CHINA'S MANNED SPACE PROGRAM

Sun Tzu or Apollo Redux?

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Nothing is more difficult than the art of maneuver. What is difficult about maneuver is to make the devious route the most direct and to turn misfortune to advantage.

SUN TZU

China is on a fast track into space. Chinese officials have stated that a manned space launch is imminent—likely in the second half of 2003. The four launches since 1999 of the Shenzhou (Divine or Sacred Vessel) spacecraft intended to launch the *taikonauts* into orbit evidence substantial Chinese technical achievement and the seriousness of the program.[1] Those achievements, plus pronouncements about timetables, space laboratories, shuttles, space stations, lunar bases, and now Mars missions, naturally make one wonder just what the Chinese are up to. Is there a new, twenty-first-century space race brewing? If there is, who is racing, and toward what goal? Analysis and commentary have spawned several, often one-dimensional, scenarios.

Policy and academic analyses of Chinese space activities have been limited and "stovepiped" within disciplines. With few exceptions, analyses have either focused on technical parameters or have been highly politicized as part of threat assessments, usually in the context of U.S. plans for missile defense.[2] In the case of the former, though much of the Chinese program remains cloaked in secrecy due to both the nature of the Chinese system and the military aspects of the topic, considerable agreement exists among technical analysts concerning Chinese capabilities, now and

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potentially in the future.[3] Securing consensus regarding political "intent" remains more difficult. There are analysts who feel that the pursuit of space technology can be benign and development oriented; others perceive it as inherently nefarious. That China is so large and complex that one can look there for proof of any thesis, and find it, complicates the situation.

Some observers see China's race to space as a battle with its own demons. Prestige, in this scenario, becomes the Chinese brass ring. Conquering space represents an opportunity in what China refers to as mankind's "fourth frontier" to recapture its lost legacy of technological mastery and innovation.[4] Certainly, a Chinese quest for prestige is undeniable. Chinese scientists and policy makers eagerly point out that when (not if) China launches *taikonauts* into space, it will be only the third country in the world to have done so. No European countries can do that, or Japan either; manned space flight will belong to an exclusive club of the United States, Russia, and China. The world was dramatically and tragically reminded of the technical difficulty of piloted spaceflight, and subsequently the high level of technical achievement requisite to accomplish such, with the recent loss of the space shuttle *Columbia*. So, the prospective domestic, regional, and international benefits of that exclusivity are considerable. But are they enough for a country that daily faces Herculean challenges in keeping its population fed, employed, and stable and pursuing essential domestic modernization, while it spends an estimated two billion dollars annually on a space program?[5]

If not, the reason the Chinese are pursuing a manned space program may be to draw attention from its military space activities, which will clearly benefit from the dual-use nature of the technology being developed. The July 2002 *Annual Report on the Military Power of the People's Republic of China,* published by the U.S. Department of Defense, stated, "While one of the strongest immediate motivations for this [China's manned space program] appears to be political prestige, China's manned space efforts almost certainly will contribute to improved military space systems in the 2010–2020 time frame."[6] Global recognition of the increasingly important role of space in military operations began with the unofficial proclamation of the Gulf War as "the first space war," and it has grown steadily since.[7] Under a worst-case scenario, the Chinese manned efforts are merely a Trojan horse. It has already been suggested, for example, that Chinese leaders may see potential military value in Shenzhou as a reconnaissance platform.[8] Chinese government officials have, after all, included national defense in the stated aims of their space program.[9]

Both history and a logical policy analysis, however, reject the notion that Chinese reasoning must be viewed as an either-or situation. Far more likely, Chinese motivations for eagerly, even aggressively, pursuing a space program, including

manned space, are multifaceted. Unless the Chinese suffer a technical disaster—which they have been working to avoid, and will post-*Columbia* even more ardently—space yields high returns on investment in multiple policy areas. Indeed, in the United States space has always been a subfield of other areas—foreign, national security, economic, and science policy being the most prominent. Examining the Chinese space program under the same premises allows for a better understanding of what the Chinese are doing and why. Extrapolating the current environment into the future makes apparent the context for a potential coming space race, as well as why it is likely the United States and China will be the primary—though not the only—competitors.

KNOW THE ENEMY AND KNOW YOURSELF . . .

Popular history tells us that the Apollo program exemplified the "can do" attitude and visionary approach of the John F. Kennedy administration.[10] If only, some space-exploration advocates still wistfully muse, another American president possessed such imagination and vision, the glory days of vigorous NASA space activity would return. Those reflections are both about half-right. Popular history's view of Apollo rightly glorifies the can-do spirit but greatly embellishes the vision aspect. Having observed the dramatic and unanticipated U.S. public sense in reaction to the Soviet launch of Sputnik during the Eisenhower administration that the United States was technically inferior to, and hence potentially weaker than, the Soviet Union—and how that impression spread worldwide—the Kennedy administration recognized the symbolic power and allure of space accomplishments.[11] Additionally, the United States already had an active military space program under way; it was patent that the technology requisite for civilian space activities would benefit the military side, and the American economy as well. If the technical risks could be managed, the benefits were potentially enormous. Space became, on one level, a Cold War battlefield, where scientists and engineers were the frontline soldiers, fighting for the prestige and global influence that would flow from technical prowess, prowess also beneficial to the military. On another level, the knowledge and hardware created would bring domestic benefits beyond the symbolic and military arenas.

Several parallels can be drawn between U.S. decision making in support of Apollo in the 1960s and that going on in China today with respect to the manned space program. Domestic, regional, and international prestige are clearly factors in Chinese decision making. Domestically, a positive "public-rallying" factor complements national pride. Images of the Shenzhou basically make people feel good about themselves and their country; they are found on consumer goods from phone cards to water heaters. Also, domestic pride and international prestige also yield increased governmental legitimacy, a strong consideration in

Beijing. Internationally, especially to the extent that prestige implies influence, in the sense that it once did for the United States, regional politics, vying for the "top spot," comes into play. Few areas of exclusive technical achievement remain; many countries (most pertinently for Chinese regional considerations, Japan and India) have satellites, launch facilities, etc. (though with a wide range of quality, size, and capabilities); however, there are still only two countries in the world with manned space programs. Hence, for purposes of prestige, accepting the exponentially higher costs associated with manned versus unmanned launches becomes obligatory.

Economically, the benefits for the United States of the space race generally and the Apollo program specifically were far reaching, both direct and indirect. Education and on-the-job experience for the Apollo scientists and engineers created a generation of highly trained technical personnel. Engineering programs were specifically set up in colleges and universities to meet the need for new and specialized aerospace skills. In China, the University of Science and Technology of China, Beijing University of Aeronautics and Astronautics, and Beijing Institute of Technology are all among the top universities, and all eagerly discuss and promote their involvement in the space program. Student interest in space is said to have exploded in China. If the Chinese experience parallels anything close to what has happened in Japan already, universities and industries must be using even remote possibilities of being involved in space ventures to lure the best and the brightest into their programs.

China's plans are for a phased, incremental, cautious—though ambitious—program.

Another economic payoff is to be seen in the movie *Apollo 13*. Tom Hanks's character shows a congressional delegation through the Vehicle Assembly Building at the Kennedy Space Center (KSC). These tours were once a regular NASA function. Escorts pointed out what parts of the program were produced in each state of the union and how the approximately twenty-five billion dollars spent on Apollo was being spread across the country—information politically necessary to keep the funds flowing. Government money spent was expected not only to get a man to the moon but to employ a great many people in the process.[12] In China today, programs that bolster technical education and create technical jobs are of considerable interest; the lessons of Apollo have not been lost on the Chinese leadership.

Conversely, China is also aware that space programs can be viewed, as was the case during Apollo, as desirable but expendable in favor of more pragmatic, near-term needs. Many U.S. scientists objected to Apollo as draining funds from too many other programs, and politicians had other priorities. Some groups in

China have quietly but deliberately let it be known that they see space programs as a waste of money. This new phenomenon—Chinese public opinion actually mattering to the government—demands returns on investment heretofore unnecessary.

While the United States blazed through the heavens up the steepest of learning curves, other countries recognized that a technology gap was developing, one potentially detrimental to their future.[13] In the late 1960s and into the 1970s, European nations aggressively pursued space activity, separately and then collectively, for economic reasons. It was deemed that space engendered technology, technology led to industrialization, and industrialization fostered economic growth. In Canada, public and political pressure for space activity that would prevent being on the wrong side of the technology gap produced a program designed to focus on one technology at a time, carefully selected to benefit the Canadian people directly. Communications satellites, linking Canada's vast geographic expanse, were the first focus. Robotics (notably the Canadarm), with potential industrial and hence economic benefits on Earth, were the second. China is keenly aware of these established relationships between space, technology, economics, and domestic politics.

Finally, there is the military consideration. According to the Stockholm International Peace Research Institute, "No country can currently rival or contest U.S. space dominance or the advantages that this provides to its terrestrial military operations."[14] *Wired* magazine put it differently in April 2002: "The Pentagon's role in world affairs has gone through an epochal transformation: from the Fulda Gap to the Highway of Death, from Agent Orange to GPS [the Global Positioning System], from arsenal of democracy to global cop. When you are a cop, sometimes you kick doors in. Most of the time you stay on patrol. Outer space is where a global cop patrols. America's eyes, ears and nerves are up there, all day, every day, circling the blue yonder. Space vehicles are the ultimate asymmetrical asset. They cannot be reached with a hijacked jet. They laugh at anthrax."[15] The Chinese are well aware of U.S. space dominance. They have read the 2001 report of the Commission to Assess National Security Space Management and Operation (commonly known as the Space Commission Report), chaired by secretary of defense and space supporter Donald Rumsfeld.[16] That report surmised that since air, land, and sea all have become battlegrounds, it is inevitable that space will too; the United States, it went on, would be remiss not to prepare for that inevitability. The Chinese are fully able to read between the lines and see the implications for development of space weapons.

Identifying potential military gains from technology specifically developed for manned space activities is not, however, as straightforward as some have speculated. Using the Shenzhou as a reconnaissance platform, for example,

hardly seems to maximize capability while minimizing expenditures. In 1969, the U.S. military abandoned the Manned Orbital Laboratory program, intended to perform reconnaissance, in large part because unmanned satellites could provide the same—or better—capabilities.[17] If the Chinese are solely or even primarily seeking what amounts to a high-resolution, real-time reconnaissance satellite, a direct approach to building one makes more sense technically and fiscally.

Nonetheless, development of space hardware and know-how for the manned programs will certainly push the Chinese rapidly up the learning curve in everything from materials to computing power to systems engineering, as the Apollo program did for the United States. Their desire and perceived need to scale that curve is unambiguous. In January 2003, the Chinese launched their second Zi Yuan (ZY-2) photoreconnaissance satellite, capable of resolution in the range of ten to twenty centimeters. It is a military version of a satellite jointly developed by China and Brazil for remote sensing (the ZY-1, or China Brazil Earth Resource Satellite, CBERS)—evidence of how development of a civil program can have clear military benefit.

The robustness and activism of U.S. military space efforts under the George W. Bush administration—especially in contrast to the generally disapproving attitude of its predecessor—must also be considered in the context of U.S.-China relations more generally. Until "9/11," when many international relationships got turned on their heads and several strange bedfellows emerged, some analysts felt that justly or unjustly, China had been deemed the next enemy of the United States. China-U.S. relations have been strained in this realm, commencing with the 1998 Commission to Assess the Ballistic Missile Threat to the United States (again led by Rumsfeld); they were exacerbated by the 1998 Cox Commission Report accusing U.S. aerospace companies of giving China technical assistance in its military space program through commercial satellite launches, and aggravated by the EP-3 incident in 2001; and they must always be considered in the context of both American military support to Taiwan and U.S. missile defense plans, which the Chinese perceive as severely impacting their own nuclear deterrence.[18]

Indeed, during this time a loose alliance of members of Congress, congressional staff, think-tank fellows, conservative journalists, lobbyists for Taiwan, former intelligence officers, and a handful of academics proudly proclaimed themselves the "Blue Team," united in their view that a rising China posed great risks to America's vital interests. They were determined and effective in encouraging a hard-line U.S. government stance on anything Chinese.[19] Their success was interpreted in China as signaling mainline acceptance of those views; that has provided in turn an opportunity for backlash from Chinese hard-liners

(potentially triggering a dangerous action-reaction cycle). Therefore, any activity that might increase Chinese capabilities in an area of clear and expanding U.S. dominance—like space—would easily garner support in Beijing.

Taken together, the political, economic, and military benefits to the Chinese in pursuing space activity, including manned space, validate their course of action as a rational policy decision. Although certainly there is no full-blown cold war, there are considerable parallels to the Apollo-era U.S. rationales in terms of domestic benefits, surrogate struggles for regional influence, and global political and military posturing. Indeed China itself is clear that it is pursuing space activity not just as an end in itself but as part of a larger strategy.

INVINCIBILITY DEPENDS ON ONE'S SELF . . .

In November 2000, the Information Office of the State Council issued the first Chinese white paper on space, *China's Space Activities.*[20] The technical milestones laid down were impressive, and the language was insightful. It reminded readers that China had invented gunpowder, the "embryo of modern space rockets." Space, then, is a field China sees itself as having initiated and once dominated, but was then overtaken in. It now wants to regain a place of distinction.

Included in the development targets provided in the white paper were earth-observation systems, independently operated satellite broadcasting and telecommunications systems, an independent satellite navigation and positioning system, upgraded launch vehicles as necessary for manned space flight, a coordinated national satellite remote-sensing application system, space science, space exploration, and industrialization and marketing of space technology and applications. Equally important, the paper also declared that these goals would be achieved through adherence to

> the principle of long-term, stable and sustainable development and making the development of space activities . . . serve the state's comprehensive development strategy. The Chinese government attaches great importance to the significant role of space activities in implementing the strategy of revitalizing the country with science and education and that of sustainable development, as well as in economic construction, national security, science and technology development and social progress. The development of space activities is encouraged and supported by the government as an integral part of the state's comprehensive development strategy.

In that context, the white paper promoted international space cooperation, placing priority on cooperation within the Asia-Pacific region and supporting Chinese participation in international launch services.

China recognizes that its current "catch-up" position is at least partly of its own making. Space scientists and engineers did not escape the wrath of the Cultural Revolution.[21] Facilities were destroyed, and individuals were starved and

sometimes beaten while being forced to continue work in austere, even unimaginable conditions. One early launch account, for example, describes rocket fuel being loaded by bicycle pump. China did have, however, well trained individuals in its space program. Many, including the program's leader, Qian Xuesen, were Western trained; Dr. Qian had a Ph.D. from Toronto University and had worked at the California Institute of Technology for more than twenty years.[22] Qian, along with approximately a hundred other Chinese scientists, was expelled from the United States in 1955 during the McCarthy era and now bears long-standing, and many say understandable, ill feelings toward the United States.

From those roots, China proceeded tumultuously but determinedly. The Chinese must be commended for development of what was, until very recently, a virtually indigenous space program. Between the updated German V-2 rocket (renamed R-2 and left behind by the Soviets when they broke relations with the Chinese in 1960), the initiation of commercial satellite launches in the mid-1980s, and collaboration with the Russians on aspects of the manned space program beginning in the late 1990s, the Chinese have worked primarily alone, though not entirely by choice. Mao Tse-tung scared off even Nikita Khrushchev with his casual attitude toward nuclear war; there followed the self-imposed isolation of the Cultural Revolution, and a relationship with the United States that was tenuous at best, especially after Tiananmen Square. The Chinese quickly made significant autonomous technical achievements, however, when left on their own. Within a decade of their first satellite launch in 1970, the Chinese could successfully recover large satellites from orbit. This is important today as a critical step in any manned program, since it requires the development of such technologies as heat shields, sophisticated tracking systems, and automated controls.

Nevertheless, the Chinese always maximized their ability to learn from others. That their Xichang launch site is at approximately twenty-eight degrees north latitude and KSC is at 28.5 degrees north is not coincidence. The Chinese picked a similar latitude to allow emulation of American post-launch trajectories, which were described in some detail in open-source U.S. literature. Even today, although the Shenzhou spacecraft bears similarities to the Russian Soyuz design, the Chinese avidly defend it as their own product, which technical comparisons seem to bear out.[23] They view having begun with the Soyuz design rather than reinventing the wheel as simply smart business practice.

In May 2002 China held a National Science Week. In one exhibition, a model showed China's vision of a permanent settlement on Mars. "From a long-term perspective, it is a historical necessity for man to travel into space," a poster proclaimed. A six-wheeled robotic detector was unveiled as potentially China's first lunar visitor. The exhibition's tone reflected China's acknowledgment that considerable self-interest was involved in its bid to become the third nation to put a

human in space. "The development and use of technologies for manned space flight have far-reaching significance for our nation in the political, military, economic and technological fields," a poster said.[24]

The current manned space effort, known as Project 921, is China's second. (Actually it is the third, if one counts Wan Hu, a sixteenth-century inventor who built a rocket-propelled chair. Upon testing, both the inventor and the chair met with unfortunate outcomes.) In the present program, fourteen *taikonauts* have been selected, and much like the first U.S. astronauts, they were drawn from the elite ranks of military fighter pilots. Two *taikonauts* trained in Russia, but most training is now conducted in a secret facility north of Beijing.[25] The Chinese are deliberately creating an aura of mystique and drama around the *taikonauts*. After the latest preliminary flight, the Chinese released rare footage of the men in training. The Shenzhou capsule is reportedly able to carry three or four *taikonauts*, though it is likely that the initial flight will carry only one. There has been speculation that Chen Long, a thirty-year-old fighter pilot, is to have the honor of being the first Chinese into space.[26]

The earlier manned program started in the 1970s and then stopped in 1980, due to lack of funds, technological barriers, and a pragmatic decision to put more emphasis on applications satellites. That project was run purely on a planned, central-economy basis, with a one-way money flow. This second round, which commenced in 1992, is being managed very differently.

The China Aerospace Science and Technology Corporation (CASC, or CASTC) was created in 1999 for the pursuit of national defense and aerospace endeavors; it spun off from the China Aerospace Corporation (CAC).[27] The change was part of an effort to become more competitive, in which the Chinese government reformed the top defense and technology corporations, like CAC, which was a large state-owned enterprise under direct supervision of the State Council. CAC, which had some 270,000 employees, was divided into the CASC and the China Aerospace Machinery and Electronics Corporation (recently renamed China Aerospace Science and Industry Corporation), presumably with about 150,000 employees. CASC, itself a large state-owned enterprise, has a registered capital of RMB* nine billion yuan.[28]

Over 130 organizations are subordinate to CASC, including five large research academies—the Chinese Academy of Launch Vehicle Technology, the Chinese Academy of Space Technology, the Shanghai Academy of Space Flight Technology, the Chinese Academy of Space Electronic Technology, and the Academy of Space Chemical Propulsion Technology; two large research and manufacture bases, the Sichuan Space Industry Corporation and Xian Space Science and Technology Industry Corporation; as well as a number of factories,

* RMB = *Renminbi* ("people's currency").

research institutes under the direct supervision of the headquarters, and companies in which CASC has major or minor shares. CASC employs around 110,000 employees, of whom technical staff accounts for more than forty thousand, including over 1,300 researchers and twenty-one academicians from the Chinese Academy of Sciences and the Chinese Academy of Engineering.[29] CASC's general manager, Zhang Qingwei, urges the corporation's workers to strive to make it globally competitive in the next three years by transforming it into a modern enterprise system. CASC projects that total income and profit will double between 2001 and 2005, as it becomes a large enterprise group boasting renowned brands, its own intellectual property rights, and powerful core competitiveness.[30]

The tricky part of reorganization and management reform in China is that cutting jobs is usually necessary. Chinese launch site workers, for example, have remarked to the author that often three or four people are assigned to a task one person could handle, and likely could handle better alone. Yet, as previously stated, creating jobs remains an important Beijing priority. So China has had to be creative, balance interests, and move slowly in its reform efforts. The aerospace industry has become something of a test case.

CASC has general authority over manned spaceflight and the Long March–series rockets. Ultimately, however, the military (specifically the Second Artillery Corps) controls the Chinese space program. Although specific efforts have been made toward separating the military aspects from the civil/commercial aspects, China, like Russia, did not initially bifurcate its program as did the United States.[31] Having said that, however, it cannot be forgotten that the U.S. civilian program too grew from military roots. The Long March (Chang Zheng) launcher series, today marketed by the Great Wall Industry Corporation, bears a legacy not unlike those of the U.S. Delta, Atlas, and Titan commercial launchers. That is, it was originally designed in the early 1970s as an intercontinental ballistic missile (Dong Feng 4 and 5) rather than simply as a rocket, like the French Ariane, for example.[32] This ultimately unified effort in sensitive areas like propulsion research but gave rise to concern in the United States about technology transfer.

Space, then, is a field China sees itself as having initiated and once dominated.

Among CASC's most important current achievements are the more than twenty consecutive successful test launches achieved since 1996. Although each of those successful launches is important independently, together they build a record of reliability important for restoring confidence among commercial launch-insurance companies. After a series of accidents in the 1990s and the subsequent Cox Commission report issued in the United States, the lucrative

Chinese launch market quickly dried up.[33] Other than thirteen satellites for the Iridium communication venture, commercial launches, which had generated hard currency for China, with considerably more likely expected, have been at a virtual standstill, and little likelihood of a dramatic turnaround is foreseen.[34] The Chinese probably hope that positive spillover from a successful manned launch, in terms of perceived technical capability, will benefit their commercial launch program. Nevertheless, problems will remain: Chinese launch costs are higher (between sixty and seventy million dollars per launch) than those of international competitors, and U.S. export laws for launching U.S.-built satellites in China are highly restrictive.

Besides launch vehicles, China has numerous satellite programs. Dong Fang Hong (DFH) communications satellites have gone through multiple iterations. DFH-1, also known as Mao 1, was launched in 1970. It is most famous for broadcasting from space the song "The East is Red." The latest DFH iteration is being cooperatively developed with Germany. The Fanhui Shi Weixing recoverable satellites were originally developed for photoreconnaissance but now are also used for remote sensing. The third application satellite is the Feng Yun (FY) series, used for meteorology and remote sensing. The Chinese have also launched a series of Shi Jian satellites, carrying science payloads. Two Bei Dou navigation satellites have also been launched. Between 2001 and 2006 the Chinese have said they intend to launch thirty satellites as part of an expanding program culminating with human spaceflight.

Announcements as early as 1996 gave 1999 as the year for the first manned launch, to commemorate the fiftieth anniversary of the founding of the communist state. Depressed finances (perhaps in part due to the loss of anticipated income from commercial satellite launches) and technical issues, however, made it impossible to keep to the original timetable. There simply was not enough time for unmanned proving missions to ensure that the first manned attempt would not meet with disaster. The first Shenzhou flight occurred in November 1999. Shenzhou I completed fourteen orbits and returned to earth after just twenty-one hours, but even so it achieved a big step forward for the Chinese.

The second flight was in January 2001; it was both more complex and more mysterious. Numerous maneuvers were conducted before the descent module returned to earth seven days and 108 orbits later.[35] The Chinese ability to maneuver the Shenzhou II independent orbital module surprised Western observers. International press reports varied, with some stating that the flight carried cell and tissue samples of eighty-seven animals, plants, and microorganisms, while others stated that animals (rats) were on board. Clearly, life support systems were being tested at some level. The Chinese were ambiguous as to exactly how, and China's state-run Xinhua Agency made no reference to animals in its

reports. Dr. Liu Yongding, life sciences payload manager for the mission, refused to comment when specifically asked if a monkey, dog, rabbit, or snails were among the live specimens on board.[36] Guidance and reentry technology was also tested. No pictures of the returned capsule were released; indeed, there was a virtual press blackout, leading to Western speculation that there had been landing problems, likely either with the parachutes or the retro-rockets. The Chinese denied such allegations.

Shenzhou III was launched on 24 March 2002 and returned to the remote grasslands of Inner Mongolia on 1 April 2002.[37] In each of the three seats dummy humans were wired to medical monitors to test life-support systems, most of which had been purchased from the Russians.

The forward part of the Shenzhou spacecraft is an orbital module, used for experiments and as a crew transfer module for future space missions (which could include docking with another Shenzhou vehicle to form an interim "space laboratory," a project Beijing has talked about). The spacecraft has an aft propulsion system; between the two is a manned capsule. Shenzhou III left the forward module in orbit, likely for future docking tests. It also appears to be carrying a relatively sophisticated remote-sensing payload (a medium-resolution imaging spectroradiometer known as MRIS), transmitting high-quality data to Chinese ground stations. The infrared technologies being validated by the instrument potentially have both civil and military applications (that is, for military satellites), again illustrating the inherently "gray" nature of most space technologies and hence the difficulty of discerning the "intent" behind any space program.

"Space vehicles are the ultimate asymmetrical asset. They cannot be reached with a hijacked jet. They laugh at anthrax."

On several occasions after the third flight and during preparation for the fourth, Chinese officials categorically stated that "no animal has ever been on board one of China's unmanned space flights."[38] Indeed one official declared, "If we sent a monkey up, it would surely make trouble, skipping and fumbling about if it got loose."[39] This kind of ambiguity, followed by contradiction and confusion on specifics, is not atypical for the Chinese program.

Shenzhou IV was launched on 30 December 2002 and landed just over a week later, on 6 January 2003, again after 108 orbits. State newspapers and media heralded stories of the spacecraft after its successful landing. Testing maneuverability and life-support systems had been the mission's priority.

China's plans are for a phased, incremental, cautious—though ambitious—program. Future launch vehicle designs provide for increasing lift capabilities, using a concept similar to the U.S. Evolved Expendable Launch Vehicle. A "family" of vehicles is to be created, based on one design but with a range of

capabilities. Further, China continues development of liquid oxygen/kerosene engines to replace the nitrogen/UDMH engines currently used on the Long March.[40] The lift capabilities planned and being developed for the next century are of such a magnitude that they are obviously intended to support such missions as a manned lunar program, potentially a Mars program as well. It should be noted, though, that these powerful launchers also expand Chinese capabilities to launch heavier military satellites.

There is really no need for the Chinese to rush (perhaps to failure), especially since small incremental steps create considerable (and positive) journalistic attention in the West. Per the *Beijing Morning Post*, they have a three-step plan: a *taikonaut* in space, establishment of a space laboratory, and eventually setting up a space station. Wang Zhuangyin, a leading space program engineer, says manned spaceflight will occur by 2005. The official *China Daily* stated that China would put a man into orbit by 2005 and on the moon by 2010.[41] Ouyang Ziyuan, chief scientist of China's moon exploration program, has stated, "China is expected to complete its first exploration of the moon in 2010 and will establish a base on the moon as we did in the South Pole and the North Pole."[42]

The Chinese, however, are adamant that they will build a sustained program, not just plant a flag or return with a moon rock, alluding to the U.S. abandonment of its manned lunar program and failure to step farther into space. In a truly rational, well laid out, and well funded plan, many analysts feel, establishment of a moon base (by any country) should ultimately lead to exploitation of lunar mineral resources. Establishment of a Chinese base on Mars by 2040 has been proclaimed as a goal. In any event, the statements now being made go far beyond the 2000 white paper; the often-reticent Chinese are going out on a limb, actually assigning dates to ambitions. Experience has shown them, however, that they need not actually meet the dates to keep the rest of the world interested; they need only keep working toward them. Nonetheless, it is likely that they will not wait for 2005 for the first manned launch. With a successful Shenzhou IV precursor launch now completed, the Chinese will likely go for a first manned launch this year, in 2003. A launch date in October would coincide with the anniversary of the founding of the communist state—and potentially while the U.S. shuttle fleet is still grounded, further reminding the world of the magnitude of their technical achievement.

That the Chinese have not been included in space projects undertaken as much for their political and cooperative aspects as for their technical utility—such as the International Space Station (ISS)—has been a source of frustration for them. *People's Daily* on 27 December 2000 stated that the Chinese government would seek acceptance into the ISS program. In all fairness, ISS partners have been expected to contribute either technology or money, or both, and until

recently China has had neither. More recently, however, Brazil, a country with far less space experience than China, has become an ISS partner, making it more difficult to deny that China's exclusion includes a strong political component. The United States has historically viewed international space cooperation as both a political "carrot" and a technical way to "guide" other countries' space activities.[43] Europe and Canada, and later Japan (even in the previously forbidden area of launch technology), enjoyed the benefits of working with the United States in space program development. That the United States has taken a different path with China has likely, though inadvertently, contributed to China's determination now to become a space power. It is also interesting to note that since "9/11," after which many international relationships were redefined, NASA has suddenly become much more open to closer ties to Beijing. Space science traditionally serves as a safe first area of space cooperation, being relatively nonthreatening from a military perspective. Progress, even incremental, toward ISS participation would be a domestic and regional triumph for Beijing. Chances of that occurring post-*Colombia,* however, are significantly lower now than they might have been.

China has signed cooperative space agreements with a number of countries, including Canada, Germany, Italy, France, Britain, Russia, Pakistan, India, and Brazil. The scope of cooperation ranges from development of the Dong Fang Hong 3 communications satellite with Germany to a broad Russia-China cooperative agreement, to narrow scientific co-ventures. One future area of international cooperation that will be especially interesting to watch is launch services; participation in international launch services is a white-paper goal. The Chinese understand that launch consortia like International Launch Services, a joint venture between Lockheed Martin and Russian companies Khrunichev State Research and RSC Energia, marketing the Proton and Atlas launchers, have become increasingly prevalent and competitive since the Cold War. The Chinese may well be looking to find partners for the Long March series.

Another interesting cooperative arrangement the Chinese have built is with the United Kingdom's University of Surrey Space Centre. Having built and launched over twenty-five "microsats" performing a wide range of scientific missions, including earth surveillance, Surrey has specialized in marketing this new capability to developing nations. Its customers include Chile, Malaysia, Taiwan, Egypt, Algeria, Nigeria—and China. A concern about microsatellite technology has been its potential as a means to interfere with other nations' use of space. China has warned that it might consider using microsats to deny U.S. use of space in a crisis or conflict.

ONE DEFENDS WHEN HIS STRENGTH IS INADEQUATE; HE ATTACKS WHEN IT IS ABUNDANT

Space weaponry (beyond the handguns that have been carried into space by astronauts and cosmonauts), including both weapons placed in space and those on the ground for use against space-based assets, has until recently been carefully avoided by all space-faring nations. For many years it was argued that space weapons were banned by the 1967 Outer Space Treaty. What article 4 of that treaty actually says, however, is:

> States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner. The moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military maneuvers on celestial bodies shall be forbidden.

The argument against weapons was hung on the "peaceful purposes" phrase. The "peaceful purposes" rationale against weapons has been eroding, however, because the parties making that argument often define "peaceful" as meaning nonmilitary, whereas the United States has long contended that "peaceful" purposes include defensive ones. Increasingly, those who argue on the ground that the 1967 treaty bans space weapons find themselves in a conundrum in the age of communications, navigation, and reconnaissance satellites—all of them dual use. Defining "peaceful purposes" as nonmilitary has become problematic for any military wanting to use space hardware.

The first efforts of both the United States and Soviet Union toward space weaponry were in the area of antisatellite (ASAT) systems; the Americans initially favored guided missiles (an early form of missile defense), while the Soviets preferred "killer satellites," basically orbiting satellites armed with shrapnel charges that would disable enemy spacecraft. Although no formal treaty was ever signed, both countries recognized the inevitable arms race that would follow if either aggressively and consistently pursued an ASAT program. (As it happened, neither state did, though more through serendipity than rational decision making, as both programs waxed and waned in domestic support and technical achievement.)[44] Further, space weaponry was recognized as not without risk to all parties. Blowing things up in space creates debris. That debris in itself becomes a threat to other spacecraft, including one's own. Soviet ASAT tests in the 1960s left debris that is still a hazard today.

The Chinese, for their part, clearly see 1998 as a turning point with respect to space weapons—a time when the Blue Team and its supporters began moving

from militarizing space—which has a long and accepted history—to weaponizing it. The U.S. Space Commission Report stated it as inevitable that space will become a battleground and that the United States would be remiss not to prepare. The United States held its first space war game in January 2001, much to the consternation of the Chinese.[45]

Chinese space efforts will, indeed already do, include militarization. Chinese use of satellites for troop communication or for reconnaissance equates to militarization. But the bigger question is whether China also intends to develop space weapons.

In November 2001 the Associated Press reported Huang Huikang, an official from the Chinese foreign ministry, as saying, "Some powers in the world are on the way to militarizing outer space, not peacefully exploring. Another arms race in outer space has begun since 1998 and we should be watchful."[46] Obviously, Chinese reasoning for seeking to minimize a space-technology gap with the United States falls much into the same lines as that of the United States subsequent to the Space Commission Report—each feeling that they would be imprudent *not* to prepare and respond. China sees the United States as having "abundant power," especially in space; with missile defense, it will have what many countries refer to as "the sword and the shield."[47] Subsequently, a comment in a Chinese newspaper in July 2000 suggesting that for countries clearly unable to defeat the United States by tanks and aircraft, attacking its space system may be an irresistible choice, is not really surprising.[48]

Many analysts feel that the first "space assault" will likely be a ground-based electronic attack on a satellite. Evidence suggests, in fact, that such assaults have already occurred, temporarily "blinding" satellites.[49] China is purportedly aggressively working on ground-based laser technology for that purpose. The easiest way to attack and destroy a satellite, however, is with a weapon launched from the ground. A small missile could deposit a cloud of sand, ball bearings, or other hard objects in a satellite's path; the target's own velocity would provide the impact needed for destruction. A dozen or so countries have the capability to build such a system, though there is no evidence any have done so. China claims, however, to have developed "parasite satellites," orbiting bombs that attach themselves to enemy spacecraft for detonation when deemed necessary. Verification of the claim is difficult, since none has ever been launched. Arguments can be made both that it behooves China to let the United States think it has these capabilities so that it will not think China's strength "inadequate," and that claims like these prod the United States to be even more aggressive in its own military space

Some observers see China's race to space as a battle with its own demons.

development. In either case, there is clearly an action-reaction cycle building, from which there is no obvious escape.

China and Russia have repeatedly called for a treaty banning weapons in outer space, most recently in May 2002. How those calls correspond to Chinese claims to have developed a parasite satellite is unclear. Likely they would deem that technology "defensive," perhaps even in a preemptive sense. In any case, their calls for a ban on space weapons have gone unheeded; indeed, they are viewed as somewhat hypocritical. Perhaps the United States believes that forcing China to spend money on space technology to keep up will "break the bank," as apparently happened in the Soviet Union because of its self-destructive efforts to respond to the American Strategic Defense Initiative. The question then becomes, however, whether it is in the best interest of the United States to deal with a strong and robust China or an imploding one, likely with problems of even greater magnitude than the former Soviet Union's.

KEEP HIM UNDER STRAIN AND WEAR HIM DOWN

Early in 2002, NASA discovered on Mars potentially vast resources of underground water, close to the surface. Subsequently, there was considerable speculation that NASA was "on the verge" of announcing plans to send a man to Mars, at an estimated cost of fifty billion dollars. Other countries (Japan, Europe, China) were making advances in space, and the question was raised: would there be a new race to space? Likely there will be, but not because of water on Mars.

Lining up competitors in any potential space race today is relatively easy, though there is a wild card. Although Russia starts from a presumed position of strength, the country is a cash-strapped, emaciated shadow of its former self. President Vladimir Putin has said that Russia now has nothing to be proud of in space.[50] European efforts, traditionally through the European Space Agency, have long been dictated—that is, restricted—by having to get fifteen member states to agree on goals, then on funding, and then on follow-through. This will be further complicated by the new and as yet undefined role of the European Commission in space activity; the Galileo program (an alternative to GPS) will be one to watch as an indicator of the extent to which Europe will be able to match actions to rhetoric. Japan, once touted as the country most consistently progressing toward a fully matured program, is now plagued with problems in its space activities, particularly the centerpiece H-II launcher. India has an aggressive and impressive space program, but Indian decision makers are acutely aware of what politicians in the United States have long known, that in a democracy, space is positively viewed by the public but considered expendable relative to other public spending concerns. While India develops specific space technology for civil and military purposes and has generated a considerable regional

technological reputation, there is little chance that the expenditure that would be required for a manned program would be domestically tolerated.

China does not have voters to worry about (though that does not mean that it can ignore public opinion). Accordingly, although China has yet to produce a Nobel Prize laureate and remains constrained by economics, it has the scientific and engineering potential and could have the political will (arising from domestic factors and action-reaction with the United States) to stay the course in space development. That, the Chinese believe, will have a significant impact on its global image, as a country's relative position on the spaceflight learning curve can be a barometer of a nation's fortunes, while the unforgiving nature of space flight can dramatically illustrate a country's failings just as graphically.

The wild card may well be South Korea. It has plans for indigenous satellite launches, including military satellites, by 2005. The prestige and military implications of that could spur Japan to reinvigorate its own efforts, in turn challenging China, with implications for India. A successful Chinese manned launch could also push Japan toward an autonomous manned program—a decision that risk-averse Japan has been avoiding for many years. On the other hand Japanese risk-aversion will be strengthened by orders of magnitude post-*Columbia.* Certainly, however, regional action-reaction considerations will come into play, the pertinent question becoming how quickly they would expand beyond the United States and China.

Sun Tzu's adage of bearing down on the enemy seems to encapsulate the current approaches of both the United States and China. China does not have to be an enemy of the United States, but it is certainly destined to be a competitor, if the U.S. benchmark for competition in Asia is anything beyond the status quo. If the United States continues to exploit the obvious military advantages of space and China feels compelled to respond, a space race of some sort seems inevitable. It is inevitable because both countries recognize that space can provide advantages, or at least avoid disadvantages, vis-à-vis the other. It may inevitably make China the third man in the fourth battlefield.

Whether China intends to be the tortoise or the hare in the space race is a relative matter. China invented the game of *Wei Qi*, the Asian equivalent of chess (commonly called "Go" in the West); it has 256 pieces with which to strategize, versus sixteen in chess. That complex a planning perspective, in the context of a country with a continuous five-thousand-year history, exemplifies the dramatic difference between China's idea of long-term planning as opposed to that typical of the United States. Nevertheless, the Chinese clearly have committed themselves to the goal of space development, at whatever rate funding permits; it will

be factored into the precarious balancing act the Chinese regularly practice. China's manned space program is about its determination to regain what it considers its deserved place in global, and by default regional, politics.

NOTES

1. Shenzhou is also referred to as "Magic Vessel," "Magic Boat," or "Vessel of the Gods." *Taikonauts* are also called *yuhangyuans* in Chinese.
2. For some exceptions, see Joan Johnson-Freese, *The Chinese Space Program: A Mystery Within a Maze* (Malabar, Fla.: Krieger, 1998); Brian Harvey, *The Chinese Space Program: From Conception to Future Capabilities* (Chichester, U.K.: Praxis Publishing, 1998); Mark Stokes, *China's Strategic Modernization: Implications for the United States* (Carlisle, Penna.: Strategic Studies Institute, 1999).
3. See David Baker, ed., *Jane's Space Directory 2002–2003,* 18th ed. (Coulston, Surrey, U.K.: Jane's Information Group, July 2002), and Make Wade's contributions at Astronautix .com for perhaps the most comprehensive unclassified sources of empirical and technical information.
4. Melinda Liu, "Time to Shoot for the Moon," *Newsweek*, 28 October 2002, p. 44. In one scenario, they are also seeking *lebensraum* for their still-expanding, 1.2 billion-plus population.
5. Estimates of Chinese space expenditures are difficult. They are usually placed at somewhere between $1.3 and $2 billion, depending on what is included and how calculations are done.
6. *Annual Report on the Military Power of the People's Republic of China: Report to Congress Pursuant to the FY2000 National Defense Authorization Act,* July 2000, at www.defenselink .mil/news/.
7. An overview of the military uses of space can be found in Daniel Gonzales, *The Changing Role of the U.S. Military in Space*, MR-85-AF (Santa Monica, Calif.: RAND, 1999); Roger Handberg, *New World Vistas: The Militarization of Space* (Westport, Conn.: Praeger, 2000); James Oberg, *Theory of Space Power* (Washington, D.C.: U.S. Government Printing Office [hereafter GPO], 1999); Peter L. Hays, "United States Military Space into the Twenty-first Century," Institute for National Strategic Studies [hereafter INSS] Occasional Paper 42 (Washington, D.C.: National Defense Univ. Press, September 2002).
8. Ben Iannotta, "China's Divine Craft," *Aerospace America*, April 2001, p. 36.
9. "China Crusades to Leading Position in Aerospace," Xinhua General News Service, 22 November 2001.
10. The subheads are drawn from Sun Tzu: here, chapter 3; "Invincibility" and "One defends," chapter 4; "Keep him," chapter 1. The epigraph is taken from chapter 7.
11. Walter McDougall, . . . *The Heavens and the Earth* (New York: Basic Books, 1985); John Logsdon, *Decision to Go to the Moon: The Apollo Project and the National Interest* (Cambridge, Mass.: MIT Press, 1970).
12. Jobs, especially in key electoral states, were key decision factors in the shuttle and other space programs as well.
13. Jean-Jacques Servan-Schreiber, *The American Challenge* (New York: Avon Books, 1967); Roger Williams, *European Technology: The Politics of Collaboration* (London: Croom Helm, 1973).
14. "The U.S. Rules in Space, at Risk of Arms Race: SIPRI," Agence France Presse, 13 June 2002.
15. Bruce Sterling, "Peace Is War," *Wired Magazine,* April 2002, at www.wired.com/wired/.
16. Available on the World Wide Web at www .defenselink.mil/pubs/.
17. John M. Logsdon, ed., *Exploring the Unknown*, vol. 2 (Washington, D.C.: GPO, 1996), p. 262.
18. On technical assistance by American firms, see Joan Johnson-Freese, "Becoming Chinese:

Or, How U.S. Satellite Export Policy Threatens National Security," *Space Times*, January–February 2001, pp. 4–12, and "Alice in Licenseland: U.S. Satellite Export Controls since 1990," *Space Policy*, August 2000, pp. 195–204.

19. Eric A. McVadon, "A Purple China Policy for the U.S.," *Far East Economic Review*, 21 December 2000, p. 29; and Jay Branegan, "A 'Blue Team' Blocks Beijing," *Time*, 16 April 2001, p. 32.
20. Full text at www.spaceandtech.com/digest/sd2000-35/sd2000-35-012_white-paper.shtml [accessed 5 November 2002].
21. After initially involving scientists and engineers in the political upheaval, Zhou Enlai himself stepped in to stop it, even putting armed guards at some facilities.
22. His name is sometimes spelled Chien Hsueshen, or Tsien Hsueshen.
23. See the description in Iannotta, "China's Divine Craft."
24. "China Planning Moon Landing as First Step to Mars," Agence France Presse, 20 May 2002.
25. Wu Tse and Li Tsinlung were sent to the cosmonaut training center in Zvezdny Gorodok.
26. "'China' picks its first astronaut," *Straits Times* (Singapore), 3 January 2003.
27. CAC was also sometimes known as CASC. Chinese bureaucracies and organizations are regularly reorganized and renamed, though personnel and buildings rarely change. Some of these reorganizations are more substantive than others. The more recent efforts are seen as real efforts toward more effective management while avoiding the kind of economic collapse, which the Chinese viewed with horror, that "reform" brought in the former Soviet Union in the early 1990s. CASTC is often still referred to as CASC, recalling its predecessor organization, CAC/CASC.
28. *Federation of American Scientists,* www.fas.org/nuke/guide/china/contractor/casc.htm.
29. Ibid.
30. BBC Worldwide Monitoring, "Chinese Aerospace Corporation Meeting Discusses Development," Xinhua News Agency Domestic Service, 13 August 2002.
31. General Cao Gangchuan, head of the General Armaments Department, has been the commander of China's manned space program. He has recently been made one of the three vice chairs of the Communist Party's Central Military Commission, an even loftier position. That means he will very likely be even better able to advance his agenda.
32. Hence, Chinese launchers are referred to as Long March (LM) or Chang Zheng (CZ), and strategic missiles as Dong Feng (DF). Many Chinese space systems (and institutions) have multiple and sometimes "classified" designations, for internal and external use. Sometimes these multiple designations are deliberate, sometimes merely artifacts of history. Individuals within China often still refer to numerical academy and institution labels (the China Academy of Launch Vehicle Technology, for example, is the former First Academy, and the organization in Xi'An responsible for commercial payloads is still known as the 504 Institute) that have long since changed, many times. This can be a source of constant confusion for outsiders.
33. See Johnson-Freese, "Becoming Chinese," "Alice in Licenseland."
34. The Chinese operate from three launch sites: Xichang, in Sichuan Province (all geosynchronous satellite launches); Jiuquan, in the Gobi Desert in Gansu Province (Chang Zheng 2F and Shenzhou spacecraft); Taiyuan, in Shanxi Province (polar orbiting spacecraft). It was from Taiyuan that the twelve Iridium satellites were launched between 1997 and 1999. There has been speculation that the Chinese may build on Hainan Island another site, more along the model of Kennedy Space Center—that is, more open to the international community.
35. The number 108 is significant in the Buddhist tradition and culture—humans must overcome 108 earthly passions before achieving enlightenment.
36. Cheng Ho, "Confusion and Mystery of Shenzhou 2 Mission Deepens," 27 February 2001, www.spacedaily.com, 27 February 2001 [accessed 21 January 2003]. The Chinese were also particularly upset about Western press reports of a fruit-fly reproduction experiment, which they dismissed as nonsense.

37. Likely the better to control media and information about the launches, the Chinese, like the Soviets before them, have opted for all terra firma landings.

38. "China to Launch Next Space Mission in New Year," Agence France Presse, 12 November 2002.

39. Craig Covault, "NASA Eyes China Ties as *Shenzhou* Flies," *Aviation Week & Space Technology*, 1 April 2000, p. 27.

40. Craig Covault, "Chinese Rocket R&D Advances," *Aviation Week & Space Technology,* 12 November 2001, p. 54. UDMH = unsymmetrical dimethyl hydrazine.

41. "China Joins Moon Race," *Montreal Gazette*, 21 May 2002, pp. B6.

42. "China Planning Moon Landing as First Step to Mars," Agence France Presse, 20 May 2002.

43. See Joan Johnson-Freese, *Changing Patterns of International Cooperation in Space* (Malabar, Fla.: Krieger, 1990).

44. See Joan Johnson-Freese, "The Viability of U.S. Anti-Satellite Policy: Moving toward Space Control," INSS Occasional Paper 30 (Washington, D.C.: National Defense Univ. Press, January 2000).

45. The first space war game was known as SCHRIEVER I. SCHRIEVER II was held in February 2003. Catherine Tsai, "Air Force Tests Next-Generation Technology in War Game," Associated Press, 20 February 2003.

46. Reported in James P. Pinkerton, "The Great Leap Forward: China Gets Space—America Can't Afford Not To," *American Spectator*, March–April 2002, pp. 38–39.

47. Even though the Pentagon has now said that the Patriot (PAC-3), the most advanced U.S. antimissile system, is still so unreliable that it would have played only a secondary role in the war with Iraq, other countries take plans for it and other systems that do not even exist as capabilities they must plan for. Paul Richter, "In Event of War, Patriots Won't Be on Front Line," *Los Angeles Times,* 2 November 2002, p. A5.

48. The Chinese report is referenced in James Oberg, "The Heavens at War," *New Scientist,* 2 June 2001, p. 2626.

49. Ibid.

50. "Runners-Up in the Space Race," *The Economist*, 14 April 2001.