But in his message of condolence to the United States, Chinese President Jiang Zemin said he "had faith that this would not affect the efforts of humanity to continue exploring the universe." The words signalled that China would not cancel its first piloted space mission, scheduled for the fall of 2003.[49]

Chinese program managers did make some alterations, however. In a meeting of the Special Committee, chaired by Premier Zhu Rongji in October 2002, the Committee approved a plan for the first mission in which two astronauts would spend three days in space. The systems on the *Shenzhou 4* mission (the last to be unpiloted) were set accordingly. Following the *Columbia* disaster, a Russian Soyuz capsule reentered steeply and landed 400 kilometers off the mark. This incident was followed by the horrible explosion of a rocket on the launch pad in Brazil that killed many of the scientists and engineers who had founded Brazil's space program. Further, SARS (severe acute respiratory syndrome) brought a halt to almost every aspect of life in Beijing in the spring of 2003. In the end, China's first piloted mission, in October 2003, carried one astronaut and lasted one day.

48. 王艳梅. 神舟内部报告: 来自中国酒泉卫星发射中心. 新世界出版社, 2005, 98–99.
49. 巩小华. 中国航天决策内幕. 中国文史出版社, 2005, 328.

The astronaut, Air Force Col. Yang Liwei, enjoyed the least troublesome of the first five Shenzhou missions. He experienced some unsettling vibrations on the way up, something the LM-2F designers were able to correct on subsequent missions, but otherwise Chinese accounts describe the country's first human spaceflight as "perfect."

Shenzhou 1–5 Chief Designer Qi Faren, who has played a leadership role in almost every Chinese space mission since the first satellite launch, noted on the thirty-fifth anniversary of the launch of *East Is Red 1* that the most important thing lacking in the Chinese space effort was "the freedom to fail." Human spaceflight is an inherently dangerous activity. To date China has yet to cope with a significant disaster resulting in the loss of life. One hopes they will never have to face such a failure, the possibility of which is the only imaginable obstacle to the continued progress of China's human spaceflight program.

OBSERVATIONS

We are reluctant to draw sweeping generalizations or make predictions based on these three historical case studies: the more we learn from Chinese sources, the less each case resembles any other. In particular, one obvious factor is how much Chinese policy-making has varied under Mao, Deng, and China's current generation of leaders. One has difficulty imagining Hu Jintao, China's current leader, demanding a 2-ton satellite because he would be embarrassed to put a "chicken egg" into orbit.

The historical development of China's space program, however, does explain much about how the current structure of that program came to be and why the major players are influential. For example, we have often heard Americans say that the PLA "runs" the Chinese space program.[50] This is true at some level, but it is a simplification; what it means to "run" the program deserves some consideration. In September 1992, when the Standing Committee of the Politburo finally gave the go-ahead for the human spaceflight program, the Party Central Committee created a new office under the Special Committee called the Human Spaceflight Project Office, responsible for coordinating and implementing what became known as Project 921, in commemoration of the date of the decision. At a policy level, decisions about the space program are made by the civilian leadership.

But the Chinese military is probably the most capable professional institution in China; it "runs" the space program in the sense that it provides for the day-to-day management of the human spaceflight program. The military's development of missiles enabled China to transition from a sounding-rocket program to launching satellites. Also, during the Cultural Revolution the mil-

50. "Space experts outside China are generally at a loss to describe how its various space programs—manned and unmanned, civil and military—are organized and overseen, except that the vast bulk of its efforts are under the direction of the People's Liberation Army"; Drew, "Space Inspires Passion and Practicality in China."

itary was able to provide stability and continuity. A considerable task for China, particularly within the context of the 863 effort, has been to take the competencies developed and preserved within the military and transfer them to a civil technology sector. To say that the military "runs" China's human spaceflight program grossly simplifies the precise responsibilities of the state and the military and obscures important dynamics that shape how China pursues high-technology endeavors.

The historical accounts also shed light on the role of certain personalities. Qian Xuesen is rightly lauded as the "father" of China's space program. But from the historical accounts, he emerges as a more complex, human figure than in English-language accounts. Qian is, first and foremost, a cheerleader, pressing China's leaders to consider the possibilities of interplanetary spaceflight even as China endured one of the worst famines in human history. In some cases, Qian's enthusiasm may have undermined China's space development. In other cases, he was essential to move the bureaucracy. In the United States, a certain mythology has grown up around Qian, suggesting that, were it not for his deportation from the United States, China might not have developed missiles and satellites. Qian was undoubtedly a major figure linking the scientists and engineers to the political leadership. But Qian, for all his technical skill, was not the principal designer of any of China's rockets or satellites. Dozens of other Chinese scientists, many of them trained in the United States, made invaluable contributions. American myths about Qian reflect views about "great men" in history, as well as the debates about McCarthyism, not Qian's role in China's space program.

All peoples have their own myths. Within the Chinese historical sources, the narrative that the Chinese themselves use to explain their own actions is *yi xi zhi di*—"a place for one's mat." The founding myth of modern China is that the Chinese people lost that place when they fell behind the West. The imagined cause of this loss is China's failure to embrace science and develop technology. Contemporary Chinese leaders are invested in space, human spaceflight in particular, because it is the ultimate expression of what being a scientifically and technologically advanced nation means. Having a space program proves to others and, more importantly, to themselves that the Chinese deserve a seat at the table.

This conception is not one of a zero-sum competition. During the cold war, the dominant metaphor for competition was a "race." Only one winner could emerge—the first to put a satellite in orbit, the first to put a man in orbit, the first to land a man on the moon and return him safely to earth.

By contrast, the Chinese metaphor carries the connotation of joining a club, becoming a member. This is subtly different from other explanations. For example, one common explanation is that the Chinese space program provides a unifying sense of national prestige and boosts the legitimacy of the

Communist Party.[51] The space program may make many Chinese proud and, as a result, modestly boost the standing of the government (though we doubt it). China's leaders are not shy about photo opportunities. But a central leadership that based its survival strategy on the space program would be foolish. Human spaceflight is a high-risk activity. Whatever one thinks of the policies of the Chinese government, its leaders are risk-averse and manifestly not foolish.

A careful review of the decision-making in these three case studies offers no evidence that boosting regime legitimacy was an important goal in any of the decisions. One can see, though, why prestige remains such a popular explanation. The emphasis on finding a place for China among the most influential nations *is* linked to the core argument for the legitimacy of the regime. But this is true only in the most general sense that every government action is, presumably, thought to be consistent with the well-being of the regime. The explanation explains everything and nothing.

An explanation needs to account for why some programs receive funding when others do not; it needs to explain priorities across political and economic circumstance. In this case, we find the Chinese explanation—a place for one's mat, with the attendant idea that China takes technical cues from external sources—a plausible starting point. This is not so much "prestige" as "keeping up with the Joneses." In particular, the cases of *Sputnik* and Reagan's SDI speech demonstrate that fear of falling behind was a much more powerful motivation than a sense that the party might improve its standing by launching satellites and astronauts into space.

A second common explanation is that China seeks to increase its national power in space. Whatever one might say about the military and economic benefits of the space program, it was surely not the most efficient way to strengthen China. Whatever Li Peng meant with his enigmatic description of a human space program as being necessary, if not necessarily wise, the leadership clearly did not see the program as producing tangible economic or military benefits.

Yet, as in the case of the legitimacy argument, the military argument has something to it. China's leaders see investment in technology as part of maintaining their national power. Again, however, this explanation is too general. Why is it that Chinese leaders see space as an important aspect of high-technology development? And why human spaceflight? We find the modeling explanation—that the Chinese take their cues from those countries seen as technical leaders—to be more compelling.

51. As one commentator argued: "For China's Communist Party, space prowess is becoming an important source of legitimacy at home and abroad, where it is trying to position China as a country whose nondemocratic model of development is worthy of emulation. The space program, for example, uses 'Long March' rockets, named after the communist forces' famous civil war maneuver; Mao Zedong cemented his place as the communists' leader during the arduous journey. A series of telecommunications and broadcasting satellites is named 'The East is Red'"; Gordon Fairclough, "China's Long March to the Moon, Beijing Heats Up Space Race Against Japan This Week; Communist Party Pride," *The Wall Street Journal*, October 23, 2007.

The implications of the Chinese explanation, compared to the explanations often heard in the United States, are profound, particularly when one considers the question of whether and how the United States and China can coexist in space. If China's goal is membership in the club, then Chinese officials are likely to be receptive to "rules of the road" in space that seek to preserve access for all. Far from being a rogue actor, the entire Chinese scientific establishment seeks membership, not isolation, from the community of spacefaring states. China might not be expected to play a leadership role in designing a new architecture to preserve civil, commercial, and security goals in space, but one would expect the Chinese to come into compliance with international best practices.

A similar phenomenon played out in the 1980s and 1990s in the field of nuclear weapons. As China's nuclear weapons scientists began to think of China as a nuclear "have," China acceded to a number of important nonproliferation agreements, promulgated and began to implement export controls, and ceased particularly egregious forms of nuclear cooperation with Pakistan and Iran. The process of nonproliferation has been slow and at times frustrating, but inarguably has made the world a much safer place.

One significant difference from the nonproliferation field is that the regime governing the peaceful uses of outer space remains inchoate. China had the option, in the 1980s and 1990s, of simply joining a number of regimes designed to inhibit the spread of nuclear weapons and ballistic missiles. Rules for managing orbital crowding, the mitigation of debris, and military uses of space, however, remain ad hoc and badly in need of elaboration. Securing Chinese participation in such regimes will likely require early and vigorous engagement with the Chinese not just to accede to such arrangements, but to actively shape their development.

As such, the *BX-1* episode is not encouraging. The number of Americans who simply assumed that the Chinese were operating irresponsibly points to the difficulties that remain, even when the interests of all parties align. Reaching agreement will be much harder when our interests are at cross-purposes. We nonetheless remain hopeful because of how the Chinese continue to conceive of their interests in space. If what the Chinese aspire to most of all is a place for their mat, the other spacefaring states can move over a bit.

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