China and Weapons of Mass Destruction: Implications for the United States

5 November 1999

This conference was sponsored by the National Intelligence Council and Federal Research Division. The views expressed in this report are those of individuals and do not represent official US intelligence or policy positions. The NIC routinely sponsors such unclassified conferences with outside experts to gain knowledge and insight to sharpen the level of debate on critical issues.

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Introduction

This conference document includes papers produced by distinguished experts on China's weapons-of-mass-destruction (WMD) programs. The seven papers were complemented by commentaries and general discussions among the 40 specialists at the proceedings.

The main topics of discussion included:

- The development of China's nuclear forces.
- China's development of chemical and biological weapons.
- China's involvement in the proliferation of WMD.
- China's development of missile delivery systems.
- The implications of these developments for the United States.

Interest in China's WMD stems in part from its international agreements and obligations. China is a party to the International Atomic Energy Agency (IAEA), the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the Zangger Committee, and the Chemical Weapons Convention (CWC) and has signed but not ratified the Comprehensive Nuclear Test Ban Treaty (CTBT). China is not a member of the Australia Group, the Wassenaar Arrangement, the Nuclear Suppliers Group, or the Missile Technology Control Regime (MTCR), although it has agreed to abide by the latter (which is not an international agreement and lacks legal authority).

The papers below reflect important trends in thinking outside the Intelligence Community on the issue of China and WMD. As noted on the title page, the views stated in the papers are those of the authors and are not necessarily those of the Intelligence Community or any particular US Government agency.

Schedule

Welcome

(9:00-9:05 AM): Robert L. Worden, Chief, Federal Research Division

Opening Comments

(9:05-9:15 AM): Robert G. Sutter, Moderator, National Intelligence Officer for East Asia

Panel One

(9:15-10:45 AM): **WMD Capabilities**

Bates Gill and James Mulvenon - *The Chinese Strategic Rocket Forces: Transition to Credible Deterrence*

Eric Croddy - *Chinese Chemical Warfare Capabilities*

Commentators: Torrey Froscher and Catherine E. Johnston

Panel Two

(11:00-12:30 AM): **Scope of WMD Proliferation**

Evan Medeiros - *The Changing Character of China's WMD Proliferation Activities*

Shirley Kan - *Chinese Proliferation of Missiles and WMD: Issues for US Policy*

Commentators: Harlan Jencks, Peter Brookes, Janice Hinton

Panel Three

(2:00-3:45 PM): **China's Views on WMD**

Michael Swaine - *The Chinese View of Weapons of Mass Destruction*

Mark Stokes - *Weapons of Mass Destruction: PLA Space and Theater Missile Development*

Ken Allen - *Key Indicators of Changes in Chinese Development and Proliferation of Weapons of Mass Destruction*

Commentators: Lonnie Henley and Vincent Bonner

Panel Four

(4:00-5:15 PM): **Wrap-Up: Implications for US Interests and Policies**

Peter Almquist, Michael McDevitt, and Thomas Fingar

Contributors

Ken Allen is with the Stimson Center.

Peter Almquist is with the Department of State.

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Eric Croddy is a senior research associate at the Chemical and Biological Weapons Nonproliferation Project, Center for Nonproliferation Studies (CNS), Monterey Institute.

Bates Gill is Senior Fellow in Foreign Policy Studies at the Brookings Institution, and Director of the Brookings Center for Northeast Asian Policy Studies.

Thomas Fingar is with the Department of State.

Torrey Froscher is with the Central Intelligence Agency.

Janice Hinton is a specialist on Chinese affairs.

Lonnie Henley is with the Defense Intelligence Agency.

Harlan Jencks is with the Lawrence Livermore National Laboratory.

Catherine E. Johnston is with the Defense Intelligence Agency.

Shirley Kan is with the Library of Congress.

Michael McDevitt is with the Center for Naval Analysis.

Evan Medeiros is a senior research associate on the East Asia Nonproliferation Project at the Center for Nonproliferation Studies in Monterey, CA.

James Mulvenon is Associate Political Scientist at the RAND Corporation, and Deputy Director of the RAND Center for Asia-Pacific Policy.

Mark Stokes is with the Office of the Assistant Secretary of Defense for International Security Affairs.

Robert G. Sutter is National Intelligence Officer for East Asia, National Intelligence Council.

Michael Swaine is with the RAND Corporation.

Robert L. Worden is Chief, Federal Research Division, Library of Congress.

Papers

Bates Gill and James Mulvenon[1]

Introduction

The doctrine and force structure of China's Strategic Rocket Forces (also known as the Second Artillery from the Chinese *di er pao*) remain some of the most heavily shrouded and poorly understood aspects of the Chinese military. Yet, as China undergoes a continued modernization of its nuclear forces, to include improved mobility, reliability, accuracy, and firepower, concerned analysts are compelled to understand and analyze the Second Artillery more precisely, including its evolving doctrine, organization, and hardware, and their implications for international security.[2]

To date, the most prominent work on China's nuclear posture has either dwelled primarily on hardware and R&D,[3] focused on doctrinal debates,[4] or described the technological development of Chinese nuclear weapons in the form of political-military histories.[5] Some past work, now more than 10 years old, attempts to weave several of these strands together in the context of a "cultural" explanation.[6] More recent work by Johnston and Xue goes furthest in providing more unifying analyses that carefully draw together aspects of doctrine and force structure, yet this work requires some reexamination.[7]

In light of China's continuing nuclear weapons modernization program, an updated and more comprehensive framework is needed that fully pulls together theoretical analysis, China's declared nuclear principles, and an empirical assessment of its nuclear force structure. Taking such an approach, we reach four key findings on Chinese nuclear posture:

- First, from a theoretical perspective, traditional approaches such as neo-Realist and organization theory do not adequately predict and explain key aspects of Chinese nuclear doctrine and force structure. Rather, an understanding of such variables as domestic political, technological, historical, and cultural factors provide far greater insight and predictive capacity about the drivers that shape China's doctrinal and force structure decisions.
- Second, from a technical perspective, although we agree with analysts who highlight the role of technology in shaping Chinese doctrine, we go beyond the somewhat simplistic understanding that technology drives doctrine. Rather, we see patterns of rational strategic choice made for China's nuclear posture, though technology limited the realm of the possible for Chinese leaders. Perhaps it could be said that the Chinese made a *virtue out of necessity* in the construction of their nuclear deterrent, accepting the technological constraints of the system and making rational choices under those constraints.
- Third, we find that the evolution over time of China's doctrine and force structure is the story of

trying to close the gap between real capability, on the one hand, and what one might call "aspirational doctrine" on the other. In the United States, the appropriate analog would be a comparison of current operational doctrine, as outlined in the Joint Doctrine publications series, with an aspirational doctrine, such as Joint Vision 2010. In the Chinese case, the discontinuity between reality and aspiration is of times referred to as the "capabilities-doctrine gap." At the present stage in the Second Artillery's modernization, China is nearing an historic convergence between doctrine and capability, allowing it to increasingly achieve a degree of *credible minimal deterrence* vis-à-vis the continental United States--a convergence of its doctrine and capability it has not confidently possessed since the weaponization of China's nuclear program in the mid-1960s.

- Finally, for the future, the doctrine and force structure of China's Second Artillery should be analyzed at three distinct levels, reflecting a multifaceted force with very different missions: a posture of *credible minimal deterrence* with regard to the continental United States and Russia; a more offensive-oriented posture of "*limited deterrence"* with regard to China's theater nuclear forces; and an *offensively configured, preemptive, counterforce warfighting posture* of "active defense" or "offensive defense" for the Second Artillery's conventional missile forces.

Theoretical Examination of China's Nuclear Posture

In reaching these findings, the work proceeds in five sections. First, we begin with a *theoretical analysis* of Chinese nuclear posture. Second, in the absence of an open and official declaration of Chinese nuclear doctrine, we examine China's *declared nuclear principles* to inferentially deduce certain aspects of China's nuclear doctrine. In a third and fourth section, we test these findings by closely examining empirical data on China's *current and likely future nuclear force structure*. A final section draws these findings together to reach conclusions about China's *past, present, and likely future nuclear force posture*.

One observer of China's nuclear program states that "for about 30 years after China exploded its first nuclear weapon there was no coherent, publicly articulated nuclear doctrine."[8] In a similar vein, others have noted that China's nuclear weapons program "proceeded without such strategic guidance" and that "until the early 1980s, there were no scenarios, no detailed linkage of the weapons to foreign policy objectives, and no serious strategic research."[9] In the absence of definitive official, authoritative open-source documentation to describe China's nuclear doctrine, how can analysts begin to understand Chinese nuclear posture? To start, one can briefly consider several theories, or "analytical lenses," to deduce likely Chinese doctrinal choices. The literature offers three principal "models," or explanatory frameworks.

The first framework to consider is neo-Realism. Neo-Realism stresses the state as the primary actor on the international scene, and focuses on the propensity of states to engage in "self-help" in order to preserve their interests in a hostile, anarchic world system. According to neo-Realist predictions about nuclear posture, China, as "revisionist power," would likely prefer offensive weapons and doctrines. Furthermore, neo-Realism would predict that as a country that faced a number of powerful adversaries in the formative years of its nuclear weapons program (first the United States and then the United States and the Soviet Union), China would wish to pursue offensive weapons and doctrines. Neo-Realism would also predict that, as a revisionist power with limited means to detect imminent attack, Chinese doctrine would favor offensive, preventive war strategies.[10]

Another theoretical approach, known as organization theory, looks to the presumed preferences of military organizations as a determinant of doctrinal outcomes.[11] An organization theory framework would suggest that under the highly militarized domestic conditions during the initial development of China's nuclear arsenal (from the mid-1950s to the early-1970s) China would have likely pursued an offensive nuclear posture. According to this framework, the strong presence of Chinese military interests in doctrinal and weapons development in the first decades of the People's Republic would likely result in the rejection of no-first-use posture, and would favor first-use options and counterforce targeting. According to the organization theory framework, this would be predicted by the fact that China's leadership during this period was made up of active and former military leaders, and the fact that the nuclear weapons program itself was conducted largely under the auspices of the military. In addition, because China went through a series of external security crises during the formative years of its nuclear arsenal, organization theory would warn of an even stronger likelihood that the military would actively pursue offensive deployments and doctrines.

A third predictive approach gives greater weight to domestic political, historical, and cultural factors as determinants for shaping doctrinal decisions. This approach, known as neo-culturalism in the academic literature, can be applied to the Chinese case by examining domestic political interests, civil-military relations, resource restraints, and historical experience. In the Chinese case, one can point more specifically to domestic political factors (especially the unusual dynamic of Party-Army relations), technical factors (particularly availability of resources), and other historical and cultural factors as critical variables compelling doctrinal decisions.[12] In examining these factors, neo-cultural explanations--unlike neo-Realist or organizational frameworks--would not necessarily predict a Chinese preference for offensive nuclear doctrines.

Certain aspects of the empirical record would lend support to the predictions of either the neo-Realist or the organizational theorist, or both. For example, the initial Chinese decision to go nuclear in January in 1955 is predicted by the neo-Realist approach that places great emphasis on threats and prestige as useful indicators. In another example, we see that midlevel Chinese military officers have been the most open in recent years to promote more offensively oriented deployments and doctrines, as shown in Iain Johnston's work.[13]

However, in taking the 45-year record of Chinese nuclear weapons development as a whole, neo-Realist and organizational frameworks would not predict the basic declared principles and empirical record of Chinese nuclear weapons posture overall. As explained in fuller detail in subsequent sections, China's nuclear posture overall has adopted such principles as no-first-use, has circumscribed use in the form of both positive and negative security assurances and the declared adherence to nuclear-weapon-free zones, provides no extended deterrence guarantees beyond its borders, and maintains qualitatively and quantitatively limited forces, resulting in likely "countervalue" (as opposed to "counterforce") targeting, and a delayed second-strike (as opposed to launch on warning or launch on attack) state of readiness.

Hence, in the Chinese case, considering the neo-cultural approach to help predict and understand Chinese doctrinal choices would be more helpful to us. What specific aspects of domestic politics, historical experience, and cultural tradition stand out in this regard?

From the perspective of domestic politics, we must recognize first and foremost that in the critical decades that Chinese nuclear weapons were first developed, Chinese nuclear weapons decisions were firmly dominated by the views and statements of Mao Zedong and a small number of other leaders under the powerful political sway of Maoist political ideology and rhetoric. Mao's own publicly expressed opinions about nuclear weapons served as the guiding principles for the development of the Chinese arsenal. Lewis and Xue have derived seven major principles from official Maoist statements in the 1960s and 1970s that helped define the future parameters of Chinese nuclear deployments and doctrine: (1) no first use; (2) no tactical nuclear weapons; (3) "small but better"; (4) "small but inclusive,"; (5) minimum retaliation; (6) quick recovery; (7) soft-target kill capability.[14] A recent study by a Chinese missile scientist argues that many of these principles continue to carry great weight in determining the fundamental quantitative and qualitative parameters of China's nuclear weapons arsenal even today.[15]

A good part of this thinking with regard to nuclear weapons was derived from the wartime experience of the Chinese ***c***ommunist leadership, especially during the Chinese civil war (1927-49), and in the war or the ***c***ommunists against the Japanese (1937-45). According to Mao, Chinese ***c***ommunist military successes of "People's War" emphasized guerrilla tactics within a protracted war strategy, the importance of manpower over technology, the moral and physical attrition of the enemy over time, and the importance of controlling the strategic "hinterland" to surround the enemy's base in the developed urban centers. For nuclear doctrine, this translated into (1) opposition to quick or preemptive military actions from a position of weakness; (2) an appreciation for "strategic retreat" and the primacy of defense in the interest of eventual victory; (3) a subordination of a strictly military viewpoint to the political-military goals of the revolution; and (4) the ultimate superiority of man over weapons and technology.[16]

Mao's opinions also were influenced by his careful reading of Chinese history and its classic texts, especially the work of Sun Zi (Sun Tzu), who wrote the classic *Art of War* in the 6th century BC.[17] Contemporary Chinese interpretations of this work emphasize the largely defensive and nonviolent nature of Chinese strategic thought, most often citing Sun Zi's well-known maxim: "To win one hundred victories in one hundred battles is not the acme of skill. To subdue the enemy without fighting is the acme of skill." Other aspects of Sun Zi's thought that favor "nonviolent" means to vanquish one's opponents--deception, wily strategy, and what is known today as "psychological warfare"--also are often cited as representative of traditional Chinese strategic thinking.[18] Moreover, this interpretation of strategic thinking finds resonance in the larger context of Confucianism--the single-most-dominant philosophy of statecraft in Chinese history--and its overarching concern with abjuring violence and assuring order through moral--rather than strictly military--strength.

Interestingly, the term in China for "deterrence" itself may help explain Chinese nuclear posture. For example, a "Confucian" approach to nuclear doctrine may be reflected in China's frequently stated "opposition" to the policy of nuclear deterrence. This apparent contradiction only leads to suspicions about true Chinese intentions, especially from Western analysts who view deterrence as an essentially defensive and stabilizing condition. However, discussions with Chinese strategists suggest that this confusion may derive in part from Chinese perceptions of the word "deter," which in Chinese (*weishe*) connotes strongly the notion of "menacing" or "terrorizing with military force," and implies threatening rather than defensive intent. Alternative terms in Chinese for "deterrence" also imply threats: *hezu*,to frighten into inaction, and *weixie*, to awe and threaten. Not wishing to portray its nuclear weapons as threatening, China traditionally stated its opposition to deterrence.

Since late 1995, China's official position has adjusted slightly its stance to criticize the "obviously anachronistic . . . policy of nuclear deterrence *based on the first use of nuclear weapons."* Track-two discussions between US and Chinese officials were able to glean a further Chinese distinction to the effect that China exercises a "defensive deterrent," while the United States wields an "offensive deterrent."[19]

A second domestic political factor in the Chinese case that neo-Realist and organizational theory cannot fully capture is the unique dynamic of China's "Party-Army" relations. Both the neo-Realists and the organizational theorists assume a discernible distinction of preferences between "civil" and "military" leaders in a given state. The revolutionary history of the Chinese political-military leadership often belies that assumption, especially in the formative years of the People's Republic and the development of the Chinese nuclear arsenal. Chinese "civilian" or "Party" leaders--such as Mao Zedong, Liu Shaoqi, Deng Xiaoping and Zhou Enlai--had considerable experience as revolutionary military leaders, while members of the uniformed military carried significant political power as Party leaders and, by dint of their status, as revolutionary heroes. Powerful "military" interests and predispositions intertwined with "civilian" (or "Party") concerns to reach decisions of a broader "political-military" nature, which is reflected in the apparent doctrine of China's nuclear arsenal.

The notion of different "Party-Army" factions is a better approach to understanding how the Party and the Army interact for decisions in China. The differences between these factions are resolved at the highest levels of Chinese politics where both ostensibly "civil" and "military" leaders represent interests as individuals of the Chinese Party-Army state, rather than the corporate interests of bodies of which they are members. Three good examples of how this factionalism and resolution played out were the intervention of the military to quell the excesses of the Cultural Revolution, the overthrow of the Maoist "Gang of Four" in 1976, and the deployment of troops to crush the Tiananmen Square demonstrations of 1989. In these cases, different "Party-Army" factions formed across institutional boundaries to advocate different, often diametrically opposed, courses of action.

We should note how key decisions under the conditions of a symbiotic "Party-Army" relationship have traditionally been taken by China's topmost leaders, who by necessity must credibly bridge the gap between civil and military constructs. The result for strategy in the formative years of the Chinese nuclear arsenal was a more comprehensive and political-military doctrine, not a strictly "military" or "civilian" approach.[20]

Third, an understanding as to how the Chinese define "doctrine" also helps explain what appear to be discrepancies between doctrine and capability. Briefly put, what Western observers might call "doctrine" is different from the Chinese definition. What the West often defines as doctrine in the Chinese context is better understood to be "basic doctrine, as distinct from operational doctrine." Doctrine for China is "less operational and practical, and is more of a systemic description of the theory or overall construct guiding the PLA's defense posture."[21] In practice, we would differentiate between "aspirational doctrine" as opposed to "actual doctrine." In the United States, the appropriate analog would be a comparison of current operational doctrine, as outlined in the Joint Doctrine publications series, with an aspirational doctrine, such as Joint Vision 2010. Thus, just as "minimal deterrence" at the beginning of China's nuclear weapons program reflected hopeful thinking as much as on-the-ground reality, so too today discussions of a warfighting or "limited deterrent" are likely indicative of future goals rather than current capabilities. To state, for example, that "the PRC's announced strategic doctrine is based on the concept of 'limited deterrence'"[22] not only misinterprets Johnston's research and wrongly implies that the Chinese have ever "announced" a formal doctrine, but also wrongly attributes a Western sense of "doctrine" to what amounts to a Chinese "aspirational" doctrine.

Finally--and again a point not well explained by either neo-Realist or organizational theory frameworks--the empirical record suggests that Chinese nuclear weapons options and doctrine were shaped by resource constraints, especially considerations of technological development.[23] As noted above, we find that Chinese doctrinal preferences were not the principal drivers behind technological deployments (as neo-Realists and organizational theorists would likely predict), but rather the other way around: doctrine was shaped by what was technologically desirable or feasible. As a developing world state, technical obstacles and resource deficiencies almost immediately limited Chinese deployments to a defensive, countervalue, minimal deterrence stance, the principal features of China's traditional nuclear weapons doctrine. For example, China's reliance on countervalue targeting derives from the questionable accuracy of its ballistic missile forces and large-yield warheads that made precise, limited counterforce attacks unfeasible.[24]

Chinese technological restraints were further exacerbated by certain domestic political and arguably "cultural" or historical factors. In turn, these developments limited Chinese doctrinal options resulting in a reliance on largely defensive and minimalist approaches. First, China's historical perception of itself as a "victim" at the hands of aggressive, more powerful states limited political choices--especially in the early years of China's nuclear weapons development--which may have favored more offensive and threatening nuclear postures. Second, the period of China's early development and eventual deployment of its rudimentary nuclear arsenal coincided closely with a turbulent period of domestic political upheaval. As Lewis and Xue have written in reference to China's pursuit of a nuclear submarine armed with solid-fuel missiles, it is "a story of politics and technology in collision."[25]

While China eventually--after a 30-year effort--deployed a nuclear-powered submarine armed with nuclear weapons, it did so only tortuously and at great technological cost; the single submarine currently serving as the third leg of China's strategic triad rarely leaves port and has constant operational difficulties.

Third, China's historical ambivalence and self-reliant stance toward political and technological dependency also had implications for its nuclear weapons development. This position, already well entrenched in Chinese thinking dating back to the Opium Wars of the mid-1800s, was considerably strengthened during China's "century of shame" and following China's "betrayal" at the hands of Krushchev in the late 1950s and early 1960s. These lessons of historical experience slowed the acceptance and integration of foreign assistance and technologies in the development of the Chinese nuclear force. This situation constrained doctrinal choice and contributed to the development of the Chinese minimal deterrent.[26]

Taken together, the available evidence suggests that, in analyzing the underlying causes of Chinese strategic choices, we need to give far greater attention to an approach that carefully considers domestic political forces, resource restraints, and historical experience.

China's Nuclear Weapons Principles

Moving beyond an explanation of the causal factors behind Chinese nuclear posture, what specific nuclear principles have resulted, and what can we deductively infer from them as a way to describe Chinese doctrine? On the whole, these declared nuclear principles tell us more about when China claims it *would not* use nuclear weapons than when it *would*. Nevertheless, we can infer from these principles certain aspects of an otherwise undeclared nuclear doctrine. Overall, these declared principles support what the Chinese claim to be the generally defensive nature of its nuclear arsenal. As we will see, there is room to question this assertion, though we find that the principles generally conform to current force structures (see next section). We can consider these declared principles in three parts: China's no-first-use principle, its negative and positive security assurances, and its declared adherence to nuclear weapon free zone agreements.[27]

No First Use

First, public Chinese statements consistently reiterate the "defensive" purpose of Chinese nuclear weapons to counterbalance foreign threats. China's long-held "no-first-use" (NFU) policy serves as the foundation of this aspect of China's declared defensive nuclear posture. Chinese leaders decided to pursue nuclear weapons in January 1955 due to US nuclear threats during the Korean war and Taiwan Straits crisis of the early 1950s.[28] In a statement issued on the day of its first nuclear explosion in October 1964, China cited this achievement in its "struggle to strengthen [its] national defense and oppose the US imperialist policy of nuclear blackmail and nuclear threats":

China cannot remain idle in the face of the ever-increasing nuclear threats from the United States. China is conducting nuclear tests and developing nuclear weapons under compulsion...China is developing nuclear weapons for defense and for protecting the Chinese people from US threats to launch a nuclear war.[29]

This declaratory policy has changed little in the subsequent 35-plus years that China has been a nuclear weapon state. In a July 1997 speech to the US Army War College, Lt. Gen. Li Jijun, Vice President of the PLA's Academy of Military Science, reiterated China's public position regarding its nuclear posture:

China's nuclear strategy is purely defensive in nature. The decision to develop nuclear weapons was a choice China had to make in the face of real nuclear threats. A small arsenal is retained only for the purpose of self-defense. China has unilaterally committed itself to responsibilities not yet taken by other nuclear nations, including the declaration of a no-first-use policy, the commitment not to use or threaten to use nuclear weapons against non-nuclear states and in nuclear-free zones...In short, China's strategy is completely defensive, focused only on deterring the possibility of nuclear blackmail being used against China by other nuclear powers.[30]

The cornerstone of this publicly declared defensive position is China's NFU policy. Since first detonating a nuclear device in October 1964, China has consistently declared an unconditional NFU policy,[31] combined with a policy of no threat or use of nuclear weapons against non-nuclear-weapon states (negative security assurances) (see below).[32] Since that time, China has persistently proposed that nuclear-weapon states conclude a no-first-use agreement. The achievement of such an agreement was one of China's initial bargaining points in its CTBT negotiations. Later, China sought to gain such an agreement with the United States in return for a Sino-US detargeting pledge. Neither of these efforts succeeded, though the CTBT was completed and a Sino-US detargeting deal was reached. China and Russia, however, signed a bilateral NFU accord in September 1994.

Several questions, nevertheless, attend China's no-first-use pledge. First, such a pledge is highly symbolic--it is not verifiable and any violation would not be detected until too late. Second, as a practical matter, the NFU pledge may be less an altruistic principle, and more a simple reflection of the operational constraints imposed on Chinese doctrine by the country's qualitatively and quantitatively limited nuclear arsenal: China maintains an NFU pledge because it fits with the realities of nuclear weapons inventory. Finally, over the years there have been some indications that China's pledge may not be relevant to the first use of nuclear weapons on Chinese soil. Faced with the threat of a conventional Soviet invasion in the 1980s, Beijing's military strategists argued that the first-use of nuclear weapons on Chinese territory would not have violated its NFU pledge. Similarly, Johnston unearths evidence in Chinese military writings that loosely interprets the NFU pledge to possibly advocate launch-on-warning or launch-under-early-attack policies.[33]

Negative and Positive Security Assurances
Another set of nuclear-weapon-related principles issued by the Chinese involves both negative and positive security assurances (NSAs and PSAs). As for NSAs, China's declaratory stance is clear:

China undertakes not to use or threaten to use nuclear weapons against non-nuclear-weapon States or nuclear-weapon-free zones at any time or under any circumstances. This commitment naturally applies to non-nuclear-weapon States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons [NPT] or non-nuclear-weapon States that have undertaken any comparable internationally binding commitments not to manufacture or acquire nuclear explosive devices.[34]

DF-21 IRBM TELs at National Day Parade in Beijing, 1 October 1999

Of note here is China's pledge not to use nuclear weapons against non-nuclear-weapon states under any circumstances; the US NSA, for example, is conditional in that the country retains the possibility of nuclear weapons use against non-nuclear-weapon states that take part in an attack on US territory, armed forces, or allies.[35]

As for PSAs, China has agreed with the other four major nuclear weapon states (France, Great Britain, Russia, and the United States) to work within the Security Council to take "appropriate measures to provide . . . necessary assistance to any non-nuclear-weapon State that comes under attack with nuclear weapons."[36] The precise nature of the assistance is not elaborated, and the Chinese statement makes clear that this position does not in any way compromise its desire for a universal NFU pledge and unconditional NSAs, nor does it endorse the use of nuclear weapons.

Of related note, Chinese declaratory policy is particularly critical of the policy of extended nuclear deterrence, or so-called "nuclear umbrellas," provided by other nuclear-weapon states to their allies. In operational terms, this means China officially opposes the deployment of nuclear weapons outside national territories, and states that it has never deployed nuclear weapons on the territory of another country, a point that is not contradicted by any open-source evidence. When Japan sanctioned China for continued nuclear testing in 1995 and 1996 during the course of the CTBT negotiations, Beijing derisively dismissed Japanese censure as hypocritical, citing the fact that Japan enjoyed the protection of extended deterrence. China also opposes the threat or use of nuclear weapons against non-nuclear-weapon states, and has repeatedly called on nuclear-weapon states to agree to a legally binding, unconditional NSA accord.

In practice, if China adheres to its NSAs and PSAs, its deployments and targeting would presumably be focused only on nuclear-weapon states and possibly other states not party to the NPT or similar arrangements. Several questions, however, arise about China's commitments, particularly with regard to NSAs. First, like the NFU pledge, China's NSAs are not verifiable or enforceable. Second, the pledge apparently would not apply to such states as India, Israel, and Pakistan, which are not members of the NPT. Even if they joined, we question whether China's NSA would still apply to a country such as India, which, although not formally recognized by China as a nuclear-weapon state, certainly has attained such *de facto* status.

Finally, some observers question the need for certain Chinese deployments--such as the DF-21 series--insofar as its range and basing mean its possible targets largely comprise non-nuclear-weapon states. For example, as discussed in the text accompanying table 2, the DF-21s' basing and ranges suggest targets in such places as Japan, South Korea, Okinawa, the Philippines, or Vietnam, in addition to targets in the Russian Far East and India. If true, as asserted by Lewis and Xue, that China's target sets for the DF-3 included US bases in the Philippines and Japan, this targeting also runs contrary to Chinese NSAs. That the DF-3 and -4 series missiles are already capable of reaching Russian and Indian targets raises further questions as to the purpose of the DF-21 series in the context of Chinese NSAs.

Nuclear-Weapon-Free Zones

China has become a signatory to several nuclear-weapon-free-zone (NWFZ) treaties: the Treaty of Pelindaba (Africa NWFZ), the Treaty of Raratonga (South Pacific NWFZ), and the Treaty of Tlatelolco (Latin American NWFZ). During the ASEAN Regional Forum minister's meeting in July 1999 China stated it also would sign the Southeast Asian NWFZ Treaty. In its 1995 white paper on arms control and disarmament, the Chinese government stated its support for "the establishment of nuclear-free zones in the Korean Peninsula, South Asia, Southeast Asia, and the Middle East."[37]

At a conference focusing on a Central Asian NWFZ convened in Tashkent in September 1997, a Chinese Foreign Ministry official heading the Chinese delegation listed seven principles related to the establishment of NWFZs. Among them, China insisted that "any other security mechanism" should not interfere with the nonnuclear status of a nuclear-weapon-free zone, including military alliance relationships. In addition, perhaps with reference to the South China Sea, the Chinese official declared that NWFZs should not include "areas where there exist disputes over sovereignty of territory or maritime rights." He also called on nuclear-weapon states to commit to an unconditional pledge not to use, nor threaten to use, nuclear weapons against NWFZs.

In practice, China's adherence to NWFZ pledges does not greatly affect its nuclear weapon deployments, especially given that it deploys no nuclear weapons abroad. China's signing and ratifying the Southeast Asian NWFZ Treaty presumably would place an added political onus on its ability to threaten or use nuclear weapons against such targets as Vietnam or the Philippines. Depending on caveats, if any, at the time of its signing, the treaty also could affect use by China in the South China Sea. However, the pledges of nuclear-weapon states to adhere to NWFZs are not verifiable, and some include escape clauses. For example, in signing the Treaty of Raratonga (South Pacific NWFZ), China stated that it could reconsider obligations in the event that other nuclear-weapon states or treaty parties violated the treaty.

Taken together, several points can be gleaned from these principles on NFU, PSAs and NSAs, and NWFZs. First, these long-held principles are consistent with a "defensive" posture and a qualitatively and quantitatively limited nuclear arsenal. Given the reality of Chinese nuclear forces, therefore, these pledges come at little to no real "cost" in terms of reductions, disarmament, or dramatic alterations to Chinese nuclear posture overall. Second, with the possible exception of some deployments, such as the DF-21-series ballistic missile, the nuclear principles noted here are consistent with a posture largely concerned with the other major nuclear-weapon states (especially the United States and the Soviet Union/Russia), as well as India. Third, nothing in these principles necessarily precludes China's nuclear weapons modernization program, but might place political limits on targeting and use options. Finally, although these principles may give us an overall understanding about China's formally stated views about when it would *not* use nuclear weapons, they provide no details about when they *would*.

Second Artillery Force Structure

Inferences drawn from theory and from declared nuclear principles may be incorrect. Theoretical inferences have not been tested under actual warfighting conditions, and China may purposely misrepresent its principles for the purpose of deception. To unravel these potential analytic stumblingblocks, in the next two sections we take a careful look at China's nuclear force structure and hardware, draw inferences from this empirical data to clarify questions about China's doctrine and capabilities, and reach understandings about China's overall posture from the vantage point that means most for strategic policy: how does the posture of the Second Artillery actually affect the security balance in strategic, theater, and conventional terms?

History

According to Chinese sources, the Chinese Missile Research Academy (also known as the Fifth Research Academy) was established in October 1956 under the direction of Qian Xuesen.[38] Ten research institutions were set up under the Fifth Academy to focus on the development of China's ballistic missiles. China began "copy production" of its first ballistic missile--a Chinese copy of a Soviet R-2 missile--in October 1958, and the missile was first tested three times in November and December 1960. Since that time the exact number of missile tests is difficult to discern through open sources, but, by the end of the 1960s, China had conducted at least 30 MRBM (the DF-2 and -2A missiles) tests at ranges of up to 1,500 km. Major milestones in China's nuclear force modernization are noted over the following pages.

DF-2 and -2A. After a failed flight test on 21 March 1962--in which shortly after takeoff, the missile erratically flew with its engine on fire before crashing near the launch pad--the Chinese successfully tested the DF-2 numerous times in June and July 1964 following the first success on 29 June 1964. Following a February 1965 decision to increase the range of the DF-2, an increase of 20 percent in the range was achieved for the DF-2A, beginning with its first successful tests in November 1965. On 27 October 1966, the Chinese launched a DF-2 with an armed, live nuclear warhead from the Shuangchengzi to an impact area in the Lop Nur testing area.[39] The DF-2 series, with ranges of 1,000 and 1,250 km, respectively, and a yield of 20Kt, was "sited in Northeast China and targeted on cities and US military bases in Japan."[40] China was believed to have produced a total of 100 missiles between 1965 and 1971,[41] deploying approximately 50 missiles at one time.[42] Retirement of the system reportedly began in 1979 and was completed by 1990.[43]

DF-3/3A. The DF-3 was China's first indigenously developed ballistic missile.[44] Official calls for an intermediate-range missile began in the summer of 1964, with formal approval to commence the R&D process granted in May 1965. After the difficulties with the DF-2's "volatile liquid oxygen fuel," the DF-3 was reportedly the first of a series of Chinese missiles designed to utilize storable liquid fuels.[45] The more stable fuels were also meant to improve readiness because the Cuban Missile Crisis had illustrated that missiles with nonstorable fuels (such as the SS-3s and SS-4s on Cuba) were ineffective in international crises, since they took long to prepare for launch and could not be maintained at high alert levels for extended periods of time.[46] The missile was first successfully flight-tested on 26 December 1966[47] although it was not until a third flight test in May 1967 that the Chinese were fully satisfied. Several years were required for the missile to be deployed, though the exact deployment date is in dispute. The IISS *Military Balance* lists a 1970 deployment, although the *Nuclear Weapons Databook* asserts a May 1971 deployment.[48] The DF-3 was designed to carry a 2,150-kg warhead to a distance of 2,650 km (intended, when first conceived in the early 1960s, to hit US military bases in the Philippines). Perhaps as many as 36 of these missiles were sold to Saudi Arabia in the late 1980s, as the slightly longer range (2,850 km) DF-3A was tested in December 1985 and January 1986, and commissioned in that year to replace the DF-3.

DF-4. The Chinese intermediate-range ballistic missile (IRBM) DF-4 was a more difficult undertaking. With a required range of up to 4,000 km ("to strike the B-52 base on the US island of Guam"[49]), the Chinese formally authorized development of the missile in May 1965. This was to be China's first two-stage rocket (using the DF-3 as the first stage), and required technical breakthroughs in such areas as engine reliability in the near vacuum of the upper atmosphere, developing high-altitude test simulator beds, developing more heat-resistant materials, and improved guidance systems for the longer range missile. The first flight test of the missile failed in November 1969--the second stage was not ignited/separated and the missile self-destructed--but the missile was successfully tested in January 1970. According to Lewis and Hua, because of the Sino-Soviet Ussuri River clashes in late 1969, the range of the missile was subsequently raised to 4,500 km (and eventually attained a 4,750-km range) in order to reach Moscow.[50] According to Norris, et al., it "was initially planned to be deployed in silos but recognition of its vulnerability lead to reconsideration of rail-mobile basing."[51] From 18 September to 2 October 1975, the Chinese conducted DF-4 rail-mobile tests over 8,000 km in 10 provinces.[52] In 1977, the Chinese finally chose a deployment plan based on cave storage, whereby the missiles would be brought out of the cave for erecting, fueling, and firing.[53] A full-range test flight occurred on 2 August 1980.[54]

DF-5 and DF-5A. China formally began development of the intercontinental ballistic missile (ICBM) DF-5 in March 1965; its progress also was delayed by the exigencies of the Cultural Revolution. A first flight test was conducted on 10 September 1971, although this test--entirely within Chinese territory--had to be conducted across a shorter range and different trajectory than the missile was designed for. Not until 18 May 1980--a full 15 years after the missile began development--could the Chinese conduct a full-range flight test from the mainland into the Western Pacific. This test was followed by a second full-range test on 21 May 1980.

Solid-fuel Missiles. According to Chinese sources, work on solid-fuel missiles in China date back as far as October 1956, when Qian Xuesen first began to set up the Fifth Research Academy.[55] First strides were made by the late 1950s and early 1960s in developing and testing prototype solid propellant. Static tests were made with 300-mm-diameter engines in 1965 and on 1,400-mm-diameter engines in December 1966.

Initially, work was conducted with the intention of using solid fuels for a single-stage rocket. But, deeming such missiles' ranges as too short, in March 1967 Chinese military-technical authorities decided to go forward in the development of two-stage, "medium-range" solid-fuel surface-to-surface strategic missiles, to be mated with the ongoing nuclear submarine under development (the submarine-based missile was later to evolve into the DF-21 land-based system). Again, owing to the exigencies of the Cultural Revolution, Chinese sources note that serious work on the solid-fuel missile program did not begin until August 1978.[56] After launch equipment tests in April and May 1984, followed by launch tests in May 1985 (DF-21) and May 1987 (DF-21A), these systems finally became fully operational in the early 1990s. This accomplishment culminated a nearly 30-year development effort.

Another version of the DF-21, the submarine-launched JL-1, was first tested from a submerged conventionally powered Golf-class submarine on 7 October 1982, but this launch failed as the missile lost control soon after ignition and self-destructed. On 12 October 1982 the missile was successfully launched from the submerged Golf submarine. As for launching from China's nuclear-powered submarine, the missile failed its first test on 28 September 1985, again turning over and self-destructing. Not until three years later, on 15 September 1988, did a fully successful JL-1 launch take place from the submerged Xia-class nuclear submarine; a second successful test was conducted on 27 September 1988, culminating a difficult 30-year development process for Chinese SLBMs dating back to the late 1950s. According to open sources, China, since 1988, has not test launched its JL-1 from the Xia-class nuclear submarine.

DF-15 SRBM Launch From TEL (U)

By the early 1990s, China also had tested and begun deployment of two short-range, nuclear-capable ballistic missiles, the DF-15 (CSS-6/M-9) and 300-km-range DF-11 (CSS-X-7/M-11).[57] Both missiles were originally developed for export; only after China pledged not to export these missiles were they incorporated into the Second Artillery.[58] The DF-15 has been operational since 1994[59] and was tested approximately 10 times as part of the missile exercises China conducted around the Taiwan Strait in July-August 1995 and March 1996.[60] The CSS-X-7/M-11 probably was not deployed with Chinese forces by October 1998,[61] though some foreign sources familiar with the PLA believe that the 300-km DF-11 already has been fielded by at least two PLA group armies.[62] The 1999 *DoD Report to Congress on the Security Situation in the Taiwan Strait* reported thatan improved, longer range version of the DF-11 might be under development,[63] which later was verified by the 1 October 1999 military parade in Beijing.[64]

Testing. China's 32-year testing program is the smallest of the five major nuclear powers, with 45 tests between 1964 and 1996. By comparison, the United States tested more than 20 times as much, with over a thousand blasts over a more than 50-year program. This static examination of the total number of tests gives us evidence of comparative scale, but changes in annual averages can also signal intent. The amount of Chinese testing increased marginally after 1979 from 1.3 to 1.7 tests per year, but American testing between 1979 and 1992 averaged 13.6 detonations per year.

By previous standards, Chinese testing accelerated significantly in the mid-1990s, though this intensified program was probably linked to China's stated intention from early 1994, at the outset of CTBT negotiations, to conclude a test ban by the end of 1996. This timeline suggests that a political decision to sign the treaty in principle had been made by 1993 or earlier and may have intensified in the face of increasing international condemnation of China's test program, which continued throughout the CTBT negotiation process.[65] The pace of Chinese testing certainly intensified over the period 1994-96. China's six tests over a 25-month period (June 1994-July 1996, which overlapped with the negotiations of the CTBT) more than doubled China's average testing pace. For the only time in Chinese history, nuclear weapons were tested twice in three successive years.[66] Also, this period marked the only time in Chinese testing history that blasts occurred in either July or August--outside the typical Chinese testing "season"--which also indicates a sense of urgency within the military and nuclear scientific communities.[67] Finally, the initial bargaining positions put forth by China--such as on verification and inspection procedures and leaving the door open to peaceful nuclear explosions--offered the military the possibility of further testing and may have succeeded in stalling the negotiation process, thereby granting China's testing program more time. Almost immediately after China announced in early June 1996 that it would have one more test, it stepped away from its objections to the treaty and allowed the negotiations to conclude.

The Cox Report strongly suggests that the combination of nuclear espionage and the intense series of underground tests described above has accelerated the PRC's attainment of advanced, MIRVable small warheads, but some important caveats must be offered. First and foremost, the warheads employed by US nuclear forces are highly complicated devices that are extremely difficult to build. They are the product of decades of dedicated research and development, using some of the most advanced techniques available. As such, there are limits on the amount of benefit that can be wrought from simply obtaining the designs for these weapons.[68] As one sober observer writes,

China's theft of the W-88 design used for the US Navy's Trident missile warhead, for example, does not allow its engineers to reconstruct the thousands of parts and electronic components that form the completed weapon. Even the computer codes China may have obtained are mathematical models of the physical characteristics of a nuclear explosion. They cannot be used to design and manufacture a warhead. Chinese engineers may well have obtained some useful information, but they lack the data and experience required to design and build replicas of sophisticated US warheads from the stolen information.[69]

This line of reasoning is supported by the damage assessment by the ***i***ntelligence ***c***ommunity, which concluded that China had not deployed any operational system using the stolen designs, despite a lapse of more than 10 years since the alleged espionage.[70] Passage of the CTBT could have locked this situation in place for the foreseeable future, although its defeat in the Senate should prepare us for the likelihood of a resumption of Chinese testing, and, thus, the possible conquering of important developmental hurdles in the area of smaller warheads.

Current Force Structure

As a result of this historical progression, one of the most intriguing aspects of China's nuclear weapons program has been its quantitatively and qualitatively limited nature over time. These limitations are characterized in practice by a relatively small number of warheads; technically and numerically limited delivery vehicles; an overwhelming reliance on land-based systems; persistent concerns over the arsenal's survivability, reliability, and penetrability; and a limited program of research, development, and testing.

Table 1
Range of Estimates of Chinese Nuclear Weapon Delivery Vehicles

Delivery Vehicle (Western designator)	**Range (*km*)**	***Nuclear Weapons Databook* (1994)**	***The Military Balance* (1998-99)**	***Jane's Strategic Systems* (1998)**	**Various**
Land-based missiles					
DF-3A (CSS-2)	2,850	50	38+	60-80	40-80[a]
DF-4 (CSS-3)	4,750	20	10+	20-35	10-20[b]
DF-5A (CSS-4)	13,000+	4	17	15-20	4-10,[c] 20[d]

DF-21A (CSS-5)	1,800	36	8	35-50	25-50[e]
DF-15/M-9 (CSS-6)	600	na	4	400	160-200[f]
DF-11/M-11 (CSS-X-7)	300	na	na	200	
DF-31[g]	8,000	0	0	0	0
DF-41[g]	12,000	0	0	0	0
Aircraft					
H-6 (B-6/Tu-16)	3,100	na	na	na	100-120
Q-5 (A-5/MiG-19)	400	na	na	na	100+
SLBMs					
JL-1 (CSS-N-3)	1,700	24	12	12	12
JL-2 (CSS-N-4)[g]	8,000	0	0	0	0

Sources: Adapted from Robert Norris, Andrew S. Burrows, and Richard W. Fieldhouse, *Nuclear Weapons Databook, Volume Five: British, French, and Chinese Nuclear Weapons* (Boulder, CO: Westview Press, 1994), p.377-78; *The Military Balance 1998/99* (London: Oxford University Press, October 1998), p.178; *Jane's Strategic Systems*, September 1998; Robert S. Norris and William M. Arkin, "Appendix 11A. Tables of nuclear forces," in *SIPRI Yearbook* 1997 (Oxford: Oxford University Press, 1997), Table 11A.5, 401; National Intelligence Council, "Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015," September 1999.

[a] *Dunbar Lockwood, "The Status of US, Russian, and Chinese Nuclear Forces in Northeast Asia," Arms Control Today, November 1994, p. 24.*

[b] *Ibid.*

[c] *Ibid.*

[d] *National Intelligence Council, "Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015," September 1999, p. 11.*

[e] *Lockwood, "The Status of US, Russian, and Chinese Nuclear Forces," p. 24.*

[f] *Department of Defense, "The Security Situation in the Taiwan Strait," Report to Congress Pursuant to the FY99 Appropriations Bill, 26 February 1999.*

[g] The DF-31, DF-41, and JL-2 are under development, and are not expected to be in service until the early 2000s or later (DF-31 and JL-2) or until approximately 2010 (DF-41); the DF-31 was flight-tested in August 1999; and a computer simulation on the DF-41 was reportedly conducted recently.

China's current nuclear weapons arsenal totals about 400 devices, 300 of which consist of warheads and gravity bombs for use on its strategic "triad" of land-based ballistic missiles, bomber and attack aircraft, and one nuclear-powered ballistic missile submarine (SSBN) (see table 1).[71] According to the US Defense Department, over 100 warheads are deployed for use on China's ballistic missiles, with additional warheads in storage.[72] The Chinese SSBN is thought to deploy 12 single-warhead missiles. The remaining warheads reportedly consist of about 100 tactical nuclear weapons, including bombs for tactical bombardment, artillery shells, atomic demolition munitions, and possibly short-range missiles.[73] China has the capability to increase the size of its nuclear arsenal using its existing stockpile of fissile material. One source indicates that China has an inventory of between 2 and 6 tons of plutonium and 15 to 25 tons of highly enriched uranium.[74] Iain Johnston estimates that China has enough fissile material to double or triple its arsenal.[75] According to the US Defense Department, however, "China is not currently believed to be producing fissile material for nuclear weapons, but it has a stockpile of fissile material sufficient to increase or improve its weapon inventory."[76]

In addition to ballistic and cruise missiles, according to the US Defense Department, "China also has a variety of fighters, bombers, helicopters, artillery, rockets, mortars, and sprayers available as potential means of delivery for NBC [nuclear, biological, and chemical] weapons."[77] China is working to modernize its capabilities in terms of ballistic and cruise missiles, bombers, and multirole aircraft, but relies upon deterrent systems and technologies that are at least 20 years behind the capabilities of the four major declared nuclear powers. According to Chinese sources, the overall capabilities of the strategic rocket forces have advanced in recent years owing to better, more modern training, the development of strategic missile simulator training, improvements in technical reconnaissance, weather forecasting, geographical surveying, antichemical warfare and logistics support, and the introduction of some "1,000 technological research results."[78] Estimates of Chinese nuclear-capable ballistic missile forces are shown in table 1. Estimates vary as to the exact number of these missiles, but China benefits from a large, well-developed infrastructure for the development and production of ballistic missiles.

From table 1, the Chinese nuclear force structure clearly is primarily land-based, relying on a range of missile systems. On the short-range end of the land-based missile spectrum, China reportedly possesses several hundred DF-11s and DF-15s, which have ranges of 300 km and 600 km, respectively. The DF-15 can deliver a 500-kg payload to a maximum range of 600 km, with a CEP (circular error probable) of 600 meters.[79] The DF-11 reportedly has an 800-kg warhead and a 150-meter CEP.[80]

In the medium- to intermediate-range inventory, the PRC fields three types of missiles (DF-3A, DF-4, and DF-21A). Deployed in caves and valleys to increase its survivability, China's liquid-fueled DF-3As have a range of 2,800 km and reportedly carry a single warhead with an estimated yield of 1-3 megatons.[81] The liquid-fueled DF-4s, with a range of 4,850-5,500 km, are deployed in silos and tunnels and have a single warhead with an estimated yield of 1-3 megatons.[82] The solid-fueled, mobile DF-21As have a range of 1,800 km and a 600-kg warhead with a yield of 200-300 Kt.[83]

In the ICBM category, China's DF-5 ICBMs can reach targets in all of the United States.[84] Each silo-based missile carries a single warhead, with an estimated yield of 3-5 megatons.[85]

In its weaker second leg of the triad, China has deployed 12 single-warhead JL-1s, a submarine-launched ballistic missile (SLBM) with a range of 1,700 km aboard its one Xia-class nuclear submarine.[86] These missiles have faced operational difficulties, and not until 1988 were they first test-launched successfully from the Xia-class submarine. According to Paul Godwin, "this troubled ship has spent most of its time docked or in local waters and is not considered operational."[87] The limited range of the missile, the problems it has had in deployment and operation, and the limited experience of the Chinese in long-range submarine operations limits the value of this system as a strategic weapon. Beijing also may have learned some valuable negative lessons from the experience of the Soviet Union, whose SSBN force was forced to retreat to bastions by a superior US attack submarine fleet.

China's bomber and ground-attack fleet is made up of two aircraft, both of which are based on 1950s Soviet designs: the Hong-6 (H-6) bomber (Soviet Tu-16 design) and the Qian-5 (Q-5) ground attack aircraft (a redesign of Soviet MiG-19). Given the nascent state of China's in-flight refueling capability, the maximum ranges of these aircraft are approximately 3,000 and 800 km, respectively. China reportedly halted production of the H-6 in 1982, and now deploys between 100 and 120 H-6s (some in a nuclear role). China deploys over 400 Q-5 aircraft (perhaps 30 currently in nuclear role).[88]

Toward an Organic View of Chinese Nuclear Force Structure

Viewed as an organic whole, the Chinese nuclear force structure seems to defy simple categorization as either limited or minimal deterrence. Instead, the multifaceted force is made up of strategic, theater, and tactical systems of varying range, accuracy, and yield. The small ICBM force, anchored by the DF-5 family of missiles, appear to be second-strike minimal deterrence forces. The theater systems are unlikely to be used in a second-strike, minimal deterrent role following a preemptive strike. Instead, theater systems look like offensive systems meant to strike US forces and bases in Asia to degrade conventional capability. The short-range, ballistic missile forces, which are also nuclear capable, further confuse the situation by serving a variety of conventional warfighting and nuclear warfighting roles. Perhaps the best way to understand the nature of this multifunction force structure is to deductively infer the purpose of each element in the force by examining range and deployments, payloads and CEP, readiness, and C4I structure.

Table 2
Suspected Chinese Strategic Missile Bases
(Derived From Open Sources)

Base Number	Base Military Unit Cover Designator	Base and Selected Brigade Locations	Reported Missile Types
51 Base	80301	*Headquarters:* Shenyang, Jilin Province *Brigades:* Tonghua (DF-3A and DF-21), Dengshahe (DF-3A)	DF-3A (CSS-2) DF-21 (CSS-5)
52 Base	80302	*Headquarters:* Huangshan (Tunxi), Anhui Province *Brigades:* Leping (DF-15), Lianxiwang (DF-3A)	DF-15 (CSS-6) DF-3A (CSS-2)
53 Base	80303	*Headquarters:* Kunming, Yunnan Province *Brigades:* Chuxiong (DF-21), Jianshui (DF-3A)	DF-3A (CSS-2) DF-21A (CSS-5)
54 Base	80304	*Headquarters:* Luoyang, Henan Province *Brigades:* Luoning (DF-5), Sundian (DF-4)	DF-4 (CSS-3) DF-5 (CSS-4)
55 Base	80305	*Headquarters:* Huaihua, Hunan Province *Brigades:* Tongdao (2 brigades of DF-4)	DF-4 (CSS-3)

56 Base	80306	*Headquarters:* Xining, Qinghai Province *Brigades:* Datong (DF-3A), Delingha (DF-4), Da Qaidam (DF-4), Liujihou (DF-3A)***a***	DF-3A (CSS-2)DF-4 (CSS-3)
NA	80310	*Headquarters:* Baoji, Shanxi Province	NA
NA	NA	*Headquarters:* Yidu, Hubei or Shandong Province	DF-3A (CSS-2)
In addition, reports also cite the following launch sites: DF-5: Jiuquan (war reserves), Wuzhai (war reserves).			
Sources: Mark A. Stokes, *China's Strategic Modernization: Implications for US National Security*, unpublished study for the United States Air Force Institute for National Security Studies, October 1997; Leonard S. Spector, Mark G. McDonough, with Evan S. Medeiros, *Tracking Nuclear Proliferation: A Guide in Maps and Charts* (Washington, DC: Carnegie Endowment for International Peace, 1995), 52-56; Bill Gertz, "New Chinese missiles target all of East Asia," *Washington Times*, 10 July 1997, A1. The MUCDs have been collected from open sources, including assorted neibu (internal) Second Artillery publications. Subordinate brigade and battalion MUCDs will be included in a later version of the paper.			
[a] The Liujihou brigade was not listed with the other brigades of Base 80306, but its proximity to Qinghai suggests that it should be part of this base.			

Ranges, Deployments, and Targets. The Chinese nuclear force inventory encompasses a wide variety of ranges, and the deployment of these forces offer a wide variety of potential targets. The range and basing of China's missiles are summarized in table 2.

From the locations of these bases and the ranges of their deployed missiles, several inferences can be drawn about the likely target for these missiles. The DF-3As and DF-21s of Base 80301 probably are targeted on Japan, South Korea, Okinawa, or the Russian Far East. The DF-15s of Base 80302 are almost certainly aimed at Taiwan. The DF-3As and DF-21s of Base 80303 probably are targeted against countries south and southwest of China, including the Philippines, Vietnam, and India. The DF-5s of Base 80304 are the major CONUS-oriented systems, while the DF-4s of both Base 80304 and Base 80305 might be aimed at Hawaii. Finally, the DF-3As and DF-4s of Base 80306 likely are targeted at sites in the former Soviet Union, including Moscow, or possibly India.

How Did the Structure Evolve to This Arrangement? Lewis and Hua maintain that China's nuclear weapons program "proceeded without such strategic guidance" and that "until the early 1980s, there were no scenarios, no detailed linkage of the weapons to foreign policy objectives, and no serious strategic research."[89] They even go so far as to say that neither the "Chinese leader nor his senior colleagues on the Central Military Commission considered, communicated, or authorized the investigation of the broader strategic purposes of the program."[90] As Lewis and Hua predicted, we have difficulty believing this to be true. From an examination of the sources of their collected works, no one can doubt the authors' access to critical personnel or documents from China's nuclear programs or missile programs, though the level of citation from central leadership documents is considerably lower. Although we doubt that the first generation of leaders, especially Mao, understood the scientific or technical aspects of nuclear combat, they at least were able to articulate the strategic targets for these weapons and task the weapons complex accordingly. Indeed, the authors seem to contradict themselves when they relate stories wherein researchers are told the specifications for specific missiles (i.e., range, payload, etc.) by central authorities, who then later change the range and payload requirements for individual missiles to reflect new strategic goals. For example, they assert that the military commission in 1970 commanded that the range of the DF-4 be increased from 4,000 km to 4,500 km, "bringing Moscow within range of bases in Da Qaidam, Qinghai Province."[91] This story, along with others in the narrative about the sequential development of missiles capable of hitting the Philippines, Guam, Hawaii, and the United States, suggest that someone, somewhere, at a central level was making decisions about the strategic purpose and direction of various missile systems, which was then reflected in the seemingly logical pattern (defined as matching geographic location with range to target) of base and missile deployments.

One important dilemma that confronts any analyst trying to understand the overall nature of the Chinese nuclear force posture is reconciling the mixture of strategic and theater systems with claims of either minimal or limited deterrence. Comparative cases of nuclear force structure evolution, however, offer clues about China's intentions. In the Soviet case, we note that Moscow did not draw a sharp distinction between its strategic and theater nuclear weapons systems. The best example of this was the road-mobile SS-20, which was developed to decouple the United States from its allies in Europe and Asia by holding theater targets at risk and preventing Washington from defending allies. The Soviets referred to this combination of strategic and theater nuclear weapons as the "seamless web of deterrence." Is the same thing happening in China? Clearly, China and the former Soviet Union share some commonalties in their strategic environment and goals. Like Russia, China seeks to decouple the United States from its allies in the region, especially Japan and South Korea, by using the threat of theater nuclear weapons. In recent years, this threat has become particularly important in a Sino-US conflict over Taiwan, which could escalate to the point that it threatens to split the US-Japan defense alliance. The United States, however, withdrew its theater nuclear forces in 1991. How has this situation changed the rationale for the DF-21A and other Chinese theater nuclear forces, because they no longer have a second-strike role?[92] To explicate this situation, a deconstruction of the Chinese force is required.

Payloads, CEP, and Targeting. Until the DF-31 comes online, the Chinese strategic nuclear force is dominated by missiles with high yield warheads and large CEPs. For example, the DF-4 ICBM has an estimated yield of 1-3 megatons and a CEP of almost a mile.[93] The mainstay of the Chinese ICBM force, the DF-5, is more accurate but still has a yield of 3-5 megatons and a CEP of more than a quarter of a mile. This combination of high yield with low accuracy suggests that the force is designed for countervalue, or "city-busting" attacks against "soft" targets such as concentrated population centers, and other locations of political and economic value.[94] Counterforce warfighting, by contrast, requires far more accuracy than offered by these systems.

Readiness and Survivability. In the past, the limited numbers, low level of readiness, and slow response times of China's land-based missiles and bombers left China vulnerable to an overwhelming and incapacitating first strike. China does not currently have space-based or land-based early warning assets. A senior US intelligence official has confirmed that Chinese missiles are usually unfueled and unmated to their warheads.[95] Furthermore, the process of loading the liquid fuel tanks and installing the warheads can take two to four hours.[96] Because of the lengthy prelaunch exposure times of more than 2 hours for the DF-3A, decisions were taken that led eventually to operating the DF-4 from caves and the DF-5 from silos.[97] Although cave and silo basing reduces prelaunch exposure, the basing mode could not significantly reduce the overall preparation time for launch, including fueling, arming, positioning (in case of non-silo-basing), targeting and range-setting, and other preparatory checks.[98] Given these time constraints, the Chinese DF-3A, DF-4, and DF-5A in today's arsenal may still require from 1 to 2 hours to launch. From this incomplete data, we tentatively infer that the Chinese nuclear force is incapable of launch-on-warning or launch-under-attack. This readiness and survivability level is consistent with a minimal deterrent posture.

DF-31 ICBM TELs. The DF-32 Is Still in the Test Launch Stage.

China has also sought to improve survivability by establishing a credible triad. As early as the mid-1950s, China began developing a sea-based deterrent, though this small program continues to face a number of serious technological obstacles.[99] China has held only one known SLBM test from the Xia-class submarine, and the existence of only a single boat obviates the possibility of regular patrolling.[100] Efforts to further integrate Chinese bombers into the triad have been impeded by the vulnerability of PRC airfields and the high cost of modern aircraft capable of penetrating advanced air defenses.[101] In addition, Chinese nuclear-capable bombers are limited in range and are highly vulnerable to sophisticated air defenses, making it unlikely that the bomber force would be effective in a nuclear delivery role against either Russia or US forces in the Western Pacific region.[102] Despite strenuous efforts, therefore, the sea-based and bomber-based legs of China's triad are still relatively unreliable, especially in the context of intercontinental nuclear combat with the United States. As a result, China has been forced to focus on ensuring the survivability of its land forces by deploying road-mobile, solid-fuel systems.

C4I Structure. The Second Artillery (SAC) is tasked with implementing the reliable and secure command and control of China's nuclear and conventional missile forces.[103] The SAC was formally established in 1966, based upon a "special" artillery corps formed in 1958 following the Chinese decision to develop nuclear weapons. The SAC is a separate service arm, distinct from the army, navy, and air force. The central command and control center for all Chinese forces, including SAC, is located is Xishan, in the hills west of Beijing, where strategic operational orders originate. Direct communication with China's six launch bases would be passed through the SAC headquarters and its communications regiment. We must note that this system bypasses China's military region commands, and connects directly to base commands. Base commands, in turn, communicate with their respective launch brigades. The SAC reportedly operates about six launch bases, each led by a major general. Each base has two to three missile brigades each commanded by a colonel, with each brigade operating one type of missile. These brigades consist of up to four launch battalions (see table 2).

At a political level, ultimate authority to use nuclear weapons is "subject to the unified command of the Central Military Commission. Only the commission's chairman (currently Jiang Zemin, who is also head of the Chinese Communist Party and the Chinese President) has the power to issue an order to use such weapons after top leaders reach a consensus on the issue."[104] However, it is likely that such a decision would require a consensus decision within the Central Military Commission and other senior military elders.[105]

As for the technical aspects of Chinese nuclear C4I, little open source information is available as to the precise systems employed to ensure safe and reliable communication between the central leadership and the launch bases. In recent years, however, reports increasingly have surfaced in the open literature describing various new technologies and systems that help strengthen China's command and control system. In some cases the "breakthroughs" reported suggest that the past level of command and control structures was not particularly advanced. For example, the official People's Liberation Army Daily in early 1998 noted that the SAC "after three years of arduous work" developed a new digital microwave communications system which now allows for a secure "all-weather" communications for missile launch. "With the new system," the article notes, "the Second Artillery will no longer be affected by natural conditions such as weather."[106]

At the same time, however, the Pentagon reports that "China has made significant efforts to modernize and improve its command, control, communications, computers, and intelligence infrastructure."[107] Given the importance of nuclear weapons to Chinese security, we assume that similar advances in C4I modernization have occurred in the strategic rocket forces. Some evidence indicates, for instance, that the Second Artillery seeks to connect much of its infrastructure with secure, landline fiber-optic cable.[108] Moreover, open-source reports detail the deployment of an "automated command and control system."[109] From these changes, we can infer desire for greater survivability and positive control of nuclear weapons. They probably also reflect a greater desire for operational security, as well as enhanced denial and deception against increasingly advanced national technical means of other countries. By itself, however, the modernization of Chinese nuclear C4I does not automatically imply that the force is transitioning to a flexible response, counterforce footing. The changes might signal desire for eventual launch under attack (LUA) capability, but the current inventory of missiles and the next generation of replacements are not capable of the reaction times necessary for such a capability. More likely, the C4I modernization program is meant to improve the credibility of China's minimal deterrent posture in the short to medium term.

Future Nuclear Force Posture

Doctrine

Over the past decade, certain indicators suggest that these long-held aspects of Chinese nuclear weapons doctrine may be undergoing some reconsideration.[110] As Paul Godwin argues,

Minimum deterrence, which uses a single countervalue punitive strike on cities to deter, is seen by many Chinese strategists as passive and incompatible with what they see as a future requirement for more flexible nuclear responses.[111]

One observer argues that, consequently, some Chinese military planners are considering a shift to a "limited" deterrent posture, which could include the introduction of limited warfighting capabilities; improved command and control and early warning systems; smaller, survivable, mobile, more accurate, and diverse cruise and ballistic missile nuclear delivery systems; possible abandonment of the NFU policy; missile defenses; and the addition of counterforce targets.[112] This view has gained backing in other detailed research that notes that "China's strategic modernization R&D [research and development] supports this shift toward a limited warfighting approach to nuclear warfare."[113] Such a capability would enable China to respond to "any level of nuclear attack, from tactical to strategic."[114]

As the previous pages suggest, however, from a strictly doctrinal perspective, such a shift probably will await shifts in the domestic political hierarchy and its view of the outside world, factors that have consistently driven Chinese doctrinal choices. Moreover, as noted in the previous section on force structure, technological constraints will remain one of the foremost drivers determining the direction of doctrine in the near term.

Rather than force a stark analytic choice between *either* a doctrine of "minimal deterrence" *or* one of "limited deterrence," drawing out two important nuances to better understand this debate is more logical. First is to recognize the differences between "operational doctrine" and what we might call "aspirational doctrine" in the Chinese context. Second is to recognize that the Second Artillery--which oversees strategic nuclear, theater nuclear, and conventional missiles--more likely operates on three levels of doctrine: *credible minimal deterrence* with regard to the continental United States and Russia; "*limited deterrence"* with regard to China's theater nuclear forces; and an *offensively configured, preemptive, counterforce warfighting posture* of "active defense" or "offensive defense" for the Second Artillery's conventional missile forces.

Force Structure

Various governmental reports suggest that Chinese nuclear force structure will increase in numbers and quality. In 1995, then Secretary of Defense William Perry stated that China "has the potential to increase the size and capability of its strategic nuclear arsenal significantly over the next decade."[115] According to the US Department of Defense in 1997, "China probably will have the industrial capacity, although not necessarily the intent, to produce a large number, perhaps as many as a thousand, new missiles within the next decade."[116] General Hughes, then Director of the DIA, testified in 1999 that "the number of Chinese strategic missiles capable of hitting the United States will increase significantly during the next two decades."[117] Publicly released estimates of the number of ICBMs capable of reaching the United States range from "tens"[118] to the Cox Committee's ambitious estimates of "up to 100" ICBMs with 1,000 MIRVed warheads by 2015.[119] According to the Pentagon, "China plans to begin production and deployment of at least one solid-propellant ICBM that will provide China's strategic nuclear forces [with] improved mobility, survivability, accuracy, and reliability."[120]

Two principal impetuses are behind the modernization of the Chinese nuclear force structure. The first is the predictable process of replacing aging weapons systems with more modern counterparts. Most of China's operational missile forces, especially the CONUS-capable ICBMs, are 1950s-vintage liquid-fueled systems. As General Hughes has testified, "China's strategic nuclear force is small and dated, and because of this, Beijing's top military priority is to strengthen and modernize its strategic nuclear deterrent."[121] This effort has been assisted and accelerated in part by the ready access to technologies now available from Russia. The second driving factor behind Chinese modernization is a rising concern about the survivability of its nuclear deterrent, particularly given the prospect of the Strategic Defense Initiative in the 1980s and now the deployment of theater and national missiles defenses by the United States. Chinese perceptions about the survivability of its force were also undermined by Desert Storm, which highlighted the ability of US conventional forces to destroy fixed targets with precision-guided munitions and the concomitant inability of those same forces to destroy mobile targets. This realization no doubt reinforced the perceived desirability of modern, road-mobile nuclear forces.

The two principal programs in this modernization effort will be the DF-31 and the DF-41.[122] The mobile, solid-fuel DF-31 will have a range of 8,000 km, and carry a payload of 700 km. The origins of this missile are controversial. Lewis and Xue argue that the First Academy drew up plans beginning in 1974 to develop not only the JL-1 SLBM, but three other solid-propellant missiles as well over the subsequent decade, namely the DF-21, DF-21A, and the JL-2 SLBM.[123] Another source claims that the DF-31 missile was an outgrowth of the DF-23 road-mobile, solid-fueled program, which began development in 1978 as a land-based missile, and was then modified to also serve as the basis for a submarine-launched

SLBM, known as the JL-2. To confuse matters even further, a different Lewis article asserts that the R&D for the DF-23 began in August 1970, during "a particularly tense moment in Sino-Soviet confrontation."[124] Regardless of its development path, the DF-23 was renamed the DF-31 in January 1985, although the designation JL-2 was not changed. In August 1999, China publicly declared the first full flight test of the DF-31.[125] We expect that the DF-31 will be deployed perhaps by the early 2000s.

The planned follow-on to the DF-31, the DF-41, was officially initiated in July 1986.[126] The three-stage, solid-propellant ICBM will have a range of 12,000 km, thus making it capable of striking all targets in the CONUS. It is therefore the logical replacement to China's aging DF-5 force, which Beijing will begin replacing around 2010. According to Lewis and Hua, the final basing mode for the DF-41 is still unclear, although it will be stored in caves and is likely to be deployed on a road-mobile TEL.

Some reports indicate that China will launch a major effort to develop and construct a follow-on to the Xia-class nuclear ballistic missile submarines to be deployed after 2000. The next-generation submarine, the 09-4, probably would deploy 16 of the new JL-2 SLBMs, with a range of about 8,000 km.[127] However, political and technological constraints may delay or even suspend the deployment of this boat.[128]

Implications

Mobility. Despite yeoman effort, the Chinese largely have failed to field a credible triad. Instead, the force remains highly unbalanced, with land-based missiles predominant over bombers and SLBMs, especially in the intercontinental category. As a result, Beijing has been forced to improve the survivability of its land-based missiles. Apart from the addition of solid fuels and improved C4I infrastructure, the Chinese began to move from silos and caves to a road-mobile force with missiles loaded on transporter-erector-launchers (TELs) as early as the 1970s.[129] With the planned deployments of the DF-31 and DF-41 ICBMs over the next 10 to 20 years, the Chinese nuclear inventory will thus become increasingly mobile over time. This move will have the effect of enhancing the credibility of China's minimal deterrent posture, as long as such a large force size asymmetry exists between China and the larger nuclear powers. Moreover, the deployment of the DF-31 and DF-41 theoretically increases deterrence stability with other nuclear powers by making China's force more survivable.

Solid Fuel. One impediment to greater flexibility and survivability in the Chinese force were the hazards associated with volatile liquid propellants.[130] The move to solid fuel increases the credibility of the Chinese force by improving reaction times, thus raising its overall readiness level. As Godwin points out, however, solid fuels also "contain less thrust than liquid fuel, requiring China to develop smaller, lighter warheads with much better yield-to-weight ratios than its older weapons."[131]

C4I Modernization. Speaking in 1999, DIA Director Hughes testified to Congress that China was actively engaged in "upgrade programs" for its nuclear C4I.[132] Overall, the modernization of Chinese nuclear C4I increases the credibility of the Chinese force by strengthening command and control. Specifically, it enhances the leadership's positive control over the force, increasing the probability that the National Command Authority could survive an attack and respond. In the paradox of nuclear strategy, this development actually increases deterrence stability between China and other nuclear powers.

Accuracy. There is reason to believe that the Chinese SAC is attempting to improve the accuracy of its strategic rocket forces. Presurveyed launch sites increase the potential accuracy of the new mobile systems. Chinese research institutes are reportedly attempting to increase precision by developing better gyros and inertial measurement units.[133] According to the Pentagon, China is using the Global Positioning System (GPS) to make "significant improvements" in its missile capabilities. As an example, the DoD cites the use of GPS for midcourse guidance correction to improve missile accuracy, and also asserts that such satellite updates will "increase the operational flexibility of China's newer mobile missiles."[134] A RAND study on this subject concluded that GPS-aiding of ballistic missile guidance could improve accuracy by 20-25 percent.[135] Greater accuracy might signal a desire for eventual counterforce capabilities, although force size will be an important constraint on successful transition to a more offensive posture.

Greater Numbers. The Cox Report and other analyses predict that the Chinese nuclear force structure is likely to increase in size, and therefore pose a greater threat to the United States.[136] Why would the Chinese force increase in size? Increasing numbers of Chinese missiles would cause an opposing force to have greater difficulty in "decapitating" the Chinese force, which has been a prevailing fear since the beginnings of the program. The fear only has become more frantic in an age of growing American predominance in space-based reconnaissance. More Chinese missiles might signal a possible shift from a retaliatory countervalue posture to an offensive counterforce posture, particularly if accompanied by necessary improvements in accuracy. According to Godwin, a sufficient number of weapons could permit China for the first time to attempt intrawar escalation control because Beijing would retain enough forces to respond at a higher level if the aggressor chooses to escalate a nuclear exchange.[137]

An increase in missiles is also the logical response to the deployment of theater (TMD) and national missile defenses (NMD) among the United States and its allies, which the Chinese view as an organic whole rather than separate programs (as one Chinese arms controller put it, "two sides of the same coin"). Proponents of TMD/NMD point out that the Chinese already are modernizing their missile forces, so defenses are not to blame for increases in the quality and quantity of the Chinese force. This claim probably is true but must also be accompanied by an honest recognition that TMD/NMD deployment is likely to accelerate this effort and push the Chinese to spend more money on such relatively cheap antimissile defense accessories as countermeasures and decoys. Perhaps the only good news is that limited increases in Chinese missiles would paradoxically increase deterrence stability between China and other nuclear powers and enable China to maintain a no-first-use principle by reducing the likelihood that the PRC's force could be destroyed in an all-out preemptive attack.

At the same time, we must also entertain the possibility that the new generation of missiles are meant only to replace the aging veterans of the fleet, particularly the DF-4 and DF-5. If the Chinese eventually exchange the road-mobile, solid-fueled DF-31s and DF-41s for these liquid-fueled, silo- and cave-based missiles on a one-to-one basis, or even two-to-one basis, then the net result is *ceteris paribus* an increase in the credibility of China's previously suspect minimal deterrent, not necessarily a fundamental shift to an offensive posture. Moreover, as the significant delays in the IOCs of past systems and the inaccurate estimates of DF-31/DF-41/DF-25 deployments in Lewis and Hua's 1992 article attest, we should not be overly optimistic about the production timelines or output estimates offered by the Chinese for the rollout of the next generation of missiles. Rather, we should maintain a sober view of the impressive but sometimes erratic production cycles in the Chinese missile system.

MIRVing? Since the late 1980s, China has conducted a series of smaller yield tests, apparently intended to develop smaller, lighter warheads with an improved yield-to-weight ratio,[138] although this trend could be traced as far back as 1970.[139] Most analysts agree that the purpose was to develop new warheads for single placement on China's next-generation solid-fuel ICBMs (DF-31 and DF-41) as well as ensure the safety and reliability of new warhead designs.[140] The antecedents of the DF-31 and DF-41 programs, which were initiated in the early 1970s, were the beginning of a move to develop mobile forces, which required the development of smaller missiles, which in turn required smaller warheads.

Other observers have added an additional, controversial motivation for the testing of smaller warheads--the development of a multiple warhead capability, possibly MRV or even MIRV.[141] The Cox Committee, for example, concluded that "the PRC has demonstrated all of the techniques that are required for developing a MIRV bus, and that the PRC could develop a MIRV-dispensing platform within a short period of time after making a decision to proceed."[142] Often, this desire is linked to a perceived future Chinese intent to develop flexible response, counterforce-oriented nuclear forces, though the smaller warheads could also be used as MIRVs on the existing DF-4s and DF-5As. Significant evidence suggests that the Chinese have been actively interested in developing multiple warhead technology for more than 20 years.[143] The current small size of the Chinese force and the mainstream projections of the size of the future force, however, make unlikely China's seeking multiple warheads for counterforce purposes. Instead, an examination of the timelines for MIRV research in China suggest that the focus of the multiple warhead effort is anti-ballistic-missile defense. Lewis and Hua assert that the Chinese began to study MRVs and MIRVs in 1970 as a response to US deployment of multiple warhead systems, but lowered the priority of the effort in March 1980 after more than a decade of problems.[144] Work on multiple warheads was resumed on 10 November 1983, however, when the First Academy included them in the DF-5A modification program.[145] Some reports suggest that missile tests undertaken between fall 1986 and late 1987 were for the development of multiple-warhead missiles, including at least one such test for the DF-5A ICBM.[146]

Why the renewed interest after years of difficulty? Lewis and Hua give us no clues, but the US announcement of the Strategic Defense Initiative in March 1983 seems too great a coincidence to ignore. If we assume that US SDI and now NMD research is driving the current round of Chinese efforts to develop multiple warheads, then a number of potential implications can be offered. The first critical variable is the status of Chinese nuclear testing. Despite allegations of nuclear espionage, Chinese accession to the CTBT would significantly impair China's ability to make progress in this area, particularly given the conclusion of the Jeremiah Commission that China has not deployed a MIRV on its ICBMs.[147] Even if we assume that the Chinese have already achieved a level of miniaturization necessary for MIRVing or will do so in the near future, a second critical variable will be the size of the future Chinese nuclear force posture, particularly the CONUS-capable forces. If China maintains a relatively small ICBM force, eventually replacing its several dozen DF-4s and DF-5As with a comparable number of DF-31s and DF-41s, respectively, then Chinese MIRVing along with robust decoys and countermeasures is likely meant to try and overwhelm the proposed 100- or 200-interceptor NMD system, not necessarily perform offensive counterforce attacks. A larger force of ICBMs makes this distinction murkier, but the overwhelming, triadic force asymmetry of the United States vis-à-vis China for the foreseeable future severely reduces the possibility that China could hope to achieve its goals with a preemptive strike.

Conclusions

Based on theoretical analysis, a review of Chinese nuclear principles and doctrine, and a study of China's nuclear force structure, we reach a number of important findings. We conclude that the operational survivability of China's nuclear retaliatory capability vis-à-vis major nuclear powers was and probably still is open to question, particularly in the context of an all-out preemptive strike. At best, then, China's minimal deterrent was primarily psychological, although the potency of this aspect of the deterrent should not be underestimated. The PRC's missile modernization program, therefore, has been a quest to increase the credibility of this deterrence posture by improving the readiness and survivability of the force. Measures being implemented are a transition from volatile liquid fuels to more stable solid fuels, a transition from fixed basing to mobile basing, and the construction of a robust C4I infrastructure. The Chinese have not operationally deployed any of their planned solid-fueled, road-mobile ICBMs, though the shorter range DF-31 seems to be nearing IOC after more than 30 years of work. When these systems come online, the Chinese finally will have succeeded in fielding a much more credible minimal deterrent force, whose mobility and readiness theoretically increase the chances that some percentage of the force could survive a first strike and thus effectively deter potential attackers.

At the same time, however, the Chinese force has grown to encompass more than simply minimal deterrent forces, including theater and tactical systems. Viewed in its totality, the Chinese nuclear force structure seems to defy simple categorization as either minimal or "limited" deterrence. The multifaceted force is made up of strategic, theater, and tactical systems of varying range, accuracy, and yield, reflecting the very different missions it is required to perform. The small ICBM force, anchored by the DF-5 family of missiles, appear to be second-strike minimal deterrence forces. The theater systems, by contrast, are unlikely to be used in a second-strike, minimal deterrent role following a preemptive strike. Instead, theater systems look like offensive systems meant to strike US forces and bases in Asia to degrade conventional capability. The short-range, ballistic missile forces, which are also nuclear capable, further confuse the situation by serving a variety of conventional warfighting and nuclear warfighting roles. For the future, the doctrine and force structure of China's Second Artillery must be analyzed at three distinct levels: a posture of *credible minimal deterrence* with regard to the continental United States and Russia; a more offensive-oriented posture of "*limited deterrence"* with regard to China's theater nuclear forces; and an *offensively configured, preemptive, counterforce warfighting posture* of "active defense" or "offensive defense" for the Second Artillery's conventional missile forces.

How did the Chinese force evolve into this arrangement? First, our analysis tends to confirm the arguments of Lewis, *et al.*, of the *importance of technology as a determinant of Chinese doctrine*. The progression of missile systems, with their gradually expanding ranges and capabilities, defined the limits of the possible for the Chinese leadership. We disagree, however, that technology alone determined the nature of the Chinese nuclear force posture. Central guidance on ranges and payloads, although admittedly vague, appears to conform with strategic-level perceptions of threats and goals in the external security environment, especially when matched with the corresponding logical deployment pattern outlined in section three. Perhaps we can say that the Chinese made a *virtue out of necessity* in the construction of their nuclear deterrent, accepting the technological constraints of the system and making rational choices under those constraints.

In the end, however, we question whether China ever actually achieved a fully credible minimal deterrent. Thus, our attention has focused on the discontinuity between reality and aspiration, which is oftimes referred to as the "capabilities-doctrine gap." At the present stage in the Second Artillery's modernization, China is nearing an historic convergence between doctrine and capability, allowing it to increasingly achieve a degree of *credible minimal deterrence* vis-à-vis the continental United States--a convergence of its doctrine and capability it has not confidently possessed since the weaponization of China's nuclear program in the mid-1960s.

But what about "limited deterrence"? Recent studies find that since at least the late 1980s, Chinese military writings have promoted the need for China to develop a "limited deterrence"--as opposed to a "minimal deterrence"--doctrine. Although these writings are not considered official declarations of doctrine, because they are written by military analysts and appear in officially sanctioned military publications they have a special salience that deserves further scrutiny. In analyzing these writings, Johnston observes the emergence of "more comprehensive and consistent doctrinal arguments in favor of developing a limited flexible response capability" and that "Chinese strategists have developed a concept of limited deterrence . . . to describe the kind of deterrent China ought to have."[148]

In general and specific terms, these Chinese writings call for limited, counterforce, war-fighting capabilities "to deter conventional, theater, and strategic nuclear war, and to control and suppress escalation during a nuclear war."[149] According to Chinese analysts, such a posture requires:

a greater number of smaller, more accurate, survivable, and penetrable ICBMs; SLBMs as countervalue retaliatory forces; tactical and theater nuclear weapons to hit battlefield and theater military targets and to suppress escalation; ballistic missile defense to improve the survivability of the limited deterrent; space-based early warningand command and control systems; and anti-satellite weapons (ASATs) to hit enemy military satellites.[150]

Because such a posture would require a significant increase in Chinese capabilities, Johnston correctly highlights the gap between this proposed doctrine on the one hand, and actual capabilities on the other. As Godwin points out, the lack of any space-based reconnaissance or early warning systems means that Beijing's command and control system does not have the ability in real time to determine the size and origin of the attack, making it difficult to determine what kind of response is required--an essential component of the more sophisticated versions of limited deterrence found in Chinese military journals.[151] Johnston also notes that actually achieving such a deterrent posture is not an inevitable outcome, owing to a number of possible constraints.

We have little basis for questioning the findings of Johnston about internal military writings on nuclear deterrence, especially the striking lack of discussion of the term "minimal deterrence." There are a number of possible explanations. Paul Godwin suggests that Mao Zedong's death in 1976 and the implementation of Deng Xiaoping's military reforms in the late 1970s permitted China's military analysts to explore issues of doctrine and strategy "free from the stultifying requirement to verify everything they wrote with a literal interpretation of Mao's writings and statements."[152] Second, Godwin points to the increased battlefield nuclear weapons threat on the Sino-Soviet border, which "raised the salience of strategic deterrence and nuclear warfighting to a level it had never before achieved," encouraging Chinese military analysts to read extensively in Western theories and journals.[153] Johnston himself offers some additional explanations in the last few pages of his *International Security* article.[154] Many of the PLA authors explicitly contrast limited and minimal deterrence, obviating the possibility that they have simply renamed the previous doctrine for bureaucratic purposes. The authors appear to be well placed to affect the operational doctrine of the Second Artillery, removing the possibility of a disjuncture between academic and military writings, as occurred between the writings of RAND strategists and the war-winning strategy of General LeMay at the Strategic Air Command. If limited deterrence is defined as flexible response, counterforce warfighting, then perhaps limited deterrence is the *aspirational* doctrine for a future Second Artillery, although the past production timelines of the missile industry should sober our expectations of its appearance anytime soon.

We would add three more caveats to interpret the emergence and meaning of an ostensible limited deterrence posture in China. First, assuming a continued adherence by China to its testing moratorium, and the possibility that it will ratify the CTBT in the future, we question the ability of China to confidently develop smaller, lighter, and more accurate nuclear warheads (including potential MRV and MIRV capability) consistent with the limited deterrent aspirations described by Chinese analysts in the late 1980s and early 1990s.

Second, the tripartite system we describe possibly is a confirmation of Johnston's conclusions about limited deterrence, and we have simply come to the same place from a different direction. Perhaps the Chinese, when they looked at the multifunctional force structure they created, felt that minimal deterrence no longer could encompass all of the various defensive and offensive, long-range and short-range systems in their arsenal. Borrowing from Confucius, they may have concluded that harmony could only be restored when the name of the thing matched the nature of thing, and the product of this *zhengming* was "limited deterrence."

Third, even if we accept limited deterrence as an overarching *aspirational* goal of this multifaceted system, however, we still reject the misinterpretation of Johnston's writings by some, such as the Cox Committee and others, to mean that the Chinese are unquestionably engaged in an aggressive modernization of their missile forces meant to enable counterforce warfighting. Indeed, as we have outlined in this paper, there are legitimate, alternative explanations for many of the hardware trends in China. Reforms in mobility, readiness, and C4I infrastructure are readily and more comprehensively explained as an attempt to increase survivability from foreign attack--simply the long-sought confidence of a credible deterrent, notwithstanding Chinese analytic differentiation between "limited" and "minimal" deterrence--and not necessarily to achieve a warfighting, war-winning strategy. Moreover, as long as the numbers of the force stay beneath a certain level, increases in accuracy and multiple warheads do not pose a threat to American and Russian overwhelming nuclear superiority. American strategic nuclear forces, we must remember, still number around 8,000 deployed on 575 ICBMs, 102 strategic bombers, and 17 SSBNs. Indeed, a single Trident SSBN, carries more missiles (24) than the entire Chinese ICBM inventory.

The troubling countertrend involves the introduction of theater and national missile defenses into the equation, dramatically complicating China's strategic environment. Whereas China previously faced a world marked by the threat of offense racing, the post-BMD world will be marked by the unpredictable interactions of offense racing, defense racing, and countermeasure/decoy racing. In this environment, China would be acting rationally if it accelerated the desultory pace of its missile modernization, spending more money on relatively cheap countermeasures and decoys. To develop smaller warheads for penetrating missile defenses, Beijing would be acting in its self-interest by opting out of CTBT and resuming testing. Finally, China might even seek to foil missile defenses by proliferating its countermeasures technology to other emerging nuclear states. All of these trends would reduce the security of the United States. We hope that a sober understanding of the nature and purpose of Chinese nuclear force modernization and doctrinal evolution could forestall such an outcome.

Chinese Chemical and Biological Warfare (CBW) Capabilities

Eric Croddy

Summary

This paper divides the two disciplines of chemical and biological (CB) weaponry. First, it discusses the PRC view of chemical weapons from a historical perspective. Next, the immediate question of Chinese CB weapons is examined, presenting the likely capabilities of a former or existent offensive capability in either area, followed by a look at Chinese CW defensive preparations. The next section sketches the development of China's chemical industry, and how its uneven progress could have affected offensive CW capabilities. Looking at the state of chemical technology in the PRC can help to establish a framework to consider the production of CW agents.

The BW side of the ledger follows, noting its historical context, facilities in the PRC that are related to the science of biological weaponry, and whether recent allegations of specific BW activity on the part of China have merit.

The main points of this study are as follows.

History

- Statements by PLA officers on CW and its historical development are often derivative of Western and Russian-language sources.
- The same sources charge that the US military used chemical weapons against Sino-Korean forces, including mustard, cyanide, and chloropicrin.
- The PRC also alleges the extensive use of BZ (an incapacitating agent) by the United States in the Vietnam war.

Chemical Warfare: China's Offensive Capability

- In Chinese literature, three CW agents receive the most attention, and probably for good reason: blister, blood, and nerve agents.
- China possessed a significant quantity of chemical weapons at least until the late 1980s, although the amount of CW agent or number of munitions did not approach anywhere near that of the former Soviet Union or the United States.
- The only chemical delivery systems in China that could threaten Taiwan directly include ballistic missiles and possibly aerial munitions.

Chinese Views on Chemical Weapons and Arms Control

- Two PLA officers who are also CBW experts are skeptical that arms inspections can stop the proliferation of chemical weapons technology *in toto*.
- The PRC is under the impression that coalition forces moved some 2,700 tons of weaponized CW agent near the Persian Gulf during the Gulf war (1991).

- With regard to the Chemical Weapons Convention (CWC), the PRC probably believes that for a country to clandestinely produce large amounts of chemical weapons and not be discovered is impossible.

The PLA's Chemical Defense Corps (Fanghuabing)

- The PLA's Chemical Defense Corps (CDC) to our knowledge first undertook offensive operations during the campaign in the Yijiangshan islands in January 1955, probably involving obscurant smoke and perhaps flame throwers.
- China was able to indigenously mass produce CW defense equipment only by the mid-1970s.
- A nuclear, biological, and chemical (NBC) defense reconnaissance vehicle recently was modified by the PLA using a chassis from the Beijing-Jeep line of SUVs.
- After 1979, a new series of CW defense materiel was designed, and, by 1987, a total of 50 different standardized models were used by the PLA.

Medical Defense Research and Organization

- During the 1960s and 1970s, China provided instruction in chemical defense medicine to students from Vietnam, North Korea, and Albania.
- The official history of military medicine in the PRC indicates China finally deduced the chemical formula and composition of VX only by the 1970s.
- The two carbamates mentioned in Chinese literature for nerve agent prophylaxis, *Cuixingning* and *Cuixingan*, offer the PLA effective nerve agent prophylaxis, possibly superior to that used in the West.
- One of the more important areas for medical defenses are efforts to protect PLA personnel from the toxic propellants and off-gases of rockets and other self-propelled weapons systems.

Development of China's Chemical Industry: 1978 to Present

- China's large oil reserves and petrochemical industry probably were adequate to manufacture blister (Lewisite, sulfur, and nitrogen mustards) in large quantities, perhaps by the mid-1950s.
- Since the founding of the PRC, production of elemental phosphorus for fine chemicals probably was a very difficult procedure for Chinese chemists to accomplish.
- If China has in fact given up an offensive CW capability, the PRC does so now when it is most able to produce a wide range of toxic nerve agents, and in large quantities.
- A pessimistic view is that, in the event of a major crisis, the PRC would have little trouble reconstituting a large chemical weapons arsenal within a relatively short period of time.

Chinese Perspectives on BW

- Allegations that the United States routinely used BW agents during the Korean war--including smallpox, plague, typhus, and anthrax--seem to be accepted as fact within the PLA.
- The PRC repeatedly makes assurances that China has no biological weapons, and categorically states that "China has never manufactured nor possessed biological weapons."[155]
- Some specialized equipment has also been fielded in some unspecified numbers to counter the threat of BW to PLA troops, including mobile laboratory units and bioaerosol sampling.
- By 1984, M.S. degrees were being awarded in the related specialization of BW defense by the

Military Medical Science University.

- Nonetheless, Chinese writings on BW reflect a rather outdated mode of thinking, with emphasis on destroying insects and vermin for defense against biological weapons.

Chemical weapons: The Chinese Historical View

In language remarkably similar to that of an East German source on the subject,[156] modern Chinese CW experts refer to the use of noxious chemicals by prehistoric man, who may have employed them either to scare off fierce beasts, or perhaps to smoke out prey ensconced in caves. Drawing upon the fecund, literary sources of their own history, the Chinese are also wont to proffer specific examples:

During China's ancient period, it is said that the rebel Chi You created a fog to confuse his southern enemies. This smoke caused such havoc that were it not for Emperor Huang Di's "directional chariot"--a legendary vehicle that could navigate in darkness--the Northern barbarians might very well have won that day. In 559 BC, the Qin kingdom is purported to have poisoned the Jing river, a source that supplied water for the Jin, Lu, and other warring states, with the result that many men and horses were poisoned, forcing their retreat.[157]

In 1000 AD, a grenade invented in China is mentioned, consisting of arsenic and crotonaldehyde (*badou*), [158] capable of poisoning the enemy by means of its issuing vapors.[159] Even the deified Gen. Guang Gong[160] who, while attacking the city of Fan, was hit by a poisoned arrow in the right shoulder, the toxin going straight to his marrow. Fortuitously, he was cured by a well-known physician who happened to be in the area.[161]

The Modern Period

Chinese writings on the subject of CW--admittedly a sparse selection--closely mirror ***w***estern sources, but little time is actually spent on presenting other historical precedents in use of chemicals in battle, at least not until World War I.[162] From the latter conflict, according to a PRC book on military history, major lessons can be drawn, particularly from the first major chemical attack at Ypres. One contributing author explains that the inattention of the British concerning intelligence that pointed to Germany's plans to attack with chlorine was a crucial misstep. After all, he points out, Germany had already tried a similar assault on Czarist troops earlier, and this should have been known to the British War Ministry.[163]

Although mentioning that White Russian armies used British CW ordnance against Lenin's troops during the civil war in 1919,[164] Chinese sources do not discuss CW activity that existed during 'feudal' Republican China by the various warlords. Why not is difficult to ascertain.

During the 1920s, Zhao Hengti, Cao Kun, Feng Yuxiang, and Zhang Zuolin all expressed interest in purchasing or enlisting foreign firms to help manufacture chemical weapons. The latter warlord apparently contracted a facility to be built in Shenyang by Witte (Germany), contracting Russian and German chemical engineers to oversee the manufacture of mustard, phosgene, and chlorine, while Zhao took delivery of a relatively small shipment of "gas-producing shells" in August 1921. The warlord Wu Peifu considered such forms of warfare "inhumane,"[165] but by all accounts no widespread use of CW occurred during this period.

This (deliberate?) omission in China's semi-official history of CW might shed light on later, post-1949 activities in chemical agent manufacture. Reliable sources indicate that, among the former Japanese chemical weapons being unearthed in modern China are found some munitions that are not Japanese, but could have been a legacy of local CW activity two decades before the war.[166] Also, they could have been more modern munitions produced in the PRC, and dumped out of expediency.

Lessons From World War II

As one might expect, the Chinese are bitterly indignant over Japan's use of CW in World War II. One source notes that, despite Roosevelt's warning to Japan in 1942 over their use of such weapons against the Chinese, the United States never did take measures to retaliate in kind.[167] Although Japan certainly did employ a significant amount of CW agents during their invasion of China--including Lewisite, mustard, cyanide, phosgene, and probably a range of irritating gases--the same Chinese source probably exaggerates the overall importance of such warfare in Japan's success against KMT armies during this period. Quoting an "authoritative Soviet source," the self-same book claims:

During its war in China, the Japanese army had prepared 25% of their artillery shells to be chemical munitions, while 30% of its aerial ordnance were chemical bombs.[168]

The authors, waxing in a nationalistic tone usually reserved for such historical judgments, also write, "The Chinese people finally gained victory on the battlefield, proving that the Chinese race are exceptional (*youxiu*), courageous, and cannot be broken down or subjugated." "Fascist" Japan used CW over 2,000 times, causing the death of 90,000, the authors continue, but "it is not a couple of new weapons here or there, but rather a just people (*zhengyi de renmin*) that will win a war, despite the great menace posed by chemical weapons."[169]

The PLA's more objective view of the European theater in the Second World War may be somewhat revealing, although it is clearly derivative of at least two Western sources, the SIPRI volume and Brown's *Chemical Warfare: A Study in Restraints*.[170]

Observing that CW did not figure into Heinz Guderian's doctrine of Blitzkrieg, Chinese authors recount that Hitler was persuaded not to use chemical weapons against the Allies in World War II, despite having a "monopoly on tabun (GA, nerve agent)." Hitler's advisors, using the open scientific literature as a means of intelligence gathering, were certain that the Allies, particularly Russia which had developed organophosphate chemistry for many years already, must have superior CW capabilities and no doubt maintained nerve agent stocks. (In fact, the G-series nerve agents were unknown to the Allies until at least 1945.) Figuring this into the potential costs of an Allied retaliatory attack, Germany's impressive array of offensive chemical weapons--including the exceptional power of tabun--became little more useful than "room decoration."[171]

The Korean War

In an otherwise objective source on chemical weapons, the Chinese charge that the US military used chemical weapons against Sino-Korean forces on more than 200 occasions, and lists the following CW agents by name: mustard, cyanide, chloropicrin, and chloroacetophenone (CN).

The authors, Wang Qiang, a captain and now research professor specializing in chemical defense, and Yang Qingzhen, a senior colonel and assistant professor at the National Defense College, write extensively concerning the United States and the Korean war, claiming that chemical weapons were used often by the US Army. Because one of the purported incidents is recounted in a nationalist film (available on VCD, incidentally), and is one of the more popular films at least among the patriotic mainland Chinese,[172] it may be worth quoting at length:

In line with the summer and autumn offensives, the US Army made incessant use of poison gas against the Sino-Korean armies. From June to December 1951, poison was used seven times against our PVA 19 Corps alone. On the fourth of October, while defending a 331.8 meter elevation line and under unremitting attack from the US Army the 141 division of the PVA 47 Army was attacked over 20 times with yellow, purple, and brown-colored poison agents fired from rocket artillery shells. Following the explosions there issued forth heavy sulfur-smelling pall of smoke; those being poisoned had difficulty in breathing, tearing from the eyes, and went into an irreversible coma. According to this it can probably be determined that it was a mixture of two chemical agents, chloroacetophenone (ben lu yi tong, *benzyl chloro ethyl ketone, CN) and chloropicrin* (lu hua ku). *On the 13th of October, during an attack by the 8th Army of South Korea there were also fired "chemical agent artillery shells" against the 199th division of 67 corps of the PVA.*

The US Army's use of chemical weapons was an often used technique that was particularly effective against our army's tunnel defense system. Chemical munitions were usually combined with the use of explosives, brought in by artillery and military aircraft. First by destroying with explosives those fortifications and chemical warfare defenses, chemical munitions would then be fired, raising the effectiveness in causing casualties. Sometimes chemical bombs and smoke munitions would be used in tandem, disorienting our troops and widening further the killing zone.

At the point of a particular offensive in the war, after capturing one area and coordinated with a surrounding siege, the American Army hurled chemical hand grenades in a tunnel with our defending PVA army inside. At about the middle of June in 1952, the United States puppet army was in Kaesong [jin cheng] attacking the 100th regiment of the 12th PVA to the east, defending [Guan dai li xi shan] and the 39th PVA group at a 190.8 meter elevation southeast of [cheng shan]. As our defenders were retreating to the tunnels, the US Army hurled several times hand grenades that utilized sneezing powder [pentixing duji]. In October, the US Army during its so-dubbed "Operation Showdown" attack on Kumhwa against the 45th division of the 15th PVA [ganling] at 597.9 elevation, tunnel no. 2, and 537.7 elevation at the Paeksan summit tunnel, there also were thrown chemical weapon hand grenades many times. The motion picture "On [ganling] Ridge" in one vivid scene accurately recreates the use of chemical weapons by the enemy against the PVA, reminding us that the victory in Korea was not going to be easy.

(Curiously, a mainland book series on the history of major battles since the PRC's founding makes little mention of this, at least not in the section devoted to the Korean conflict.[173])

The PRC generally has taught its citizens, among other things, that the United States and its "puppet" ally in the South instigated the Korean war by invading the north. (This idea is given serious thought among some Western revisionist historians as well.) Allegations of CW use by the United States also could be accepted matter-of-factly in mainland China, despite no foundation for such charges.

The Vietnam War

The PRC also alleges the extensive use of BZ (an incapacitating agent) by the United States in the Vietnam war, to have been delivered using M44 and M43 CW agent munitions.[174] In one of these supposed attacks, a whole platoon of NVA apparently became anesthetized and were subsequently wiped out by bayonets. One NVA soldier, however, was undiscovered and after waking up after three days reported back to his barracks.[175] Of interest here is the fact that the PRC clearly takes credit for having, along with other unnamed countries, given the North Vietnamese training in CW defense, as well as supplying protective gear and equipment during the conflict against US forces.[176]

CW Offense

China possessed a significant quantity of CW agents, and this would include chemical weapon delivery systems, at least until the late 1980s. The amount of CW agent or number of munitions, however, probably did not approach anywhere near that of the former Soviet Union (40,000 tons, according to the general consensus).

Former Soviet chemical munitions could have constituted an early Chinese inventory, perhaps before 1960.[177] If so, these were probably first- and second-generation CW agents only, such as phosgene, mustard, and Lewisite. Although certainly potent by themselves, this chemical ordnance probably was not augmented by the modern nerve agents, at least not for some time. The weaponization en masse of the G-series nerve compounds did not proceed quickly in the Soviet Union, despite the Soviets having discovered German tabun and sarin manufacturing facilities in 1945. Krause and Mallory write that in the former Soviet Union,

It is safe to assume that during the 1950s there was small-scale production of nerve agents such as soman and sarin and that testing and development activities took place in order to familiarize Soviet military officers with the effects of these new agents. . . . Once again, the Soviet military's greatest problem was its technological backwardness in the field of military chemistry. There is evidence pointing to some "development aid" rendered to the Soviet Armed Forces by East German military chemists. However, it seems that these activities did not start before 1965 or 1966.[178]

With Chinese-Soviet relations ever worsening in the 1960s, the same could probably be said of chemical weapons work in the PRC.

Current Status of Chemical Weapons in the PRC

The PRC in submitting its data declaration to the CWC reported that it destroyed three production facilities, capable of producing militarily significant amounts of CW agent (from low hundreds to thousands of tons). This claim is consistent with PRC statements that deny any previous production of biological weapons, but make no categorical claim regarding past work in CW agents or weapons. The aforementioned declarations, according to some who were in close proximity to the offices that handled such documents, recorded Chinese CW agent-related activities in voluminous detail. Possible Chinese chemical munitions could have followed in the Soviet model:

Soviet Chemical Artillery	Caliber	Radius of effect (m^2) Filling	Fill Weight (*kg*)
76 mm	30	Mustard	0.10
107 mm	80	Mustard	0.25
122 mm	100	Mustard	0.50
152 mm	200	Mustard, HCN, phosgene	1.00[a]
[a]*Ibid*., p.47			

Literature on Chinese CW in its offensive context is practically nonexistent. One of the only credible hints surfaced in 1989, when a marketing manager of Duphar medical devices was told by mainland Chinese that, in addition to having nerve agent antidotes, the PRC possessed much more than they were letting on: "But we don't know what, and we can't verify the claim at all," the manager was reported as saying.[179] Another source indicates that a Chinese-manufactured mustard shell of unknown caliber was recently found among Albanian munitions, and although containing live agent it appeared to be intended primarily for training purposes.[180] Finally, a report in March 1997 alleged that Ukraine sold China 500 tons of sarin left from former Soviet stocks, in addition to chemical protection equipment.[181] (The original report apparently began with a comment from a Taiwanese "intelligence officer."[182]) This story was vigorously denied by the Ukranian Ministry of Defense.

The training and research in handling the effects of chemical weapons is routine in the PRC, but to date no defector or other report in the open literature has elucidated any detail on actual Chinese chemical munitions or offensive doctrine in CW. Later in this report, the role of Chinese medical sciences in CW defense will be treated in some detail, but for now it is sufficient to point out that the PRC is cognizant of all known CW agents, except perhaps novel agents such as the Russian *novichok*,[183] has developed a nominal defensive infrastructure to deal with these threats, and is quite knowledgeable from both indigenous research and second-hand (foreign) information.

Chinese literature regarding chemical and biological warfare, often draws directly from Western sources, and one can even pinpoint certain passages that were translated practically word for word, such as the SIPRI volumes on CBW by Robinson, Leitenberg, et al. Therefore, when an officer of the PLA suggests that multiple launched rocket systems (MLRS) offer the most efficient means of delivering CW agent, he is not necessarily speaking from experience or drawing from any doctrinal axiom. He is just as likely quoting directly from the aforementioned SIPRI volume on chemical weapons.[184] However, he does point out that "at present, the United States and Russia both have this type of weapon system to fire CW agent rockets."[185] From the Chinese point of view, and considering their intimate knowledge of Soviet MLRS capabilities, the CW threat from the ersatz Soviet Union must have been an especially unsettling one.

And once the Soviet Union shrank back to pre-Revolution borders, and even now is cooperating militarily with the PRC, the Chinese apparently have little incentive to maintain an offensive CW capability. The remaining land-based opponent, India, could pose a threat to China, but would this justify holding on to a form of warfare that does not coincide with the new revolution in Chinese military affairs? We cannot say for certain, but it does not seem likely.

As for Taiwan, the only delivery systems remaining would be ballistic missiles and possibly aerial munitions--a Chinese concept for a binary nerve bomb that could be dropped over Taiwan will be addressed shortly. With China already armed with nuclear warheads, however, offensive chemical weaponry utilized against Taiwan seems redundant, possibly anathema, particularly when considering their shared past and kinship ties. At least two PLA officers regarded the use of chemical weapons to be equivalent to employing nuclear war:

Chemical weapons could be the fuse to ignite a nuclear war, for as soon as mass casualty weapons such as CW are used, there is no reason why nuclear weapons won't be as well. Once CW begins, it will be *just like releasing the evil spirits from Pandora's box, eventually slipping towards the abyss of nuclear war*.[186]

When it comes to the actual chemical weapons themselves, we can identify some of the impressions of the PLA, however. In some respects these are surprising to an American observer:

- Three main agents receive the most attention, and probably for good reason: blister, blood, and nerve agents.

  Blister agents, or vesicants, include mustard and Lewisite and are standard for CW arsenals. Sulfur mustard in particular requires a low level of technology investment compared to nerve agents, is well suited for a country well endowed with petroleum, and has a proven track record of effectiveness in battle. Nerve agents, as explained in the chemical industry section below, would have presented a challenge to early PRC technological capabilities, but this situation has changed dramatically in the past two decades.

- Chinese CW experts on CW defense center upon the Soviet-style method of contaminating the ground with chemical agents of various kinds.

  A 1985 CBW defense encyclopedia reported that "the Russian military has been equipped with thickened mustard gas for many years now, and recently it has also come to possess thickened soman."[187] As a means to counter such threats, viscous preparations of nerve agents--the Chinese cite methacrylate polymers and tributyl phosphate[188] as possible thickeners for CW agents such as soman as well as mustard--would have given China the full range of persistent application of chemicals needed to slow down a Soviet armored advance. Although it may very well be that China was not able to mass produce VX until the 1970s (see medical research below), the utilizing tributyl phosphate--a compound that is easily produced[189]--as a thickener would have afforded sufficient viscous character to other Chinese nerve agent preparations.

  The PRC, however, was certain to be aware of Soviet preparations for operating in contaminated environments, and could not hope to wreak the kind of havoc on the Red Army with CW agents alone. However, in line with the Maoist "lure the tiger into the cave" stratagem, ground contamination with viscous agents would force the enemy to suit up, constantly reconnoiter with detection equipment, and then intermittently halt to decontaminate equipment and possibly the troops themselves. This situation could have given PLA forces breathing room and time to regroup. One Chinese source chose VX and mustard as illustrative examples for slowing an enemy's advance, canalizing opposing forces, and for area denial, especially against mechanized forces.[190] (Such tactics go back to the early Soviet *1936 Provisional Field Service Regulations*.[191])

  In the latter vein, the PLA, and by extension its CW defensive training regimens, emphasize the decipherment of changes in the color of surrounding fauna to determine what CW agent may have been used by the enemy and has taken the trouble to photograph such training. (For example, VX on certain plants such as floating lilies or eggplant flowers will turn the original pink or purple colors to blue-green hues, sarin turns purple/red petals to pink, Lewisite purple/red flowers to a fuller red color, etc.[192])

  The more surprising part of PRC writings on the subject is the matter of cyanide, specifically hydrocyanic acid. This emphasis surely stems from the influence of former Soviet attitudes toward its practicality as a deliverable weapon. This weapon was long eschewed in the West. But World War II tests conducted by the Red Army showed that--provided the user is willing to fly slow and low enough in the face of enemy flak--HCN can be laid down in a dense enough concentration by aerial release.[193] HCN production, also, would not have necessitated advanced technology nor great cost, again, relative to nerve agent production, and would have found significant dual use in the civilian sectors (in its potassium or sodium salt form for gold mining, electroplating, etc.). Although HCN is an excellent "knock down" gas, it is nearly entirely dose dependent in terms of toxicity, and either kills very quickly or has little effect. It is best used against unprotected, front line troop concentrations, for it has little staying power once applied.

- Binary chemical weapons are given special attention, indicating their compatibility with low-cost production of weapons of mass destruction (WMD).

We do not know where the PRC got the idea, but apparently China understands that the Soviet Union was producing binary chemical weapons as early as 1978. This conclusion could have been reached from the open literature on the subject, figuring that the technology was hardly a secret by that time.[194] Drawing from other Western sources, the Chinese also make some hay concerning the theoretical binary construction of a KB-16 (nitrogen mustard analogue) munition, utilizing a relatively nontoxic, tertiary amine compound and a separate container of nitric acid.[195]

In 1990 Rosita Dellios pointed out that, as far as China was concerned, binary munitions possess five distinctive features that are compatible to a "people's war under modern conditions," namely, safety in storage, delivery, suited to nuclear-capable systems, extended shelf life, and "suited to the people's war requirements of surprise and deception."[196] The PLA also points out the much safer production, easier logistics, handling, and storage of binary components. At least the latter points are valid. The drawbacks, as far as the PRC is concerned, is that the components do not yield full product (the US 155 mm had a 70-percent yield) and the reaction between difluor and the alcohol components usually take about 8-10 seconds to complete.[197] This delay puts a damper on fielding direct fire weapons such as the MLRS, although certainly most large caliber howitzers and gliding bombs (see below) largely would be unaffected by this constraint. Furthermore, unspecified side-reactant by products of binary mixing make detection by the enemy much easier.[198] Although not a true binary, Iraq made use of a similar, "quick mix" method using difluor, and combined cyclohexonal (to form GF) and isopropyl (sarin) in bombs just before being delivered.

Unlike the West, which sees binary chemical weapons, particularly the VX "Bigeye" munition, as a rather expensive boondoggle, the PRC takes a different view of this delivery system. One Chinese source reports that the costs associated with the US 155 mm, binary sarin chemical projectile to be 25 times less expensive than the unitary munition.

The diagram shows a conceptual diagram of a binary bomb, possibly with the Haiqing cruise missile body in mind. However, like much of PRC writings on the subject this, too, is probably derivative of a Western illustration showing a VX binary system.[199]

The main difference between the latter and the Chinese rendering is that the PRC depicts two liquid systems rather than QL and solid, elemental sulfur (plus catalyst, etc.). Also, the PRC diagram indicates a device at the aft that would issue forth the aerosol, probably sarin.

> An Haiqing missile as the delivery system would afford more than 500 kg--possibly much more if the bomb glides and no longer requires propellant--of difluor/alcohol fill. With 70-percent yield, we would expect that (approximately) 175 kg of actual nerve agent would be delivered over a target. Because sarin is so volatile (as is soman, a theoretical alternative), however, the bomb must fly low and slow to make an effective line source pattern.

China and the Chemical Weapons Convention

Since ratifying the Chemical Weapons Convention (the treaty coming into force in 1997), and having submitted its declarations to the executive body responsible for verification, the PRC ostensibly has no chemical weapons. Also an official from the Chinese Ministry of Foreign Affairs repeated this claim to me.[200]

China is displeased because it perceives lack of benefit from joining the CWC. An Iranian official stated that "China sees a lot of liability with little benefit in being a State Party." Although this was said in the context of inspections, the PRC clearly is disappointed that it is not obtaining the technology, assistance, and bonuses it anticipated gaining from joining the Convention. Perhaps China expected more after having destroyed its remaining chemical arsenal, although Beijing's stockpile probably was quite small.

Chinese Views on Chemical Weapons and Arms Control

> *Chemical weapons could be the fuse to ignite a nuclear war, for as soon as mass casualty weapons such as CW are used, there is no reason why nuclear weapons won't be as well. Once CW begins, it will be just like releasing the evil spirits from Pandora's box, eventually slipping towards the abyss of nuclear war.*
>
> --*Capt. Wang Qiang and Col. Yang Qingzhen*[201]

The handbook on chemical weaponry written by two PLA officers is skeptical that arms inspections can stop the proliferation of chemical weapons technology. These authors state that a fundamental concern is that the basic components involved in manufacturing binary chemical munitions are not far removed from technology used in industry. No matter how many intrusive inspections are carried out, they cannot stop the basic research conducted by civilians, thus making the spread of such CW technology easy.[202] As chemical weapons proliferate, the possibility of their being used increases when a nation, equipped with a CW apparatus, is pitted against another country that has none.

China's View of the Gulf War (1990-91)

The PRC seems to be under the impression that, in addition to 1,000 tactical nuclear warheads deployed by the United States,[203] coalition forces also moved some 2,700 tons of weaponized CW agent near the Persian Gulf, posing a "name-brand recognition" type of threat to Saddam Hussein. The latter claim, of course, cannot be supported by the available evidence, [204] but the PRC believes this deployment of chemical weapons played an important role in the course of the war, demonstrating that CW is "by no means inferior" to high-tech weaponry.[205]

Referring to the export control efforts of CW precursors and equipment by Australia Group, the authors above suggest that:

Although many countries have adopted these measures, it is doubtful that they will be effective. Because *companies want to earn high profit margins, they are not going to concern themselves with governmental prohibitions, and will secretly export these kinds of materials. The reality is that nations are helped by foreign business, supplying them with the materials, equipment, and technology to acquire a chemical weapons capability.*

A solution, they suggest, is to establish chemical-weapons-free zones.[206]

Reiterating the futility of stopping the proliferation of CW-related technical know-how, the authors nonetheless concede that, if international agreements like the CWC use intrusive inspections (*yange de hecha cuoshi*), a country will have great difficulty--perhaps near impossibility--clandestinely producing large amounts of chemical weapons without being discovered.[207]

The PLA's Chemical Defense Corps (Fanghuabing)

History and Defensive Materiel

The 8th Route Army in 1939 established a Chemical Group (*huaxuedui*) at the Chinese People's anti-Japanese Military College. The group received rudimentary instruction, probably from Soviet instructors, on measures to defend against Japanese chemical warfare.[208]

According to Maj. Gen. Jiang Zhizeng--chief of the Chemical Defense Department of the PLA in 1989 and a significant contributor[209] to an encyclopedic treatment of NBC defense--during the period following the war for "liberation" separate chemical groups were established in the 7th, 9th and 13th columns of the PLA's East China field army. "According to the recollections of comrade Liu Baicheng," writes General Jiang, "the 2nd Field Army established a large Chemical Group." On 11 December 1950, following the personal approval of Chairman Mao and Premier Zhou Enlai,[210] the first Chemical Defense Corps school was founded, leading to the formation of the Chemical Defense Corps (CDC). Its earliest instructors at this point were former Nationalist officers who had prior training in CW defense, and who had apparently "revolted from the KMT."[211] In 1951 an Oxford-educated chemist, Dr. Huang Xinmin, left England to direct the chemistry department in the PRC, along with several Soviet advisers, in "protection" against CW agents.[212]

With regard to the allegations that chemical weapons were used during the Korean war (see also below), the aforementioned preparation in CW defense prior to China's involvement could have made the PLA overly amenable to suggestion. When aggressive use of artillery, napalm, and aerial bombing hit the Chinese People's Volunteer Army during the war, the resultant off gases and suffocating smokes no doubt had the semblance of real chemical weaponry. These factors, together with posturing and outright fabrication for propaganda purposes (which are similar to charges that the United States used BW), are the best explanation of why the PLA continues to assert that the United States used CW (for more on the Korean war, see "History" below).

The wholesale import of Soviet-made CW defensive gear, including detectors, clothing, decontamination equipment, smoke generators, and flame throwers began in 1953.[213] The latter two types of equipment would be deployed as early as 1955, according to General Jiang.

In December 1954, Zhang Aiping was ordered by Mao Zedong to prepare an assault on Yijiangshan island.[214] Full-scale military operations were conducted during 18-20 January 1955, to seize control of the Yijiangshan island off of the coast of Zhejiang Province. General Zhang noted that "this was the first organized operation in which sea, air, and land forces worked in concert," and quickly finished off remnants of KMT soldiers (Jiang's Bandits) in this rather lopsided affair.[215] These are the first known operations for the nascent PLA's Chemical Defense Corps.

A grainy photograph published in *PLA Pictorial* shows troops boarding landing craft, wearing protective suits of some kind, and many carrying portable tanks on their backs, consistent with portable smoke generators or flame throwers.[216] Upon the quick victory by the PLA, a congratulatory telegram to the front lines was sent by the commander in chief of the East China army (presumably from Zhang Aiping).[217]

Bingqi Zhishi has it that on 19 April 1955, the Central Military Commission named Zhang Xigeng as the first minister of the Ministry of Chemical Defense. General Jiang, however, uses the date January 1956 for its founding.[218] In any event, General Jiang states the mission of the CDC in this way:

[The Chemical Defense Corps] is to guarantee the protection of our army while under battle conditions that include nuclear, chemical and biological weapons. It is composed of troops in the CD (surveying, reconnaissance, decontamination), those responsible for flame throwers, smoke generation, etc. Among the major responsibilities are: Directing the use of collective protection against chemical weapons, carrying out of survey and reconnaissance for nuclear radiation and chemical analysis, testing for agents and infection, the neutralization of poisons and infection, providing an organized and assured obscurant smoke, as well as directing the coordinated use of flame throwers with advancing troops in combat.[219]

A Chinese NBC defense manual dating from 1957 grouped CW agents in four categories, the systemic poisons, asphyxiating gases, blister agents, and irritants. Probably in the interest of simplicity for its intended--chiefly juvenile--audience, nerve agents were not mentioned by name. They were listed along with cyanide under the heading of systemic or blood agents, referring to them as being "odorless and colorless liquids, very poisonous, not very easy to detect, demanding that special caution be taken." It also gave simple instructions on how to build shelters, don protective CW suits, and decontaminate one's skin.[220]

By 1959, of the 20-odd different types of CW defense materiel formerly imported from the Soviet Union, the PRC became 90 percent self-sufficient in their development and manufacture. For example, in the mid-1960s, the Model 64 respirator mask was an indigenous product.[221]

In 1971 the Chinese developed a detector (type 65) alarm for organophosphorus (OP) compounds (i.e., nerve agents). Although the type 65 OP detector is praised for its easy use and sensitivity to detect nerve agents at a considerable distance, like Western counterparts it is prone to interference[222] (and probably susceptible to false alarms). Nonetheless, the 65 and type 75 testing kit (analogous to the M256A1) are the current CW agent detection accouterments used by the PLA.[223]

But the ability to indigenously mass produce CW defense equipment, at least enough to outfit significant numbers of personnel, was achieved only by the mid-1970s, when the imported and copied Soviet-style equipment finally began fading out of service. In 1975, mechanized chemical and radiological surveying became more specialized, and CW defensive gear became standardized for the battlefield. A CW defense reconnaissance vehicle was modified using a chassis from the Beijing-Jeep line of SUVs, the same outfitter for the Gonganbu (Public Security Bureau), among others. This vehicle represented the first generation of laboratory testing on wheels. Although personnel must get in and out of the vehicle to perform field recon, the PLA could see many improvements in automation.[224]

Combining appropriate gas masks, individual chemical testing kits, and CW agent alarms, the Chinese Navy, Air force, and Second Artillery were already equipped at this time with CW defense equipment. After 1979, a new series of CW defense materiel was designed, and by 1987 a total of some 50 different standardized models were used by the PLA.[225]

Food and Water Testing
Various testing methods were supplied in kit form to examine provisions for CW agent contamination, beginning with the types 59 and 62 testing kits that were put together in the 1950s. Later, when the toxins VX and BZ came to light, improvements were made in the new type 67 kit supplied to the PLA. Later in the 1980s, a more comprehensive list of CW agents could be tested for in food and water by the type 85, and a kit especially designed for water quality testing was developed in the Shenyang type 81, which is well-suited for use by mobile armed forces.[226]

Gas Masks: Measure Twice, Cut Once
The Chinese military depended upon used and foreign-made gas masks going into the Korean war. The PLA notes that in the beginning it encountered an immediate problem, namely, the gas masks did not appear to fit the Chinese face very well. The PLA worked hard to find a solution:

It was necessary to make it suitable for the shape of the head that typifies our nation's race. In 1958, data was culled from the measuring of some 40,000 PLA soldiers heads, resulting in a lightweight and very protective model 64 mask.[227]

Later, types 65 and 69 masks were made for more flexible use on the battlefield, the latter model having activated charcoal in its filter. An additional model 87 was introduced, along with one specifically crafted for rocket propellants, the model 75.[228] No. 75 is considered a "special-purpose mask," having a filter/canister construction best suited for personnel who are stationed near rocket propellants and fumes. It is also designed for tank crews and use in aircraft by connecting directly with the oxygen system.[229]

Chemical Suits
The first-generation protective garments in the PLA were and still are the venerable, 1966-vintage butylene polymer rubber suit. Having strong resistance to acids, mustard, VX, etc., and weighing some 2.5 km,[230] this suit must be terribly uncomfortable, especially in the many hot days of the year in southern China. The CDC seems to be using this suit for most of its specialized training and operations. For battle front troops, mercifully, a gas-permeable suit layered with activated charcoal has been made available since its introduction in 1982.

Decontamination Equipment/Vehicles
Having noticed the former Soviet TMC-65 turbine engine platform--basically a jet engine that uses the force of water to decontaminate vehicles--the Chinese seem to have adapted their own. Whereas the Soviet system did not necessarily require special decontamination fluid[231] or hypochlorite solutions--heat and kinetics of the spray are probably violent enough for the purpose of sustaining combat operations--the PLA includes a tank of decon fluid in its diagram. This "Jet Exhaust Decontamination Vehicle" vents with a flow rate of 400 meters/second, with vapor immediately out of the nozzle reaching temperatures of over 500¼C, and reducing to 200¼C upon reaching the intended surface. Onboard computerized control can adjust the rate of fuel (diesel) burn, heating, etc.

One of the more interesting aspects of this arrangement, which includes a wireless automated control and a secondary driver's booth, is that the same engine can be used for laying down smoke screens. Apparently, the secondary operator changes the intake to allow supply of smoke-generating fuel into the turbine.[232]

We do not know if this endeavor represents a serious effort to deploy such vehicles in large numbers in the PLA forces, or even within the smaller organization of the CDC. Nonetheless, Chinese authors on this topic are apologetic concerning this particular need:

Although today the world is gradually moving towards a peaceful trend, the Chemical Weapons Convention (CWC) has been signed, and despite the reduction in risk from chemical attack, there is still an unending research and improvement in decontamination equipment.[233]

Decontamination fluids used in the CDC are made up of the usual types found in other armies, the PLA often utilizes a 3:2 ratio of calcium hypochlorite and calcium hydroxide, in addition to bleach, and chlorides of ammonia are especially recommended for dealing with V-agent contamination.[234]

Individual Decontamination and First Aid Kit
In 1958 the PRC copied the Soviet-type "IPP-51" decontamination kit, and later developed types 58, 63, 71, and model 1-0 for cleaning skin exposed to CW agents. Other models, No. 14 and 25 in particular, were specifically formulated to handle V-agent threats.[235]

The modern kit contains pharmaceutical preparations for countering the effects of nerve agents, and a moistened, chemically impregnated cloth for decontaminating skin. A cylinder holds tablets, presumably for a carbamate, and beneath it is a spring-loaded atropine injector. Although the main purpose of this kit is, again, for nerve agent first aid, it is also recommended for decontaminating other agents, such as mustard and Lewisite.[236]

Chemical Warfare Defense and the Chinese Antichemical Corps

Medical Defense Research and Organization
The following are highlights from the official history of Chinese military medicine.

China's development of a professional cadre to treat CW casualties took form in 1951, when the first Military Medical Sciences Learning Hospital was founded. Expertise in medical defense against CW was initially brought to China from the Soviet Union, and the first semester of high-level training in this area began with 45 students in 1954. Early emphasis on mustard agent (the king of CW agents) soon gave way to even more serious attention on the nerve toxins, and Chinese staff of the General Hygiene Department (*Zonghou Weshengbu*) visited the Soviet Union for advanced studies. In 1958, the disciplines of military toxicology, pharmacology, and biochemistry were combined into a Pharmacological and Toxicology Research Institute headed by Yang Tenghan, also referred to as the Chemical Defense Medical Science Research Institute, (and later changed in 1987 to the Toxicology and Pharmacology research Institute). Nationwide conferences that dealt with military chemical defense were held in 1961, 1974, and 1979.

In the beginning of the 1960s, owing to "strategic demands," a Chemical Defense Testing Unit (*Fanghua Jianyan Fendui*) was formed, shortened to "*Fangyandui*," and later called the Chemical Defense Medical Science Specialized Unit (*Fanghua Yixue Zhuanye Fendui*). Its duties were to assist in evaluating conditions on the borders or within the country, to quickly ascertain threats and provide medical, testing, and other support for chemical defense medicine. Depending upon their anticipated requirements, each military region formed its own version of this type of organization.[237]

With gradual improvements in technology, and the accumulated scientific knowledge, chemical defense medicine became even more important in the 1960s and 1970s. Qualitative improvements were made in the general treatment of mustard casualties, ways to counteract incapacitating agents, treatment for poisoning from cyanide compounds, as well as prophylactic defense and antidotes for nerve agents. In addition to packets made for skin decontamination, a testing kit was also designed for alerting one to the presence of contaminated food and water provisions. By 1963, the realization that the irreversibility of enzyme by nerve agents due to aging also led to renewed efforts at finding better acetylcholinesterase reactivators. During the 1960s and 1970s, instruction in chemical defense medicine was provided to students from Vietnam, North Korea, and Albania, with specialists sent to help these and other countries establish their own testing laboratories.[238]

Along with investigation of therapeutic herbs to counteract the toxic effects of CW agents, in the 1980s enzyme immobilization indicator technology was developed, along with more advanced spectrographic, immunoassay, and ionization-based (*fangshe*) detection systems. During this time the PLA also sent abroad specialists to study the problem of treating the toxic effects of nerve agents, communicating with the experts in the field in the United States, Great Britain, France, Japan, Switzerland, Australia, among others. From 1971 to 1989, the General Logistics and Sanitation Departments cultivated 81 specialists in the area of chemical defense medicine. In 1989, 19 Masters degrees were awarded in hygiene and chemical defense medicine.

Chinese Research in Defense Against Nerve Agents
For protection against nerve agent exposure, three main types of compounds are commonly used, both before and after the fact.

Carbamates are reversible inhibitors of acetylcholinesterase (AChE), and protect the enzyme from irreversible (aging) or long-term impairment by the G-series and VX. Because soman, for example, can age enzymes in a matter of minutes, carbamate prophylaxis is especially important. Pyridostigmine bromide (PB) is used in the United States and most other countries, but physostigmine, a naturally occurring carbamate found in the calabar bean, also is effective, although it probably is of higher toxicity. (In my view, current speculation that PB has a role in Gulf War Syndrome is completely unfounded.)

Oximes are administered after nerve agent intoxication to remove the nerve agent from the enzyme, hopefully revitalizing enough AChE to put the victim on the road to recovery. Pralidoxime HCL (Protopam Chloride, 2-PAM-Cl) is used in the autoinjector supplied to the United States and NATO, but may be replaced in the future with more effective oximes.

Anticholinergic compounds are those that block acetylcholine, restoring some normalcy following nerve agent poisoning. **Atropine** is the drug of choice for military chemical defense, although other similar compounds could be used, depending on the level of perceived risk.

Chinese development of antidotes for nerve agents may be broken down into three stages: 1) the initial treatment regimen typed No. 11, consisting of atropine and an oxime, etc., 2) efforts to find treatment for soman poisoning, and 3) general efforts to raise the capabilities of treatment, made more pressing by reports of the V-series of agent revealed from foreign reports in the 1970s.

With regard to the V-series of nerve agents, open literature referring to the basic structure of VX goes back to at least 1958.[239] Between the actual date of discovery (1952), and its open publication revealed in 1975,[240] Soviet military intelligence (GRU) probably had filched the basic formula in 1955.[241] But regardless of how it actually obtained the information on V-agents, the Soviet Union then proceeded to replace much of its G agents with its own structural isomer, VR-55 by 1960.[242] Are we to believe that, at least according to the official history of the Chinese military medical sciences, the PLA pharmacology and toxicology department only became aware of the details of VX by the 1970s?

The chemical formula and composition of VX was finally deduced in China after considerable laboratory investigation. Finally, China subsequently introduced the type 85 emergency antidote for treating nerve agent intoxication, "bringing the PRC to international standards." This effort, along with work in carbamates for protecting acetylcholinesterase from the effects of nerve agents, led to the exhaustive research of more than 15,000 compounds, 2,000 of which were novel formulations. Of these, more than 10 were shown to be effective, some of them typed as No. 11, No. 60, No. 68, No. 51, No. 73, No. 85, and others for emergency treatment of nerve agent poisoning, No. 85 simultaneously winning a second-level national prize as well as an award for advancing military technology.

In terms of enzyme protection with carbamates, traditional medicine yielded *Cuixingning* and *Cuixingan*. As work on natural sources of carbamates began in 1968, in the realm of enzyme reactivation, Song Hungqiang, et al., synthesized two new types of oxime compounds in cooperation with the Beijing Medical Pharmacological Industry Research Institute. These two compounds showed effectiveness against soman poisoning, surpassing international standards. For blocking acetylcholine, Zhang Qijie and others finally was able to synthesize new compounds, among them one that is found in traditional medicine.[243]

The two carbamates referenced above, *Cuixingning* and *Cuixingan*, are worth mentioning for they offer the PLA effective nerve agent prophylaxis, possibly superior to that of pyridostigmine bromide used in Israel, the United States, and many other Western countries. Lieske, et al., credit Ahmed and Robinson with having first prepared the following compound, referred to in the Chinese literature most commonly as Cuixingning, but also "*youselin*," and "*Jiebiling*" in the 1997 *Junshi Yixue Cidian*.[244]

The Chinese claim, however, that the latter compound was first synthesized in China during the early 1960s.[245] A study performed at the US Army Research Institute of Chemical Defense (USAMRICD) found that Cuixingning showed promise as an effective prophylactic for nerve agents, while also having an acceptable index of toxicity.

Another compound, *Cuixingan*, is also mentioned in Chinese writings on CW defense.

Jiebling
Cuixingan

Regarding this compound, the Chinese claim that:

The pharmaco-toxicological action of cui-xing-an is the same as that of physostigmine and cui-xing-ning, but its toxicity is only one-tenth that of cui-xing-ning. The nicotinic action of cui-xing-an and its effects on the cardiovascular system are milder that those of cui-xing-ning.[246]

Little information exists in Western literature, however, to support such claims.

In the field of anticholinergics, Chinese investigators undertook substantial research on herbs and other traditional forms of medicine. As early as 1959, the PRC copied from abroad an atropine autoinjector, developing later a partially automated, ampoule-style injector mechanism, built with an extruded plastic injector. A fully automated injector has been supplied since the early 1980s, and the PLA Veterinary College successfully developed an OP antidote syringe (*jielinzhen*) for animals. Additional work through the 1980s included the elucidation of the mechanism of nerve agents, including soman and VX, as well as work in the area of using hydrolyzing enzymes to protect against lethal doses of soman. Many clinical trials involving this knowledge were performed on the personnel, reflecting a "a spirit of selflessness" on the part of the researchers. Such tests in chemical defense medicine alone were performed in individuals on some 3,000 occasions.[247]

Blister Agents (Vesicants)

Recognizing the "Great Old Difficulty" in treating mustard agent casualties, Chinese chemical defense medicine is resigned--much like everyone else--to the fact that supportive care is at present the only realistic course of action. A complete report elucidating mustard's effects on the human body, including its comprehensive toxicity, was produced in the 1980s. The official history does, however, refer to a typed No. 14 ointment designed to absorb and decontaminate exposed skin to vesicants, and the Kunming Military District's 60th Hospital and Medical Research Institute treated five serious mustard casualties, four of them "successful" (presumably, the fifth did not survive.) These casualties may very well have been caused by Chinese mustard, as the history refers to "other regional hospital departments having treated victims of mustard from leftover Japanese munitions, gaining much experience in the process."

The PRC seems to have adopted its own mercaptan type of treatment for Lewisite exposure, a certain dithiosodium butyrate, different from British Anti Lewisite (BAL) and the Soviet variety. As a CW agent, however, Lewisite does not receive as much attention as does mustard. [248]

Incapacitating Agents

When it was learned that the United States had developed BZ weapons in the early 1960s, the PRC undertook efforts to characterize the compound and to develop treatments for BZ intoxication. BZ (3-quinuclidynil benzilate) was prepared in China by 1965, the official history noting that the compound was finally revealed in the open literature in 1972. In the 1970s, the Military Medical Science University, the Jinan Military Region's 88th Hospital, as well as the PLA General Medical Institute successfully used "Jiebiling" [the aforementioned carbamate, Cuixingning] to counter the effects of BZ poisoning. (Treatment in the United States for anticholinergic poisoning, such as Jimson's weed, calls for the judicious administration of a carbamate (physostigmine), if only for diagnostic purposes.)

Reports also surfaced that work overseas was being done on what were termed "body incapacitants" (*Qutixing shinengji*) in the mid-1960s, substances that would cause personnel to become numb and paralyzed (*mabi tanhuan*). These might be references to fentanyl and its derivatives. The Chemical Defense Medicine Research Institute then speedily researched effective antidotes in the event such agents were to be encountered.

Blood Agents (Systemic Poisons)

In 1961 the Seventh Military Medical University Medical College Protection Teaching Research

Institute, together with the Chemical Defense Medicine Research Institute of the Medical University College of Sciences, carried out investigations into treating cyanide casualties, both HCN and cyanogen chloride (CK). Novel treatments were researched between 1970 and 1980, including the use of 4-dimethyl amino-aniline [4-erjiajianjifen] and p-amino benzylacetone. In the 1980s an antidote kit was developed, typed the No. 85 anticyanide injector. The No. 85 is also used in industrial and shipboard settings where accidents involving cyanide might occur.[249]

Asphyxiants

Phosgene and diphosgene present similar problems to mustard in that very little exists in therapy other than supportive care. In the 1960s, the Fourth Military Medical University's Protection Teaching Institute laboratory emphasized research in the choking gases, discovering, among other things, that vitamin C lessened the severity of pulmonary edema. Some 70 clinical trials were carried out in investigative drug therapies, many showing promise. Treatment for phosgene and diphosgene gas, including rapid diagnosis, also was investigated thoroughly by the Fourth Military Medical University and the Lanzhou Military Region Medical University Research Institute.[250]

Protection Against Rocket Propellants and Off-Gases

One of the more important areas for medical defenses was undertaken simultaneously with China's push for strategic aerospace weapons, primarily to protect personnel from the toxic propellants and off-gases, and especially to provide expertise in protection from "harmful gases produced from underground nuclear explosions."[251]

In the latter part of the 1950s, the upper echelons directed scientists to fully elucidate the dangers of unsymmetrical dimethylhydrazine (UDMH), and in 1960 the Military Medical Science Institute established a Rocket Propellant Toxicological Research Laboratory, with a staff of about 20. The institute focused attention on protecting eyes and skin from possible exposures, decontaminating tissue safely, and treating casualties.[252] Determining that UDMH could be used safely in aerospace vehicles was considered a major achievement, winning the institute a 1965 National Discovery award. Additional toxicological research institutes conducted studies on decaborane, another propellant, and in 1966 Zhu Kun, et al., found that Vitamin B-6 was helpful in treating UDMH exposures.

As the strategic missile program grew even larger in the 1970s, solid fuel propellants also demanded toxicological study, including those compounds used in missiles and torpedoes. Both the National Defense Science Council and the SAC each established medical defense groups (*fangjiandui*) and laboratories (*fangjiansuo*) dedicated to addressing the problems of toxic propellants.[253]

Development of China's Chemical Industry: 1978 to Present

The PRC's Chemical Industry Base

For a nation to manufacture chemical weapons, a sound chemical industry base is obviously advantageous, particularly for the unfettered supply of important precursors and intermediates. It becomes even more important when the production of militarily significant quantities (in the hundreds of tons) of CW agent fill are required. During World War I, first-generation CW agents (chlorine and phosgene) were originally seconded from German dye industry stocks: The gas attacks at Ypres in April 1915, for example, required roughly 500 tons of chemical agent,[254] and represented half of Germany's supply of chlorine for that year.

At the same time, some countries can do much more with a lot less. Iraq, for example, is not among the most highly developed nations in terms of a comprehensive chemical industry. However, its large phosphate reserves and imported technology (e.g., a French phosphorus trichloride manufacturing plant) enabled it to produce, with the possible exception of Soman (GD),[255] every known CW nerve agent and in large quantities (including an obscure chemical, cyclosarin or GF). In terms of its own chemical industry base, a similar picture could be drawn for China, with one major difference, namely, the lack of foreign technology and the withdrawal of Soviet assistance, especially during the years 1959-78.

Although today the PRC could be ranked seventh in the world in terms of total GDP, its level of technological competitiveness is still rated much lower; by one account China ranks 28th.[256] No Chinese conglomerate appears in the top 50 chemical producers in 1998, for example. Taiwan's Formosa Plastics comes in at 46 (with Chevron following at 47).[257] More recently, the nurturing of China's chemical industry has brought some rather spectacular results.

To understand better the environment in which the PRC stands in terms of CW weaponry, assessing its past and present levels of chemical technology is useful, particularly since the Sino-Soviet schism in 1959. This section sizes up the development of China's chemical industry, with emphasis on its course since the founding of the PRC.

Background on Chinese Chemistry: History

In 1928, an Institute of Chemistry was originally founded in Shanghai as part of Academica Sinica, was subsequently transferred to Kunming during the war, and eventually returned to Shanghai following hostilities. The Peking Academy also contained under its auspices an Institute of Chemistry that was formed a year after its Shanghai counterpart. In the late 1930s the Chinese Chemical Society had a membership of about 2,000, and by 1950 there were 218 Chinese research institutes devoted to chemistry.[258]

Not surprisingly, the Soviet Union played a very important role in the formation of scientific societies in Communist China, and in early 1956 a 12-year plan was instituted that prioritized technological research in the following order by the CCP leadership:

- Peaceful utilization of nuclear energy.
- Radio and associated electronics.
- Jet/turbine propulsion technology.
- Remote control and automation.
- Exploitation and exploration of minerals/petroleum.
- Metallurgic applications.
- Fuels and fuel technology.
- Heavy machinery and power equipment.
- Control of the Yellow and Yangtze ***r***ivers.
- Chemical fertilizers and agricultural mechanization.
- Disease prevention and eradication.
- Basic theory in natural science.[259]

On 8 October 1956, the CCP announced the beginnings of the Chinese space program, establishing the first Rocket Research Institute under the Fifth Research Academy, led by Marshall Nie Rongzhen.[260]

With the concurrent programs in both atomic bomb assembly and missile development under way in the PRC, the demands for the production of chemicals must have been especially acute, and even more so when the Sino-Soviet agreements fell apart in 1959 and the ironically titled "Great Leap Forward" (GLF) began in earnest.

To address the needs of advancing technology and the building of a chemical industry in particular, in 1957 the Chinese Society for Chemical Engineering was established. Although this move certainly was a step in the right direction, the shortage of technical expertise in chemistry was such that in 1959 China was unable to find the necessary materials for building a launching pad for a sounding rocket, nor could it acquire liquid oxygen.[261] (This is despite the fact that the eminent scientist Qian Xuesen, who himself had carried out post-war intelligence work on Werner Von Braun's V-rockets for the United States, had been the primary project leader for the PRC's Fifth Research Academy since 1956.)

The 1950s were not devoid of any progress in the field of applied chemistry. In 1958 the PRC developed special methods to produce both superphosphate and calcium-magnesium phosphate for the production of fertilizer.[262] Despite such efforts, however, chemical fertilizers were more cost effective to import than would be procuring grain from abroad,[263] and even in 1993 fertilizers were still being imported for reasons of cost.[264]

Unfortunately--not just for the 30 million victims but with regard to China's scientific progress as well--the late 1950s also heralded a period during which Mao's mass movements were just gaining speed. Making a virtue of necessity, these exhortations to pull the wisdom from the grassroots can only be described as antiintellectual pogroms. Reminiscent of Lysenkoism (*Lysenkovshina*) in the Soviet Union--where the experimental musings of peasants drove Russian biological sciences back to the stone age--elitism in scientific research was decried by all media outlets in China, while workers and farmers were praised for their practical applications of "science," however loosely defined.[265] Work in basic research (i.e., that which may not have immediate or obvious practical use) was listed last on the CCP's to do list for the above-mentioned 12-year plan. (This aversion to theoretical work in the sciences and preference for applied chemistry persists even to this day in the PRC.[266]) Although mass movements may have assisted in prospecting for uranium,[267] and the near elimination of schistosomiasis (recall the "People's War against the Snail" in 1950),[268] scientific and other higher institutions were being led by party hacks and slogan-mouthed rubes, and as a result "red" nearly always trumped "expert," severely retarding technological advances. Until Marshall Nie Rongzhen intervened, more than two-thirds of Chinese rocket scientists suffered from edema stemming from malnutrition, much like everyone else (save for the party leadership.)[269]

A condition approaching normalcy returned in 1962, but the GLF clearly had taken its toll on the sciences, especially in the field of chemical engineering. By 1965, a substantial effort made progress bringing back science and technology in China. Between 1950 and the mid-1960s the number of institutes in the Chinese Academy of Sciences (CAS) had grown from 20 to more than 120.

But such progress was stymied by the Cultural Revolution, which brought back the antielitist themes of the GLF, displacing real academics with soldiers, workers, and other political cadres who then were put in charge of the universities. While the inmates were running the asylum, both the Chinese Chemical Society and the Chinese Society for Chemical Engineering were shut down,[270] and, according to a CAS academician Tang Youqi, organic, inorganic, and physical chemistry were no longer taught at colleges. Fei Changpei told *Chemical & Engineering News* that "during the 10 years of the Cultural Revolution, no new scientists and teachers were trained."[271] Unless Chinese chemists were working directly for the strategic rocket and hydrogen bomb projects, which enjoyed special status, they were not protected from the political onslaught by the Red Guards; many scientists left the PRC during this chaotic period.[272]

By at least one account, Mao Zedong and Zhou Enlai tried to reintroduce the need for advanced and professional training in the sciences in the early 1970s. In January 1975, Zhou urged that agriculture, industry, national defense, and science in general be modernized, looking toward the year 2000 as a goal. An "Outline Report" delineating areas where attention was most needed was produced thanks to Zhou's urging; with its emphasis on cultivating professional technicians and professors, however, the document offended the retrograde tendencies of the "Gang of Four." Only after Mao's death in 1977 was a serious discussion of scientific progress possible, and, finally, a National Science Conference was held in March 1978.[273]

As Deng Xiaoping's reforms were starting to be implemented in the late 1970s, scientists involved in research or teaching in China could be grouped into the following two cohorts: 1) those 55 and older who had obtained Ph.Ds in the United States, 2) scientists aged between 45 and 55 who had obtained graduate-level training in the USSR, and others at Chinese universities before the 1949 revolution. Chemical engineering departments in the PRC during the late 1970s, for example, primarily consisted of those who had studied in the United States, returned to China during and after the revolution, and were still fondly nostalgic of their previous time spent abroad. Those potential scientists between 30 and 45 years old, however, who would have ushered in the next 20 years of scientific development in the PRC, were effectively lost because of the tumult of the Cultural Revolution.[274] The effects still are felt today: official PRC sources indicate that by the year 2000, the generation of leading scientists and academics--and quite a few of these holding influential government positions--will begin retiring, producing an "academic vacuum."[275]

The late 1970s witnessed a move toward the importation of foreign technology in chemical engineering, as well as investment from overseas. At this stage of development, as far as it pertains to CW agent production, the technical and infrastructure base for chemicals in China probably would have been self-sufficient to produce the first generation of weapon fills, namely, mustard (sulfur and nitrogen), Lewisite, chlorine, phosgene, and hydrocyanic acid. Because changes or rapid improvements in the Chinese chemical industry were unlikely to have occurred during the Cultural Revolution, data from 1977 could be extrapolated modestly downward to the early 1970s, and still have an approximate picture of what China could produce in the way of intermediates and final products:

Product/Intermediate (*1,000 tons)*	**1977**	**1978**
Ethylene	302	380
Plastic	524	679
Synthetic fibers	189	284
Fertilizers	7,238	8,693
Insecticides[a]	457	533
Pharmaceuticals	35	40
Sulfuric acid	5,373	6,610
Caustic soda	1,386	1,640
Salt	17,100	19,530

Detergents	257	324
Crude oil	93,640	104,000
Coal	550,000	618,000
[a] These would have been mostly in the form of oil-based and chlorinated hydrocarbons, such as DDT.		

If China did maintain a stockpile of, at the very least, blister (mustard) and nerve agents (e.g., sarin), stocks of such vital precursors as thiodiglycol (mustard) and phosphorus trichloride (nerve agents) would be needed. Chinese chemical technology developments suggest the rudimentary necessities of three separate CW categories. Example agents demonstrated how production and weaponization could have been affected:

CW Agent Category	Agent Type	Code	Industry Base Components/Steps
Blister	Mustard (sulfur), Lewisite	HD, L	Ethylene (petrochemical), sulfonification, chlorination
Blood	Cyanide (HCN)	AC	Petrochemical, metallurgic reaction chemistry
Nerve	Sarin, VX	GB	Phosphorus chemistry, petrochemical

The demands for these starting materials and their CW agent products would include the following.

Mustard (Sulfur)
Mustard had, at least until the end of World War II, been considered the "king of CW agents," and this was nowhere more true than in the Soviet Union, where both Lewinstein and thiodiglycol processes were successively used in its production. Initially, the Lewinstein process used in the Soviet Union was probably the combination of ethylene and sulfur chloride:

$$2C_2H_4 + S_2Cl_2 \rightarrow (CH_2\text{-}CH_2Cl)_2S + S$$

or alternatively with sulfur dichloride,

$$2\ C_2H_4 + SCl_2 \qquad (CH_2CH_2Cl)_2S$$ [276]

This method had many drawbacks, not the least of which was the rapid degradation of mustard as well as explosive (hydrogen) off-gasses that required constant maintenance.[277] Even more distressingly, within a span of five years the Soviet Union gauged that 25 percent or more of its mustard decomposed while in storage.[278] China almost certainly would have been aware of, and much more in favor of, the thiodiglycol method (Victor Meyer-Clarke process) invented by Germany in World War I. If the experience in the later Soviet Union and Iraq[279] is any guide, China would have followed in analogous fashion:

Oxidation of Ethylene

$$C_2H_4 + HOCl \qquad CH_2\text{-}OH\text{-}CH_2Cl$$

A sulfonification step, most likely using hydrogen sulfide

$2CH_2\text{-}OH\text{-}CH_2Cl + Na_2S$ [or H_2S] $(CH_2CH_2OH)_2S + NaCl$

Utilizing hydrogen disulfide to obtain thiodiglycol, according to Hirsch, led to a 70-75-percent yield. The remaining step is a straightforward chlorination reaction:

$(CH_2CH_2OH)_2S + 2HCl$ $(CH_2CH_2Cl)_2S +$ H_2O[280]

The precursors and intermediary steps of either process would have presented no difficulty for the PRC, and likewise for the nitrogen mustards. Hirsch reports that nitrogen mustard was probably made in the Soviet Union in World War II "in the usual way by chlorinating the chlorhydrate of triethylamine with thionyl chloride or phosphorus trichloride. A method of chlorination by HCl is also known, but this has many technical difficulties."[281] If the PRC did follow in similar fashion, again, the materials and processes--with the possible exception of phosphorus trichloride--should not have been problematic, since at least the mid-1960s.

Lewisite
Lewisite production was carried out in the former Soviet Union by reacting arsenic and a chlorinated ethane-mercuric chloride compound. Although as a blister agent it does not receive as much attention as does mustard in PRC publications, it could also have been produced in large amounts with little (relative) difficulty.

Nerve Agents
The major challenge for the production of G-series (V-agents would not appear until at least the mid-1960s[282]), would have been finding precursors for nerve agents, primarily phosphorus trichloride (PCl_3), perhaps phosphorus oxychloride ($POCl_3$), and perhaps later phosphorus pentasulfide (P_2S_5/P_4S_{10}) for VX.

During the 1950s and 1960s, supplies of technical-grade phosphorus in China would have been sparingly small. Although dedicated facilities to thermal phosphoric acid production could have been built to feed the military use of chemicals, similar to the Muscle Shoals plant in the United States during the 1950s, no open-source data exists on China's approach. Moreover, competing needs for basic chemicals among different industries and even strategic weapons programs may have limited developments in this area.

With regard to civilian use, phosphates are extremely important in providing fertilizer and feed supplements to farm animals, food preservation, metal finishing, oil additives, flame retardants, and pesticides, among other uses. Fluorine and phosphorus (in the form of tributyl phosphate), for example, are used both in nuclear fuel processing as well as the manufacture of sarin and soman nerve agents. But, whereas the latter chemicals are utilized within closed systems and some recycling could take place, CW agent production in the hundreds of tons would have presented rather daunting challenges, at least in the years before 1978:

Phosphorus (Elemental) Production by Country, 1969	**Metric Tons**
United States	533,000
Soviet Union	142,000
Canada	100,000
Germany (FRG)	70,000

Japan	26,000
China	18,000
East Germany	15,000[a]
[a] Ferguson, Hylton and Mumma, *Studies on the Technical Arms Control Aspects of Chemical and Biological Warfare*. [Midwest Research Institute final report for ACDA.] Reliability Studies. ACDA/ST-197 Volumes II, III. November 13, 1972, p. 19.	

In 1972, technology for the production of elemental phosphorus via thermal methods was held by the United States, United Kingdom, and West Germany, the latter (Uhde of Farbwerke Hoechst) having built the Chimkent plant in the Soviet Union.[283] Relations between the PRC and these countries were at their nadir during the early 1970s. Without similar turnkey plants China would have experienced great difficulty becoming sufficiently self-sufficient to build large stockpiles of nerve agents, although modest amounts could be produced by diverting elemental phosphorus from other uses, or via the time-consuming purification of phosphorus via the wet (acid) process.

Further, China claims to have developed an organophosphorus agent detector in 1971,[284] apparently to fulfill a need to detect the use of contact insecticides, and perhaps in part stemming from concerns regarding Soviet CW capabilities on the border. Insecticides of concern probably would have included ethyl parathion and methyl parathion, both in use by the late 1960s, and resulting in many accidental poisonings in China.[285] By 1971, the price of either insecticide dropped rather dramatically compared to 1966 levels, from US $0.75 per pound to US $0.40,[286] leading to their wide-scale use. Perhaps an example of "off the shelf" technology used for military purposes, this detector may not have changed substantively since its inception.

Brain Power
Economic reforms in the late 1970s resulted in a concomitant increase in institutions devoted to applied chemistry and research. By 1991, 240 R&D agencies had been established for chemical industry, consisting of 20,000 scientists and engineers, plus an additional 12,000 technical staff.[287] This progress is remarkable, particularly when considering that in 1984 the PRC only produced 15 graduates in science at the Ph.D. level, and these were primarily in theoretical research.[288] Using data from a year earlier, these numbers reflect a large proportion of effort toward the chemical sciences, comprising 40 percent of all scientific research institutes, and another 40 percent of those personnel classified as "scientists or engineers."[289] Today, China produces thousands of Ph.D.s in the sciences, although the significant problem of brain drain to more lucrative jobs in foreign countries continues.[290]

Infrastructure
In a barter arrangement that included mostly petroleum, Japan and China stuck a deal in 1978 for $20 billion in which Japan was to sell manufacturing facilities to produce ethylene, fertilizer, and synthetic leather.[291] From 1982 onward, foreigners invested in some 940 ventures over the next 10 years.[292] By 1994, 5,540 chemical enterprises with overseas funding were started in the PRC,[293] and in 1997 there were 6,800.[294] Foreign chemical conglomerates have since participated in the building of large chemical facilities, particularly ethylene plants to satisfy large demands for plastics and other polymers:

Western partner	Location	Ethylene capacity *(metric tons)*

Shell Chemicals	Huizhou	800,000
BASF	Nanjing	600,000
BP	Jinshanwei, SH	650,000-1,000,000
Dow Chemical	Tianjin	600,000
Exxon	Fuzhou	600,000
Phillips Petroleum	Lanzhou	600,000
Arco Chemical	Ningbo	500,000-700,000[a]

[a] Jean-Francois Tremblay, "Petrochemicals in China," Chemical & Engineering News, Vol. 76, No. 48, November 30, 1998, pp. 16-18.

Production of Phosphorus and Organophosphorus (OP) Compounds in the PRC

In 1999, chemical outputs in China surpass levels originally targeted in Beijing's respective five-year plans, particularly in the area of pesticides. For example, the production plan in 1995 for pesticides (i.e., herbicides and insecticides) was 230,000 tons, with an actual output of 349,000 tons.[295] This year the capacity is estimated at 750,000 tons for all pesticides, and outputs have averaged nearly 400,000 tons per year. In chemical fertilizers, the PRC has nearly always been self-sufficient in terms of nitrogen but continues to import potash and phosphate fertilizers.[296]

As demonstrated previously, production of elemental phosphorus for food-grade phosphates and chemical intermediates in OP chemistry has typically been via thermal processes, although recently the world market has been changing toward wet-process phosphates. The significant point about phosphate production in the PRC is the ability to produce large amounts of pure phosphorus trichloride (PCl_3) and phosphorus pentasulfide (P_2S_5), precursors for G-series nerve agents and V-agents, respectively. With large phosphate reserves, even if the phosphate content in rock is of low quality,[297] China has increased dramatically its production of several phosphate-related chemicals. Yunnan Province, for example, utilizes hydroelectric power to provide a source for thermal phosphoric acid. In 1990 plans were made to develop a 60,000 metric ton/year phosphoric acid plant in Yunnan.[298] Bottlenecks and other production problems remain. In 1997, a manager based at a foreign-invested chemical company in China that is heavily involved in pesticide production, remarked:

China lacks the essential intermediates to carry out contract synthesis. They often have to do more steps due to this deficiency. We often have to ship raw materials from the West to ensure production schedules.[299]

In 1998, however, apparently there was enough phosphorus pentasulfide to allow the clandestine shipment of 500 tons to Iran via a Norinco front company in Hong Kong.[300] Although it violates the Australia Group chemical precursor restrictions, which brought about sanctions from Great Britain and the United States, P_2S_5 technically is not a controlled substance under the CWC. Though not a member, and a vociferous opponent, of the Australia Group, China has voluntarily added P_2S_5 to its list of controlled chemical exports.[301]

Phosphorus oxychloride, which is produced in China by more than 20 facilities, may also be considered within the context of nerve agent precursors, but primarily for tabun (GA) production. Interestingly in this regard, Lianshiu Chemical Works has introduced a process that combines sulfur, chlorine, and phosphorus trichloride over a catalyst to produce both phosphorus oxychloride ($POCl_3$) and thionyl chloride, 1 ton of $POCl_{3}$ producing about 0.8 ton of thionyl chloride during the process.[302] (Thionyl chloride is considered a chemical that has proliferative use in nerve agent synthesis.)

Possible Nerve Agent Precursors	**Production Facilities in the PRC**
Phosphorus trichloride (PCl^{3})	Suzhou Huagongchang, Shanghai Pudong Huagongchang, Hangzhou Nongyaochang, Shandong Nongyaochang, Qingdao Hongqi Huagongchang, Tianjin Nongyaochang, Beijingshi Nongyao Erchang, Shijiazhuangshi Dianhuachang, Chongqing Nongyaochang, Fushun Youji Huagongchang, among others [a]
Phosphorus pentasulfide ($P^{2}S^{5}$)	Liaoningsheng Liaoyang Huaxuechang, Zhangjia Koshi Huagong Yuanliaochang, Yunhua Gongsi Linfeichang, Tianjin Nongyaochang, Sichuan Santaixian Huanglinchang, Lianyungang Huagongchang, Wuhan Gedian Huagongchang, Guangzhou Nongyaochang, Jiangxi Zhangshu Linfeichang, Heilongjiang Nongyaochang, among others [b]
[a] *Huagong Chanpin Guoji Maoyi Wushi Shouce* (Beijing: Huaxue Gongye Chubanshe, September 1997), p. 261. [b] *Ibid*., p. 262.	

The PRC has made a concerted effort to move away from chlorinated hydrocarbons to organophosphorus (OP) pesticides.[303] Two major pesticide research institutes were recently established in China, one in Shenyang (National Pesticide Engineering Research Center), and the other in Shanghai (National Southern Pesticide Formulation Center). In 1995, for the first time since the Communist revolution, representatives from the China Pesticide Industry Association visited their counterparts on Taiwan. Then, more than 10 joint-venture projects were financed by Taiwan firms in the PRC and were devoted to the export of pesticides, amounting to "tens of million[s] US dollars."[304] In 1998, China produced 382,000 tons[305] of pesticides and of this total exported 100,000 tons, earning a reported US $320 million.[306]

One of the more significant developments has been this ability on the part of the PRC to produce large amounts of OP pesticides, including an indigenous supply of precursors that could be used in nerve agent synthesis, particularly phosphorus trichloride and phosphorus pentasulfide. Although the production of OP pesticides is quite different from that of the extremely toxic nerve agents, the basic expertise and the basic starting materials are not that far removed. Significantly, the PRC produces the following OP pesticides, on the order of 5,000 tons/year (or more, 1994-1995):[307]

Pesticide	**Alternate Name(s)**	**Production Facilities in the PRC**
Monocrotophos (*Jiuxiaolin*)	Azodrin	Shandong Qingdao Nongyaochang, Jiangsu Nantong Nongyaochang, Jiangsu Haian Nongyaochang, Hebei Cangxian Nongyao Huagongchang, Shandong Gaomi Nongyaochang, Jiangsu Zhangjiagang Dier Nongyaochang[a]

Dimethoate (*Dongguo*)	Cygon, Rogor, Perfekthion	Sichuan Chongqing Nongyaochang, Jiangsu Sujiang Huagong Nongyao Jituan Gongsi, Guangdong Guangzhou Nongyaochang, Liaoning Nongyang Xincheng Huagongchang, Guangdong Jiangmen Nongyaochang, Jiangxi Fengcheng Nongyaochang, Hunan Changde Nongyaochang, Zhejiang Hangzhou Nongyaochang, Fuzhou Sanming Nongyaochang, Shanxi Huaxuechang, Shanghai Nongyaochang[b]
Methamidophos (*Jia'anlin*)	Tamaron, Monitor	Zhejiang Linghu Huaxuechang, Jiangsu Suzhou Huagong Nongyao Jituan, Sichuan Chongqing Nongyaochang, Guangdong Jiangmenshi Nongyaochang, Anhui Anqingshi Nongyaochang, Henan Xinyang Huagong Zongchang, Zhejiang Lanxi Nongyaochang, Hunan Nongyaochang, Tianjin Nongyao Zongchang, Jiangsu Wujin Nongyaochang, Haian Nongyaochang, Guangdong Huaxian Nongyaochang, Zhejiang Wenzhou Nongyao Guang, among others [c]
Trichlorfon (*Dibaichong*)	Trichlorphon, Dipterex, Dylox, Neguvon, Tugon, Chlorofos, Agroforotox, Anthon, Bovinox, Britten, Briton, Ciclosom, Chlorophose	Shandong Nongyaochang, Jiangsu Nantong Nongyaochang, Guangdong Jiangmenshi Nongyaochang, Yunnan Kunming Nongyaochang, Guangxi Nanning Huagong Jituan Gongsi, Zhejiang Lanxi Nongyaochang, Hunan Nongyaochang, Jiangsu Haian Nongyaochang, Guizhou Guiyang Nongyaochang, Guangdong Guangzhou Nongyaochang, among others [d]

Methyl parathion (*Jiaji Duiliulin*)	Parathion-methyl, Metaphos, Metacide, Folidol-M, Metron	Jiangsu Suzhou Huagong Nongyao Jituan, Shandong Lingyang Nongyaochang, Hunan Nongyaochang, Anhui Anqing Nongyaochang, Jiangxi Gannan Nongyaochang, Fuzhou Longhai Nongyaochang, Henan Xinyang Huagong Zongchang, Zhejiang Hangzhou Nongyaochang, Hubei Shashi Nongyaochang, Sichuan Jianyang Nongyaochang [e]
Parathion (*Duiliulin*)	Alkron, Alleron, Aphamite, Danthion, Vitrex, thiolphos, Ethyl parathion, folidol, Niran	Tianjin Nongyao Zongchang, Anhui Anqing Nongyaochang, Henan Xinyang Huagong Zongchang, Jiangsu Danyang Huagongchang, Jiangsu Haian Nongyaochang, Henan Anyang Linyaochang, Shandong Donglong Nongyaochang [f]
Glyphosate (*Caoganlin*)	Roundup	Zhejiang Jiande Nongyaochang, Sichuan Shefang Nongyaochang, Jiangsu Nantong Huagongchang, Nantong Nongyao Erchang, Zhejiang Ningbo Huagong Erchang, Lanxi Nongyaochang, Henan Anyang Linyaochang, Jiansu Wujin Nongyaochang, Shandong Haiyang Nongyaochang [g]
Omethoate (*Yangdongguo*)	Folimat, Dimethoxon	Shandong Nongyaochang, Chongqing Nongyaochang, Anhui Suxian Nongyaochang, Henan Chengzhou Nongyaochang, Zhejiang Jiande Nongyaochang, Henan Anyang Linyaochang, Jiangsu Haimen Nongyaochang, Hangzhou Nongyaochang, among others [h]

[a] *Huagong Chanpin Guoji Maoyi Wushi Shouce*, September 1997, *op. cit*., p. 584.
[b] *Ibid*., p. 591
[c] *bid*., p. 585.
[d] *Ibid*., p. 585.
[e] *Ibid*., p. 587.
[f] *Ibid*., p. 586.
[g] *Ibid*., p. 616.
[h] *Ibid*., p. 586.

If local production and consumption of pesticides in the PRC (estimated by Monsanto to be approximately US $ 600,000[308]) remains at current levels, starting materials will also be in strong demand, especially for phosphorus trichloride. Of the pesticides listed above, two in particular often use the phosphorus pentasulfide route in synthesis. Many others probably are produced in smaller quantities in China:

Dimethoate (*Dongguo*)

example, $4CH_3OH + P_2S_5 \Rightarrow 2(CH_3O)_2PSSH + 2H_2S$ (+ additional organochlorine steps)[309]

Parathion (*Duiliulin*)

example, $4C_2H_3OH + P_2S_5$ (or PCl_3) $\Rightarrow$(Chlorinating step in the case of synthesis with P_2S_5)[310]

These two formulations alone would require enormous quantities of phosphorus if 5,000 tons of agent were to be produced. Thus, the phosphorus industry in China is capable of producing large quantities.

Conclusion

In terms of chemical technology and knowledge base, some crossover from erstwhile Soviet assistance would have occurred in the late 1950s, particularly in the areas of fluorine chemistry and organophosphorus compounds. (The latter two are critical for the enrichment of uranium, and form the basis for the German series of toxic nerve agents, respectively). Nonetheless, at the time of the Sino-Soviet feud, as far as military chemistry is concerned, China was even more backward than the Soviet Union. (Substantial East German assistance to the Soviet Union probably did not occur until 1965--long after the Sino-Soviet split.[311])

We do not know what degree of technological competence and production levels in chemical manufacture existed in China before 1978, especially during the times when economic data was considered "secret." By the 1990s, however, China clearly has mastered many commercial methods of producing fine chemicals, including key precursors and intermediates that could be diverted to CW-agent manufacture.

If China has in fact destroyed its chemical weapons--and by its reported documentation to the Organisation for the Prohibition of Chemical Weapons (OPCW) in The Hague, it has--the PRC did so at a time when it could produce nearly any of the known CW agents in mass quantities. From an economic point of view, joining the CWC was for China a strategic decision to ensure that it's "pillar industry," namely chemical, would not be impeded by international export controls. An optimistic assessment would be that Deng Xiaoping's policy to subordinate the military to a strong economy applies to the Chinese chemical industry as well. The pessimist would note that, in the event of a major crisis, the PRC would have little trouble reconstituting a large chemical weapons arsenal within a relatively short time.

Chinese Perspectives on BW

Official PRC histories of BW, justifiably, recount at length the experience of Japan's invasion of China, and the gruesome experiments conducted by Gen. Ishii Shiro and his Unit 731. Also mentioned is a report about "Operation Golden Triangle," allegedly from a Russian defector who fled to Germany, claiming that near the end of the Second World War the Soviet Union conducted experiments with plague, anthrax, and cholera in Soviet-occupied Mongolia.[312]

Allegations that the United States routinely conducted BW during the Korean war, however mendacious and insupportable, also seem to be accepted as fact by the PLA. The book on BW printed by the PRC's National Defense Press, for example, extensively covers the issue. Defense Minister Chi Haotian, who served during the Korean conflict and wrote the preface to the series on weapons and war, including CBW,may have influenced the book to publish a lengthy laundry list of "biological crimes" committed by US forces. Nonetheless, despite no reliable evidence of US complicity (and even recent proof that the Chinese themselves have colluded with North Korea to fabricate biological weapons), the charges are ingrained among senior Chinese leaders. The recent publication by Endicott and Hagerman,[313] as well as the unreconstructed claims of Maoist fellow traveler Joseph Needham, may have sealed the idea even further, for now there is "Western" concurrence to the allegations.

At the very least, this legend provides a historical starting point for the PLA's development of anti-BW defense measures and training. But with regard to future arms control agreements and intelligence assessments, the belief of the PRC that the United States employed biological weapons during the Korean war is significant. The Chinese, who see even the Opium War of the 1840s as having happened only yesterday, will be influenced by their interpretation of such historical events, no matter whether true or false.

China alleges the following US BW attacks in North Korea:

- *While the United States was retreating south under attack by the united Sino-Korean Army, in December of 1950 the United States military disseminated smallpox against the Korean capital of Pyongyang, Hwanghae do, and other areas.*
- *On the 28th of January, US forces used aircraft on areas such as [*Lung Zhao dong*], southeast of Inchon, [*Long shui dong*], etc., to disseminate large quantities of three insect types never before seen in Korea: The first type was a kind of black fly, the second was in the form of something similar to fleas, and the third was a kind of tick.*
- *Laboratory test evidence showed that the insects disseminated by the United States carried plague, choloera, and other infections disease-causing pathogens.*
- *Accounts have revealed that the US Chemical Corps operations department produced 16 different types of deadly BW agents in large quantities. In March 1951, [Brigadier General Crawford] Sams[314] who was in charge of the Public Health and Welfare department of the "United Nations Army" command, led the No. 1091 microbiology lab on a landing boat to Wonsan harbour, and onward to Koje island. They used POWs as targets for biological weapons experiments. As the US military progressed in their manufacture of biological weapons, they utilized the work of the*

Japanese war criminal Ishii Shiro, Wakamatsu Yujiro, Kitano Masaji, etc., and even sent them to South Korea.

- *[E]xamples of various technologies used ranged from fountain pens filled with infectious disease-causing black ink to feathers contaminated with anthrax bacilli, as well as fleas, lice, and mosquitoes infected with plague and yellow fever. Various kinds of flies, fleas, spiders, beetles, bedbugs, crickets and other insects were found, many of which had never been seen before in Korea.*
- *The types of bacteria found were* Vibrio cholerae, Salmonella typhi *(typhoid),* Yersinia pestis, *paratyphoid (A and B types), the causative agent of typhus, and* Shigella dysenteria. *Laboratory results showed that the insects tossed down carried plague, cholera, and other infectious diseases. . . . Not long after discovering these containers, many people came down with plague or cholera. Of 53 total plague victims, 39 died.*
- *According to relevant information, from the 28th of January, 1952, to the 31st of March, the US military disseminated bacteria as many as 804 times in North Korea.*
- *Several years later, the American government acknowledged that they had used biological weapons during the Korean War.*[315]

Similar conspiracy type of allegations seem to continue into the 1990s. For example, the PLA may actually believe that unusual outbreaks of hemorrhagic fever that occurred in Kenya in 1995, were in fact the results of US BW experiments,[316] and makes similar insinuations concerning the Ebola virus outbreaks in Zaire.[317]

BW Offense

Writings are scanty on Chinese CW capabilities and even more so on BW. A PRC official from the Chinese Ministry of Foreign Affairs assured me that China has no biological weapons.[318] A book on the subject, with the imprimatur of Chi Haotian, states categorically that "China has never manufactured nor possessed biological weapons."[319]

According to its submitted Biological and Toxin Weapons Convention (BWC) declarations, the PRC has declared the following facilities as having a "national defensive biological warfare R&D program," and listed the following facilities:[320]

Dual Use/BW Defense Research Facilities (1993)

- Institute of Microbiology and Epidemiology.

Vaccine Production Facilities

- National Vaccine and Serum Institute.
- Shanghai Institute of Biological Products.
- Lanzhou Institute of Biological Products.
- Changchun Institute of Biological Products.
- Wuhan Institute of Biological Products.
- Chengdu Institute of Biological Products.
- Institute of Medical Biology, Chinese Academy of Medical Sciences.

The PRC claims that no BL-4 (highest containment for extremely contagious and virulent organisms) laboratories exist, at least as far as BW-related research is concerned. Most biological weapons, however, can be produced and studied in BL-1-3 conditions, and a BL-4 facility is less relevant from a weaponization capability standpoint.[321]

Little of the scientific literature that the PRC reports in its BWC declarations is worth noting except for public-health-related research on bioaerosols and reviews on staphylococcal toxins. The remaining citations consist of the typical infectious disease reporting and epidemiological studies on hepatitis (of just about every type), hemorrhagic fever with renal syndrome (HFRS), and insect abatement programs.

Allegations of BW Activity in Xinjiang Province

Ken Alibek, formerly with the Soviet/Russian Biopreparat BW ***c***omplex, suggests that an outbreak of hemorrhagic fever in Xinjiang Province near Lop Nor was the result of Chinese activity in BW research:

Intelligence sources found evidence of two epidemics of hemorrhagic fever in this area in the late 1980s, where these diseases were previously unknown. Our analysts concluded that they were caused by an accident in a lab where Chinese scientists were weaponizing viral diseases.[322]

Another source in Taiwan told me that he felt certain a BW facility of some sort did exist in Xinjiang Province, not far from the nuclear testing facilities.[323]

As for the allegations of the source of outbreaks in Xinjiang, we should be cautious because of the natural occurrence of Xinjiang hemorrhagic fever (HF) endemic to the area, a variant of Crimean-Congo HF of the bunyaviridae-type virus that occasionally strikes in northeastern China, and where a significant outbreak occurred in 1968.[324] But even if we discount the 1980 outbreaks as having military-related origin, we cannot rule out the actual existence of the BW-related facility. The list of declared research and production sites above shows nothing further northeast than Gansu Province. The Soviet Union, in open violation of the BWC, built the largest BW capability thus far known. Given the poor track record of the BWC as it is currently implemented (or more accurately, is not being implemented), China probably is withholding much information about its BW research, although such research primarily may be defensive in nature.

Agricultural BW

A newspaper in the United States intimated that the foot and mouth disease (FMD) outbreak in Taiwan could have been due to mainland Chinese sabotage.[325] The largest known FMD outbreak, it has caused more than $5 billion damage to the Taiwanese pig farming industry.[326] After hearing a presentation by Dr. Terrance Wilson on the subject,[327] and following discussions with some knowledgeable Taiwanese, I am fairly certain that the FMD outbreak was purely accidental. A similar conclusion was also reached in the Taiwan agricultural community. For example, *Stock-Farming of Tendays* [sic] (*Nongmu Xunkan*), 25 September 1999, writes:

The outbreak of FMD in Taiwan was caused by the introduction of virus through either the smuggling of goods or related agricultural products. As a consequence, the defense against such smuggling is of great importance. . . It was finally determined by means of analysis in foreign research institute(s) that the FMD outbreak was absolutely the same as that in the mainland, thus proving that infection was brought into Taiwan from the PRC. It was completely because of smuggling meat products across the boundary by smuggling that caused great economic losses to Taiwan amounting to one percent of (1997)'s

[GNP].[328]

The few Chinese writings on the subject of BW preponderantly discuss the allegations of US use of BW during the Korean war. Thus, even today, there is emphasis on training and equipment to rid the immediate environs of insects and vermin, as if modern armies would deploy such crude methods of delivery. For example, to foil the enemy's germ-laden, flying insects or plague-infested rats, the PLA handbook on BW even suggests how to use simple brooms and nets, and procedures for burying the offensive detritus.[329]

BW Defense in the PLA

In keeping with the definition of BW as "public health in reverse," PRC writings on the subject treat the matter more in terms of infectious disease control, an approach that is standard everywhere. As one would expect, considerable amount of research has been conducted in China on potential BW agents including tularemia, Q fever, plague, anthrax, West and Eastern Equine Encephalitis, psittacosis, among others.[330] Some specialized equipment has also been fielded in some unspecified numbers to counter the threat of BW to PLA troops.

Type 76 Microbe Sampling Kit[331]
First introduced in 1975, and includes the 76-1 variant,[332] this portable laboratory can test surface, waterborne, and airborne particles to determine the presence of BW agent threats, and also has five different types of insect and small animal reference specimens. Resembling a low-tech, gravitation/settle plate,[333] a small, rotating mechanism is placed windward, and aerosol particles will adhere to the sampling or petri dish. Disinfectant is supplied along with culturing supplies.

Large-Volume Electrostatic Air Sampler[334]
This equipment has no classification number, and little information is provided concerning its attributes. It probably is similar to the corona discharge-based large volume air sampler (LVAS) used in the West. This technology in general offers excellent results, and is capable of isolating viral particles from the air, including rabies and human respiratory disease viruses.[335]

JWL-I Model Bioaerosol Sampler[336]
Like the LVAS mentioned above, the reference to this equipment offers little in the way of details. This automated air sampler resembles most closely a single stage impactor, drawing in air and depositing aerosolized particles onto agar for further testing. An example of this type of instrumentation is the Casella slit-to-agar, single-stage impactor used in civilian environmental monitoring.[337]

In 1974 an improved version of the WJ-85 microbiological laboratory vehicles was introduced,[338] and could have resulted in this motorized laboratory platform, described as somewhere between "a railway car and a sedan," is separated into three sections, with airtight sealed gaskets on the doorways. The forward section houses the driver and carriage for occupants, the midsection contains the laboratory room **(See Mobile BW Assessment Laboratory)**, and the rear section contains decontamination apparatus plus extra clothing. Laboratory equipment includes a glass glove box for handling infectious material, a bacteriostatic device, a refrigerator, an incubator (*hengwenxiang*), a fluorescent microscope, an inverted microscope, culture media, diagnostic reagents, cell culture instruments, etc. A separate station allows testing for bacteria and viruses, accommodating up to four people. Some 200 bacteria and 50 virus samples for reference and identification are supplied with the laboratory vehicle.

PLA Military Medicine and BW Defense
The earliest semblance of routinized BW defense in the PLA were the 1952 sanitation/anti-plague units, formed during the involvement of the Chinese People's Volunteer Army in Korea. At the same time, educational campaigns to rid disease-carrying pests were conducted, and, when combined with experience of the supposed BW casualties treated during the Korean war, "a great victory was achieved in anti-bacterial warfare."[339]

Building a more formal curriculum in BW defense, the PLA continued work in anti-plague research, and in 1954 delegations and students visited the Soviet Union for expertise in microbiology and infectious disease.[340] Perhaps in tandem with the fanatical anti-pest campaigns carried out during the Great Leap Forward, a full-fledged, national investigative research project was carried out during 1958-61, led by the Military Medical Science University and sanitation units, from every military region, on down to individual cadres. By 1984, M.S. degrees were being awarded in the related specialization of BW defense by the Military Medical Science University.[341]

The Changing Character of China's WMD Proliferation Activities

Evan S. Medeiros

Beginning in the early 1980s, China's weapons proliferation activities emerged as an issue of growing concern for US policymakers. This trend has persisted for close to 20 years. Chinese companies in the last two decades have exported to several countries a variety of goods useful in building nuclear weapons, chemical weapons, and ballistic and cruise missiles. In some cases, China has provided critical materials, equipment, and technical assistance to nations who could not otherwise acquire these items for their weapons programs. Most notably, China provided Pakistan with a basic nuclear weapon design and substantial assistance in fabricating weapons-grade nuclear material. Moreover, China has provided some countries with production technologies, allowing these nations to indigenously build certain missile systems with little external assistance. Although China's proliferation behavior over the last two decades has been highly egregious, it has also improved dramatically in recent years, especially since the mid-1990s. The Chinese government has gradually signed onto a number of key nonproliferation treaties, such as the Nuclear Nonproliferation Treaty (NPT) and the Chemical Weapons Convention (CWC) and has developed internal bureaucratic and regulatory structures to carry out these commitments. This is not to say that China no longer engages in exports of proliferation concern to the United States. Rather, the nature of the China-proliferation problem is fundamentally different, and US nonproliferation policies on China should be changed accordingly.

This paper addresses one central question: What is the current scope of China's proliferation activities related to weapons of mass destruction (WMD),[342] and how has it changed over the last 20 years? Answering this question will help to establish the factual and conceptual basis for understanding the nature of the problem and determining viable options for US policy-makers in an effort to change

Chinese behavior. To evaluate the scope of Chinese proliferation activities, this paper considers three indicators: the geographic scope of China's WMD exports, the types of exports (e.g., weapon-specific or dual-use technologies) and their contribution to WMD programs, and the frequency of such transfers. These three indicators are applied to three case studies around which this paper is structured; the three case studies cover China nuclear exports, missile (ballistic and cruise) exports, and chemical exports. The paper examines each of these case studies over a 20-year period to provide a historical perspective on the shifts and changes in the scope of China's WMD proliferation activities.

Drawing on this analytical framework, this paper argues that in the last two decades the overall scope of Chinese proliferation activities has declined across the board. The geographic distribution of Chinese proliferation-relevant exports has narrowed from almost a dozen countries to three: Iran, Pakistan, and to a lesser extent North Korea. The character of China's exports similarly narrowed *from* a broad range of nuclear materials and equipment (much of it unsafeguarded) and complete missile systems *to* exports of dual-use nuclear, missile, and chemical technologies today. In addition, during much of the 1980s and 1990s, China's nuclear and missile assistance directly contributed to the nuclear and missile programs in other countries; today such assistance is indirect, at best. The frequency of such exports also appears to have declined to a dribble of dual-use items, albeit declining less than the scope or technical character of China's exports. Despite this overall narrowing of China's WMD-related exports, further progress will be slow. Significant policy differences between Washington and Beijing exist about controlling dual-use nuclear, chemical, and missile goods to Iran and Pakistan. These contrasting policies are based on profound differences between the respective foreign policy approaches of the United States and China to Iran and Pakistan, the utility of supply-side technology control regimes, China's ability to implement and enforce its export control laws, and linkages to such bilateral issues as US arms sales to Taiwan.

This analysis of the scope of China's WMD exports requires a major caveat, however. Tracking China's nuclear, chemical and missile exports based on nonclassified, open-source information is an inherently difficult task. Reliable and comprehensive information is scarce. Much of the information--especially detailed technical data--is based on press accounts of leaked intelligence information. This classified data is often leaked for specific political purposes, is often incomplete, and thus is of questionable reliability. To offset these informational weaknesses, this paper relies on multiple sourcing combined with extensive conversations with US and Chinese officials from a variety of government agencies in both Washington and Beijing.

China and Nuclear Proliferation[343]

Chinese nuclear exports have changed dramatically over the course of the last twenty years. The geographic distribution of Chinese nuclear exports has narrowed, the character of nuclear items sold and their relative contribution to nuclear proliferation has positively changed and the frequency of nuclear exports (including technical assistance) has decreased significantly. As of 1999, US concerns about Chinese actions that contribute to nuclear proliferation are fundamentally different as compared to 20 years ago. To detail these trends, this section compares China's nuclear exports in the 1980s and 1990s.

Chinese Nuclear Exports in the 1980s[344]

Beginning in the early 1980s (only a few years after Sino-US normalization), Chinese state owned companies began providing a variety of nuclear assistance to an eclectic mix of countries all over the world. Chinese nuclear companies used nuclear exports as a means to generate hard currency as China opened up to the outside world and sought to better integrate its economy with Western ones. Central authorities in Beijing encouraged nuclear exports as a way for China's large military-nuclear complex to diversify into producing civilian goods. The profits from these activities were then funneled into improving China's dilapidated nuclear infrastructure, both military and civilian.[345] Given these pressures, Chinese companies began providing nuclear equipment, materials, and technical assistance to such countries as Argentina, Algeria, Brazil, Chile, India, Iran, possibly Iraq, Pakistan, and South Africa. Initially, Chinese companies sought to create long-term relationships with many of them. Throughout the 1980s, China signed nuclear cooperation agreements (NCAs) with Argentina, Algeria, Brazil, Iran, Pakistan, and a variety of other countries of lesser proliferation concern in an effort to create sustained export relationships.[346] Many of these NCAs are currently active, although trade between China and many of these countries has been scaled down in recent years.

China's nuclear sales covered a variety of nuclear items and technical assistance that directly contributed to the military nuclear activities in several countries. In the early 1980s, Chinese nuclear exports were not placed under International Atomic Energy Agency (IAEA) safeguards, which facilitated their use in military nuclear activities. Chinese firms exported different types of reactor fuel, complete reactors, reactor technologies, technical assistance for indigenous nuclear projects, and nuclear facility training. In the case of Pakistan, China also provided substantial direct assistance in designing and building nuclear weapons. Beginning around 1983, China sold Argentina a wide variety of nuclear materials such as uranium concentrate (yellow cake), uranium hexafloride, 20-percent low-enriched uranium (LEU), and heavy water. None of these exports was under IAEA safeguards, and all probably were used in Argentina's dual-use nuclear program. China's exports to Brazil were less extensive but also probably were diverted to Brazil's military nuclear activities. China sold some 200 kg of LEU (3-20-percent enriched) to Brazil in the early 1980s, none of which was subject to international safeguards. Of greater proliferation significance were China's nuclear exports to South Africa, which operated a dedicated nuclear weapon program--as opposed to the "military options" programs in Brazil and Argentina. South Africa purchased unsafeguarded LEU and uranium hexafloride that probably were used to fuel its pilot enrichment plant at Pelindaba East. In addition, China sold South Africa 60 metric tons (MT) of unsafeguarded heavy water for other nuclear projects. China's strong financial motives for exporting nuclear items were especially evident in its willingness to provide nuclear fuel to its strategic competitors. Between 1982 and 1987, China provided India with 130-250 MT of unsafeguarded heavy water; this item was probably used in India's CANDU reactors that for many years served as the main plutonium producers for India's nuclear weapons program.

Chinese nuclear exports in the 1980s went beyond nuclear fuel. In 1983, China and Algeria signed an agreement for the construction of a small 15 MW heavy-water research reactor.[347] The reactor initially was not subject to any international inspection, and several indicators suggested the reactor could have been part of a nascent nuclear weapons program in Algeria.[348] Chinese officials originally argued that the reactor deal was exempt from inspection because the contract was signed in 1983, a year before China joined the IAEA. Only after significant US and international pressure was applied beginning in 1988 (when US satellites noticed the reactor's construction) did China and Algeria agreed to open the reactor to IAEA inspection when it was completed.[349]

Ironically, China's nuclear assistance to Iran was of lesser concern in the 1980s. China's nuclear relationship with Iran was just taking shape in the 1980s and did not flourish until the 1990s. This assistance involved limited amounts of training and nuclear equipment exports; none of it was directly applicable to nuclear weapon development, and all of China's assistance was placed under safeguards.

Reports say that China and Iran signed a secret nuclear cooperation as early as 1985. The first manifestation of this accord was the training of Iranian technicians in China; by 1991 some 15 nuclear engineers from Iran's Isfahan facility had been trained in nuclear reactor design and research in China.[350] In 1989, China's initial nuclear exports to Iran were minimal and involved transfers of two or three electromagnetic isotope separators (EMIS or calutrons) and a 27-kilowatt (kW) subcritical reactor. Although EMIS is used to enrich uranium, it is highly inefficient, and hundreds are needed to produce significant quantities of enriched uranium.[351] The Chinese-supplied calutrons were placed under IAEA safeguards and stationed at two facilities in Iran. The Chinese used the subcritical reactor to began training the Iranians in basic nuclear physics, isotope production, and reactor operation. Such training--both in Iran and in China--provided the Iranians with a technical baseline from which greater expertise and presumably nuclear weapon knowledge could eventually be developed. Yet all of China's aid was consistent with and, in fact, encouraged under the Nuclear Nonproliferation Treaty (NPT).

During the 1980s, China's nuclear relationship with Pakistan was Beijing's most extensive in terms of the technologies/assistance provided, the contribution to proliferation, and the frequency of transfers. China directly assisted Pakistan's nuclear weapon program. In the early part of the decade, China reportedly provided Pakistan with a nuclear weapon design of a crude but highly reliable Hiroshima-sized weapon; reports say China also transferred enough HEU for one or two cores for this weapon; and in 1989 China may have allowed Pakistani scientists to observe nuclear tests at Lop Nor.[352] In addition, Chinese technicians provided equipment and assistance to several of Pakistan's unsafeguarded fuel-cycle facilities that supported the nuclear weapons program. In 1986, China concluded a comprehensive nuclear cooperation agreement with Pakistan. Under this accord, Chinese companies supplied Pakistan with a variety of nuclear products and services, ranging from uranium enrichment technology to research and power reactors. Specifically, Chinese scientists may have assisted Pakistan with construction of the PARR-2 research reactor and operating uranium enrichment centrifuges at the Kahuta facility. China also reportedly transferred enough tritium gas to Pakistan for a few nuclear weapons.[353]

China's extensive nuclear exports to Pakistan, Argentina, Brazil, and South Africa during the 1980s largely are explained by the weakness of China's formal nonproliferation commitments combined with the relative lack of bureaucratic infrastructure in China to support nuclear nonproliferation. For years, Chinese officials had rejected the NPT as a biased and inherently discriminatory treaty and viewed nonproliferation as a means for the superpowers to entrench their nuclear superiority by denying other nations equivalent capabilities.[354] This view began to change slowly in the 1980s as China re-engaged with the international community.

Beginning in 1984, China made two initial nonproliferation commitments, neither of which was verifiable or enforceable. First, China joined the IAEA and pledged to require safeguards on all of its nuclear exports to non-nuclear-weapon states; this promise also included third-party retransfer prohibitions. Second, China's then Premier Zhao Ziyang provided a verbal commitment in a White House toast that China does not "advocate or encourage nuclear proliferation" and that China "does not engage in nuclear proliferation ourselves, nor do we help other countries develop nuclear weapons." Both of these commitments probably were motivated by the Chinese desire to conclude negotiations on a bilateral nuclear cooperation agreement so that China could gain access to US reactor technologies. The ability and/or willingness of the government to implement them was limited. Neither of these commitments was part of China's export law and probably were not communicated to the Chinese nuclear companies involved in exporting goods. At that time, China had no functioning export control system, set of export control laws, or technology lists that governed China's nonproliferation commitments. China's arms control and nonproliferation community similarly was underdeveloped. China's nascent community of arms control and nonproliferation experts were based mainly at the UN in New York or at the Conference on Disarmament in Geneva and focused on broad arms control issues like nuclear disarmament and nuclear testing. Nonproliferation was not an independent discipline in China. Also, there was little bureaucratic support in the Foreign or Trade ***m***inistries to understand or implement the 1984 pledges. China's continued nuclear relationship with Pakistan throughout the 1980s provides the best evidence of the limited scope and weaknesses of China's initial nonproliferation pledges.[355]

Chinese Nuclear Exports in the 1990s

By the early 1990s, the character of China's nuclear exports had begun to change. Chinese companies stopped providing nuclear-specific materials, equipment, and technologies to unsafeguarded facilities in countries with suspected nuclear weapons programs like Argentina, Brazil, India, and South Africa. The geographic scope of China's nuclear exports declined to cover mainly Iran and Pakistan; the character of China's remaining nuclear exports gradually shifted to dual-use nuclear goods; and the relative contribution of these exports to nuclear proliferation accordingly declined. These developments were further enhanced by the gradual expansion throughout the 1990s of China's formal nuclear nonproliferation commitments (China signed the NPT in 1992), its nuclear export control laws, and bureaucratic support within China for nuclear nonproliferation. These trends are detailed below.

China's nuclear cooperation with Iran expanded in the early part of the 1990s, but by the end of the decade it had almost entirely stopped. This contraction was a direct result of US pressure on China to cease all nuclear cooperation with Iran. Beginning in the early 1990s, China signed several reactor deals and contracts for other fuel-cycle-related facilities with Iran. China sold Iran a small zero-power research reactor and a zirconium tube production facility. Both of these were placed under IAEA safeguards and have been visited several times by inspectors. During this same period, China and Iran concluded a deal for a small 20 MW research reactor. Yet, by 1992 China canceled the deal under US pressure. Chinese officials were concerned that the deal would have complicated China's bid to secure renewal of Most-Favored-Nation (MFN) trading status with the United States.[356]

Around 1992, China and Iran signed another, larger contract for the export of two 300 megawatts electric (MWe) Qinshan-type reactors and a uranium hexafloride (UF_6) production facility. As before, the United States opposed these transactions, fearing they would contribute to Iran's nascent nuclear weapons program. US officials argued that two reactors and the UF_6 facility--although legal under the NPT--would move Iran further up the "nuclear-weapon ladder." Chinese officials countered that Iran was a member of the NPT, previous inspections had found no evidence of noncompliance with the treaty, and all these facilities were subject to IAEA safeguards.[357] Sino-US debates about these facilities came to a head in 1997 as Beijing and Washington began to discuss implementation of the dormant 1985 US-China nuclear cooperation agreement. Both sides finally reached an agreement during the Clinton-Jiang summit in October 1997. In exchange for China's cancellation of these two projects and its agreement to halt all future nuclear cooperation with Iran, the United States would allow the NCA to enter into force. As part of this deal, China was allowed to continue two nuclear projects: the zero-yield reactor and the zirconium production facility.[358] The CIA has verified in several reports to Congress that since 1997 China continues to adhere to this pledge to end all nuclear cooperation with Iran.[359] Thus, as of 1999, almost all of China's nuclear exports to Iran have stopped. This virtual halt to Sino-Iranian nuclear cooperation stands in stark contrast to the ambitious plans for bilateral nuclear cooperation that Tehran and Beijing reached at the beginning of the decade.

During the 1990s, direct assistance to Pakistan's nuclear weapons program appears to have ended, while the scope of China's other assistance has narrowed significantly. Chinese firms provided Pakistan with a variety of nuclear goods and technical assistance that *indirectly* contributed to Pakistan's nuclear weapons program. Much of the assistance over the last 10 years involved exports of dual-use nuclear goods and nonnuclear technologies to unsafeguarded facilities involved in fabricating nuclear materials for weapons. China's assistance to Pakistan on three projects will help to elucidate the scope of the relationship.

First, China reportedly provided Pakistan with construction assistance for a 50-70-MW plutonium production reactor at Khushab; this facility is not under IAEA safeguards and, if operational, would provide Pakistan with an unsafeguarded source of plutonium-laden spent fuel. In 1995, for example, a Chinese company exported a special industrial furnace and high-tech diagnostic equipment to the Khushab facility.[360] Although these technologies have clear civilian functions, their destination suggested a more pernicious end use. China has since promised to halt all assistance to this and other unsafeguarded facilities.

Second, Chinese firms reportedly were assisting Pakistan with the construction of a partially completed, unsafeguarded reprocessing center located at Chasma; if Pakistan completes this facility, then operating it in conjunction with the Khushab facility would provide Pakistan with an unsafeguarded source of plutonium. Also at the Chasma site, China is building a 300 MWe power reactor for electrical generation purposes. The reactor has little proliferation relevance and will be under IAEA safeguards.[361] Yet, Chinese work on the reactor could function as a "cover" for assistance to the Chasma reprocessing facility or other projects in Pakistan. Some sources indicate that Chinese and Pakistani experts already have considered this possibility.[362]

Third, in 1995 a Chinese firm supplied Pakistan's Kahuta Research Laboratory with 5,000 custom-made ring magnets for use in high-speed gas centrifuges. This plant, which is not under international safeguards, serves as Pakistan's main source of HEU for the nuclear weapons program. The proliferation relevance of these specialized magnets is not readily evident, however. They are a dual-use item that are not listed on any international nuclear trigger list but rather are part of a key technology, magnetic suspension bearing, which is a controlled as a dual-use item. Yet, the sale of these magnets raised concern on the part of the US due to their custom-made design for enrichment centrifuges and, more important, their destination at the Kahuta facility. The ring magnet incident was particularly significant because it raised questions about the ability of Chinese officials to control the actions of Chinese firms. Chinese officials claimed not to know about the magnet deal, and thus argued they should not be held accountable for it.[363]

The ring-magnet incident was especially important because it both highlighted the emerging problem in the 1990s of the government's difficulty in controlling exports, and catalyzed China to institutionalize many of its nonproliferation commitments. Following the episode, Chinese officials began to clarify its nuclear nonproliferation commitments and to codify them in domestic law. In 1996, following the incident, China publicly pledged not to "provide assistance to unsafeguarded nuclear facilities." This promise built on China's 1992 NPT obligations by expanding them to cover dual-use nuclear items or *any* nonnuclear goods to unsafeguarded facilities in Pakistan or other countries. These pledges were followed by the promulgation of nuclear export control laws that incorporate the Nuclear Supplier Group (NSG) trigger lists.[364] China's first nuclear export control law was issued and published in 1997 and a second one, specifically covering dual-use nuclear goods, was released in June 1998. The latter law importantly includes a "catchall" clause to stop any and all dual-use nuclear exports not specifically mentioned in the regulations; this step even goes beyond the NSG restrictions on dual-use exports. (See Appendix III.) Since the early 1990s, China has also developed the bureaucratic infrastructure to help implement these commitments. The China Atomic Energy Agency or CAEA (*Zhongguo Guojia Yuanzineng Jigou*) in conjunction with MOFTEC and the Foreign Ministry have assumed responsibility for overseeing the nuclear export control process. Recent organizational changes in China have further bolstered this process. First, the CAEA was separated from the China National Nuclear Corporation which is China's main exporter of nuclear materials, equipment, and technologies; thus the CAEA is no longer subject to the direct pressure of the CNNC when making export control decisions. Second, the Foreign Ministry within the last two years established a Department of Arms Control and Disarmament Affairs (*junkong si*) under the directorship of one of China's most experienced arms control experts, Sha Zukang. This department has an entire division of some 10 experts devoted to Chinese nuclear affairs including nuclear exports and export control issues.

Although these bureaucratic changes represent a step in the right direction, concerns about Sino-Pakistani nuclear cooperation persist. First, the Chinese Government continues to have difficulty implementing and enforcing its nonproliferation commitments and nuclear export control laws. There are Chinese companies, usually small ones, that either do not know the government's laws or that disregard them in an effort to earn hard currency. China's commercial nuclear ties to Pakistan are deep, which may facilitate continued nuclear-relevant exports. The ring-magnet incident in 1996 represented the first public instance of the continuing problem of how to promote respect in China for the government's international commitments and domestic laws. Until the central government is able to control the activities of these small, "rogue" firms, Chinese nuclear exports will remain an issue of concern for US policymakers.

Second, aside from illicit exports of dual-use equipment and materials, Chinese scientists and technicians may still be providing secret technical assistance to their Pakistani counterparts. Although China has adopted controls on exports of nuclear materials, equipment, and technologies, tracking and controlling technical exchanges by personnel is inherently difficult. Mutual visits by key scientists to weapons-related facilities in both China and Pakistan probably continue. In one instance, China's existing nuclear cooperation with Pakistan on the Chasma power reactor may provide a cover for exchanges related to Pakistan's construction, operation, and maintenance of unsafeguarded facilities.[365]

China and Missile Proliferation[366]

In the last 10 years, China's exports of ballistic and cruise missiles and related technologies have undergone an evolution similar to, but not as dramatic as, the reduction in China's nuclear exports. The geographic scope of China's missile exports has narrowed to include Iran, Pakistan, and, to a lesser extent, North Korea. The character of China's missile exports has shifted from sales of complete systems to exports of dual-use missile technologies. China also has assumed a growing number of missile nonproliferation commitments. In contrast to the nuclear area, however, many of them are vague, lacking legal basis, and poorly implemented. Significant concerns also persist about China's interpretations of its pledges. As of 1999, the principal US concern about China's missile proliferation revolves around the continued export by Chinese firms of dual-use missile technologies and production technologies to organizations in Pakistan, Iran, and North Korea that are involved in missile development.

Beginning in the late 1980s and ending in the early 1990s, China actively marketed and sold a variety of complete ballistic and cruise missiles to several countries. As early as 1986, China sold hundreds of HY-2 Silkworm and C-801/YJ-8 cruise missiles to Iran and Iraq; in Iran some of these systems were fitted on land-based batteries for coastal defense, and others were mounted on fast-attack crafts and used to threaten Persian Gulf shipping.[367] China also provided Iran with production technologies to facilitate indigenous construction of these systems. As China's missile cooperation with Iran began to expand rapidly, China exported 30-35 DF-3 (CSS-2) intermediate range ballistic missiles to Saudi Arabia in 1988. These missiles, drawn from China's stock of aging missiles, possess a range of approximately 2,800 km that allowed Saudi Arabia--for the first time--to target most Middle East capitals.[368]

Chinese exports of complete missiles continued in the late 1980s when Chinese firms began to market and sell the newly developed M-9 and M-11 missiles. The M-9 and M-11 were developed specifically for export and were welcome additions to the international missile market in the late 1980s. These missiles, which are Chinese designed and solid fueled, were far more reliable and accurate than the majority of the Scud-derivatives available at that time. China negotiated with Pakistan, Iran, and Syria for the sale of both M-9s and M-11s. By late 1989, China and Syria reportedly signed a $285 million contract for approximately 30 M-9 missiles and launchers; the Syrians even provided advance funds for the missiles that the Chinese promptly spent before deliveries began.[369] China and Iran had also engaged in extensive discussions about exports of M-9 missiles. One report indicated that by January 1990 China and Iran agreed on the export of M-9 missiles and production tooling, suggesting the possible sale of production technologies along with the full missiles.[370] Other reports indicated Iran financially supported the M-9's development as Tehran is known to have done for North Korea's Nodong missiles.[371] There is little evidence to suggest that Iran was interested in the M-11 missile, however. China also began selling Iran a short-range, battlefield missile with a 150-km range; it was known as the 8610 or CSS-8. By 1989 China had sold some 150-200 of these systems to Iran and also had begun providing technologies for the creation of a production line to facilitate Iran's indigenous development of the 8610 system.[372] China's discussions with Pakistan focused on the possible supply of the M-11 missile. Sino-Pakistani negotiations proceeded quickly, and by 1990 China had transferred a training M-11 missile and launcher. A final shipment of 34 M-11s reportedly arrived in November 1992.[373]

In response to China's missile marketing, the United States actively sought, and in many cases succeeded, in curbing China's behavior. Reeling from the shock of China's DF-3 sale to Saudi Arabia and its perceived impact on Middle East stability, the Bush Administration immediately launched a vigorous effort to halt China's exports of M-9 and M-11 missiles. This campaign involved several rounds of bilateral discussions combined with the imposition in 1991 of limited economic sanctions for violations of the 1990 Missile Control Act. Finally in late 1991 and again in 1992, Chinese officials pledged verbally (and later in writing) that China would adhere to the guidelines and parameters of the MTCR. By assuming this commitment, China was forced to cancel the proposed sale of M-9 missiles to both Iran and Syria; this was especially difficult in the case of Syria because a contract had been signed and advance funds had been provided to Chinese firms. Neither the Iranian nor the Syrian deal went forward. The 1991/1992 MTCR commitment is particularly important in evaluating the changes in the scope, content, and frequency of China's missile export activities. Beijing's 1991 MTCR commitment provided a tangible, upper-bound limit on China's missile export activities. Since late 1992, China has not sold any complete MTCR-class missiles to any countries. Beijing even denied Saudi Arabia's 1997 request for replacement versions of the DF-3s purchased in 1988. Rather, China has limited its missile exports to transfers of dual-use missile technologies to Iran, Pakistan, and, to a lesser extent, North Korea. These exports continue today and define the scope and content of China's missile proliferation activities.

Two ambiguities in China's original MTCR pledge have directly influenced the character of China's missile exports in the 1990s. Detailing these areas of confusion will help to explain the scope of China's exports in the last decade. First, during the 1991 negotiations on the MTCR, both sides explicitly agreed that the MTCR covered the M-9 missiles, given its 600-km range. Yet, US and Chinese officials failed to reach agreement on whether the MTCR covered the M-11 given its published range of 290 km. The bilateral MTCR negotiations ended with no resolution to this issue.[374] This ambiguity helps to explain the subsequent Sino-US controversy over China's late 1992 M-11 exports to Pakistan; from China's perspective, M-11 exports to Pakistan were not covered by its MTCR commitment. A second factor to consider is that in China's original MTCR formulation, Beijing never agreed to accept the MTCR annex, which specifies all of the technologies controlled by this regime. China's reluctance to accept the annex has resulted in the continuation of missile technology exports to Iran, Pakistan, and North Korea.

Chinese Missile Exports in the 1990s and Beyond

Since 1991, Chinese firms have provided limited amounts of dual-use technologies to help Iran build short-range ballistic missiles; some of these technologies also may have been used to improve Iran's medium-range systems. Chinese assistance can be divided into two general categories. On one level, China has provided Iran with production technology for key sub-components for Iran's short-range 8610 missiles; these systems are below MTCR parameters and are not prohibited by any international agreement. China reportedly sold computerized machine tools, specialized steel, gyroscopes, accelerometers, and test equipment that Iran uses to build and test missile airframes and guidance and control systems.[375] Based on this type of assistance, Iran has probably developed a self-sufficient production infrastructure for short-range missiles, possibly including the construction of a facility to produce the Chinese missiles. On a second level, Iran may be using these production technologies to build subsystems for medium- and long-range systems, which are explicitly banned by the MTCR. The production technologies used to build the 8610 missile may also accelerate Iran's construction of indigenous missiles like the Shahab-3 or to improve the Scud-type missiles supplied by North Korea. Some reports suggest that China also may have transferred telemetry equipment for use when test launching medium-range missiles banned by the MTCR.[376] Chinese officials continue to defend these deals by citing the dual-use nature of its technology exports to Iran and the lack of agreement between the United States and China on the MTCR technology annex.

However, the proliferation significance of China's missile technology exports to Iran must also be evaluated in the context of Iran's overall ballistic missile program. Given the limited scope of China's assistance, its technology exports are not likely to be crucial to the long-term viability of Iran's missile development. The Iranian missile program is dominated largely by North Korea missiles improved with some Russian assistance. Iran's preference in the last several years appears to be for the purchase of complete missile systems that readily are available from Pyongyang. Iran has purchased numerous Scud B, Scud-C and No Dong missiles from the North and Iran's two newest missiles--the Shahab-3 and *Zelzal*--probably are Scud-derivative missiles. Chinese technologies do not contribute significantly to the development of any of these systems.[377]

Until 1997 China's contributions to Iran's antiship-cruise-missile arsenal were arguably more significant than its ballistic missile assistance in the 1990s. China provided Iran with a full array of antiship cruise missiles and the ability to indigenously produce these systems.[378] Yet, by the end of the decade such assistance had stopped. As mentioned above, in the mid-1980s China sold Iran hundreds of HY-2 and C-801 cruise missiles.[379] This cooperation expanded in the early part of the 1990s when China began providing Iran with the equipment, materials, and technologies needed to indigenously produce these missile systems. As Iran's naval modernization program accelerated in the early 1990s, China and Iran concluded a deal for China's newest and most capable antiship cruise missile known as the C-802. In the fall of 1993, China delivered its first shipment of C-802s to Iran, and these were quickly followed by the means for Iran to indigenously produce the missile.[380]

This cooperation lasted until Fall 1997 when China agreed--under US pressure--to cancel all C-801 and C-802 shipments. At that point, China had delivered approximately 150 of the 400 missiles Iran previously ordered. For months US officials heavily lobbied their Chinese counterparts to cancel these deals by arguing that they would threaten the free flow of oil through the Persian Gulf. In the context of the first Clinton-Jiang summit in October 1997, Chinese Foreign Ministry officials provided Secretary of State Madeline Albright with a verbal pledge that China would cease all C-801 and C-802 exports to Iran. This pledge reportedly also covered exports of production technologies.[381] China's Defense Minister Chi Haotian reaffirmed this ban in January 1998 during meetings with Defense Secretary Cohen; US intelligence documents indicate that during these meetings Chinese military officials also agreed not to provide over-the-horizon targeting for the C-801s and C-802s Iran already possessed.[382] Recent questions about China's adherence to its 1997 cruise missile export ban have proven unfounded. In response to press reports that Chinese firms were assisting Iran with air-launched cruise missiles, both the US State Department and China's Foreign Ministry issued statements confirming that the 1997 commitment banned exports of only C-801s and C-802s and not other cruise missiles. Thus, in the course of 10 years, China's antiship cruise missile assistance had declined dramatically; not only has China stopped selling additional C-801s and C-802s to Iran but also all production assistance for these missiles has stopped as well.

Similar to China's missile cooperation with Iran, China's assistance to Pakistan's missile programs narrowed significantly in the 1990s. Following the M-11 deliveries in late 1992, China capped its M-11 exports to Pakistan and is not known to have supplied Islamabad (or any other country) with MTCR-class missiles. Rather, Chinese firms have supplied Pakistan with a wide range of equipment, materials, and technologies for its missile programs. According to 1998 Senate testimony of Gordon Oehler, China has focused on exports of "production technologies and components" for Pakistani missiles.[383] Much of this assistance has been for China's largest missile project in Pakistan: the construction of a missile production facility at Rawalpindi. A 1997 Pentagon report on global proliferation developments confirmed the existence of this facility and China's central role in the plant's construction.[384] China is reported to have provided Pakistan with the blueprints and much of the equipment to build and possibly to outfit the facility; the plant's construction reportedly began in 1995 based on a decade-old contract.[385] Open sources are unclear whether this facility will be used to build complete missiles or just missile components and sub-systems; this determination will affect China's compliance with the MTCR. Thus, until this facility becomes operational, questions will remain about the nature of China's missile assistance to Pakistan and the degree to which China's actions are consistent with its MTCR pledges.

As of 1999, China's missile cooperation with Pakistan remains an active issue worthy of significant US and international concern. China's past missile assistance has been extensive (as detailed above), and it is continuing despite the deterioration of the security environment in South Asia. Chinese firms continue to aid in the construction of the missile facility at Rawalpindi that are likely to produce M-11/DF-11 missiles under the Pakistani designation Hatf-3. Also, Pakistan's recently tested *Shaheen* has design characteristics that are similar, but not identical, to China's M-9/DF-15 missile. Although China's missile nonproliferation commitments regarding South Asia have recently expanded, Beijing's willingness and ability to implement them remains ambiguous. Following the June 1998 summit meetings in Beijing, the United States and China issued a Joint Statement on South Asia that said "our respective policies are to prevent the export of equipment, materials, or technology that could in any way assist programs in India or Pakistan for nuclear weapons or for ballistic missiles capable of delivering such weapons, and that to this end, we will strengthen our national export control systems." This statement appears to remove all remaining uncertainty about the commitment of the Chinese Government to halt further missile assistance to Pakistan (including MTCR Category II technologies) and signals China's commitment to begin developing legally based export controls on MTCR-controlled technologies. Yet, this agreement--which was reached by senior US and Chinese leaders--is opposed by many parts of the Chinese bureaucracy, and Chinese Government officials have done the minimum to implement it.[386] The ability of the government to enforce these commitments is also not clear. Chinese firms have deep relationships with their counterparts in Pakistan. These Chinese entities often do not share the government's commitment to nonproliferation, and thus Beijing has difficulty controlling their export activities. This situation is especially true in the missile realm because China lacks regulations covering these items; thus, the government has no legal basis to monitor or punish firms.

China's Uncontrolled Missile Technology Exports in the 1990s

The ability and willingness of Chinese firms to sell dual-use missile technologies to potential proliferants is particularly evident in the patterns of exports to countries *other than* Iran or Pakistan. Throughout the 1990s, Chinese firms have concluded a number of deals with potential proliferants. These deals raise questions about the Chinese Government's ability to control various Chinese companies and, ultimately, to implement China's nonproliferation commitments. In 1992, a Chinese company exported 300 tons of ammonium perchlorate to Syria, possibly for use in making solid rocket fuel; that same year Libya received a shipment of lithium hydride, which has direct application to missile fuel production, and in 1994 another Chinese firm also exported ammonium perchlorate to Iraq in direct violation of the UN embargo.[387]

One of the most recent and most worrisome examples of unapproved assistance involved exports by Chinese firms to North Korea's ballistic missile program. Reports in early 1999 indicated that scientists from China's Academy of Launch Technology (CALT) had provided some low-level assistance to engineers in North Korea. Chinese firms also allegedly sold a variety of dual-use technologies to the North including accelerometers, gyroscopes, and specialized machinery used to build missile airframes. Yet, there is little evidence that the Chinese Government approved any of these exports.[388] A further confirmation of the links between firms in China and North Korea came in a recent CIA report on global proliferation developments. An unclassified CIA report on proliferation developments in the latter half of 1998 indicated that Chinese "entities" had sold specialized steel to the North and had provided some unspecified space technologies to organizations involved in missile development.[389]

Understanding China's Missile Nonproliferation Commitments

China's interpretations of it missile nonproliferation commitments lie at the heart of the problem of Beijing's continued sales of missile technologies to Iran and Pakistan. As argued above, China's original MTCR pledges suffer from some basic weaknesses. China has never accepted the MTCR annex as the definitive list of items to be controlled under the regime. China has also never accepted the 1993 revisions to the MTCR's guidelines and parameters. Thus, the United States and China have little basis for agreement on which items are banned under the MTCR. In stark contrast to China's work in the areas of nuclear and chemical goods, China has not yet issued a series of export control regulations covering MTCR-controlled equipment, materials, and technologies. Without these regulations, the Chinese Government has no legal authority to monitor, control, or curb the exports of Chinese firms. Chinese Foreign Ministry nonproliferation specialists maintain that, at best, the Foreign Ministry can request that a firm halt certain export activities but their power and influence is limited by the absence of regulations.

Barriers to a resolution of this issue are real. First, Chinese officials generally are reluctant to expand their existing MTCR commitments. From its inception, Chinese officials have criticized the MTCR as a discriminatory regime that relies on double standards and that focuses too heavily on the supply side of the issue. In particular, the Chinese are quick to point out that the MTCR does not control exports of strike aircraft, which arguably are better delivery vehicles for WMD than missiles and which the United States sells all over the world. Although China agreed during the June 1998 Clinton-Jiang summit to "actively study" MTCR membership, Chinese officials have been reluctant to carry out this commitment. Many Foreign Ministry officials opposed this summit statement, which they regarded as a political commitment made in the context of bilateral talks. Thus, they have been reluctant to implement it fully. As a result, in the last year, the United States and China have achieved very little movement on China's membership in the MTCR. Aside from one bilateral meeting in November 1998, there have been no further discussions.

Second, China's original and subsequent missile nonproliferation commitments are bilateral, political promises made in the context of US-China bargaining. Chinese officials probably interpret them from that perspective. According to a recent study on Chinese arms exports, "Beijing's pledges may rest more on political understandings about US-China relations rather than apolitical contractual obligations" that uphold international norms.[390] As such, China has begun to link its missile technology exports to changes in US policy, such as reductions in US arms sales to Taiwan. Chinese officials and scholars argue that continued US arms sales--particularly missile defense exports to Taiwan--constitute a form of missile proliferation.[391] They maintain that China will become a member of the MTCR when the United States curbs its military sales to Taiwan. Chinese Foreign Ministry officials argue that only when the United States respects China's security concerns about US weapons exports to Taiwan will China seriously consider US security concerns about China's missile technology cooperation with Iran and Pakistan.

China and Chemical Weapons Proliferation

Unlike Chinese exports in the nuclear and missile areas, China's chemical-weapons (CW)-related exports did not emerge as a serious problem until the early 1990s. China's chemical industry in the 1980s (particularly the private chemical producers) had just begun to grow and expand, and they assumed a wide-scale export orientation only at the beginning of the 1990s. Yet, the nature of China's CW-related exports has not changed significantly throughout the last decade. The geographic scope of this problem has remained limited to Iran and, to a lesser extent, Syria. The nature of the assistance continues to be dual-use equipment, materials, and technologies used to produce chemical weapons; specific exports have included chemical precursors, chemical production equipment, and production technology. The central problem continues to be illicit sales by Chinese firms operating outside of government control in marketing and selling dual-use items to Iranian and Syrian organizations involved in chemical weapon production.

The linkages between Chinese and Iranian firms have been documented numerous times in official US Government documents and policy statements. As early as 1992, then CIA Director Robert Gates noted in Congressional testimony that Syrian firms were actively seeking CW production assistance from China.[392] In 1995, Deputy Assistant Secretary of Defense Bruce Reidel added that "Chinese firms have provided some assistance (to Iran), both in terms of infrastructure for building chemical plants and some of the precursors for developing agents."[393] The Defense Department's 1997 report on global proliferation developments bluntly affirmed these connections:

China is an important supplier of technologies and equipment for Iran's chemical warfare program. Therefore, Chinese supply policies will be key to whether Tehran attains its long-term goal of independent production for these weapons.[394]

US concerns about these activities culminated in May 1997 when the United States imposed economic sanctions on three Chinese companies and five Chinese citizens for assisting Iran's chemical weapons program in the early 1990s. This case involved the exports of nerve gas precursors (e.g., thionyl chloride, dimethylamine, and ethylene chlorodydril) and chemical production equipment and technology. The Chinese Government was not implicated in this incident because the exports were attributed to private chemical-producing firms operating without government consent.

In assessing China's CW-related exports to Iran and Syria, one factor that may have declined throughout the last decade has been the frequency of such exports. In the early part of the 1990s, Chinese exports of CW-related goods largely resulted from the inability of China's export control infrastructure to regulate adequately these types of sales. China simply lacked the proper regulations, the legal authority, and the bureaucratic structure to control the activities of Chinese firms. This situation began to change in the mid-1990s as China assumed a number of international commitments and set up domestic structures to limit CW-related exports. These probably have helped the government to control illicit exports to known CW aspirants like Iran and Syria. Beginning with China's signature of the Chemical Weapons Convention in 1993, the Chinese Government has taken numerous steps to erect an extensive chemical export control architecture. In 1995 China issued its first "Regulations on Chemical Export Controls" (*Jiankong Huaxuepin Guanli Tiaoli*); this law included a "schedule" of controlled chemicals based on the CWC and regulations that provide for strict control on the transfer of items listed in the schedule.[395] (See Appendix III.) In March 1997, the government issued a supplement to the 1995 regulations in preparation for China's CWC ratification.

An August 1997 law further buttressed the existing ones. The Ministry of Chemical Industry (MCI) in conjunction with the Foreign Ministry, the Ministry of Foreign Trade and Economic Cooperation (MOFTEC), and the Customs Administration jointly issued a circular to further strengthen China's controls on chemical exports. This step was especially important because it established a registration, licensing, and approval process for all chemical equipment, materials and technologies; the law also importantly required authorized exporters to seek special approval for export to non-CWC signatories. Most recently, China expanded the scope of these regulations in June 1998 when it added some 10 dual-use chemicals not previously covered in the 1995 law. In addition, powerful bureaucratic interests in the Chinese Government track this issue. China's CWC Implementation Office has high-level political backing because its nominal head is Wu Bangguo, a vice premier. Also, the Foreign Ministry has a division of some 10 experts within the Department of Arms Control and Disarmament Affairs devoted to tracking China's compliance with the CWC and China's export control laws.

Although the Chinese Government has erected these legal barriers and committed parts of the bureaucracy to monitoring China's chemical exports, Beijing's ability to implement and enforce its laws and commitments remains a continuing challenge. Despite the promulgation of the laws in 1995 and 1997, CW-related exports by Chinese firms to entities in Iran has continued. In November 1996, China reportedly sold about 400 metric tons of chemicals (including carbon sulfide) used in the production of nerve agents and riot-control and tear gas to an Iranian chemical center.[396] Also in 1996, the US Central Intelligence Agency reported that Iran "obtained considerable CW-related assistance from China in the form of production equipment and technology" and that "Iran obtained the bulk of its CW equipment from China and India."[397] One such instance involved a 1996 delivery of two tons of calcium hypochlorate, a chemical used for decontamination, and an additional 40,000 barrels in early 1997.[398] More recently, in May 1998 the I>Sunday Telegraph reported that a Chinese firm had supplied Iran with 500 tons of phosphorus pentsulphide in 10 consignments of 50 tons each for an estimated $924,000. The chemical can be used for pesticides, but it is also a precursor for VX. The secret deal reportedly was concluded in April 1998 by Iran's Defense Industry Organization and a local branch of the SinoChem Agency.[399]

Several factors help to explain the difficulties the Chinese Government faces in curbing the chemical export activities of Chinese firms. First, China's chemical industry is one of its largest and most widely dispersed, and unlike the nuclear and aerospace industries, most chemical exporters are private, nonstate enterprises. China produces some 15,000 chemical products by 14,500 chemical producers scattered throughout 22 provinces (not including Taiwan), 5 autonomous regions and 4 municipalities. Gansu Province, which is one of China's most underdeveloped provinces, has 157 chemical production plants.[400] Informing these companies about government regulations and monitoring their behavior is an inherently difficult task. Many of these small companies probably do not know about the regulations; their priorities are to make profits rather than strictly adhere to government regulations.

Second, the export control culture in China is not strong. During the Maoist period, laws regulating exports were not required because only a small number of companies were allowed to trade on the international market. Modern export control laws, which are highly detailed and require strict adherence, differ significantly from the day in which firms were required to interpret broad-based policy directives. Third, the deal-making activities of certain Chinese individuals, like Chen Qingchang (a.k.a. Q. C. Chen), who operate outside government control, have been instrumental in promoting contracts between Chinese companies and Iranian firms. The activities of this individual, in particular, have undermined the Chinese Government's ability to meet its CWC obligations. The Chinese Government's apparent inability or unwillingness to control Chen's dealmaking contributes to China's continued chemical exports to Iranian organizations involved in chemical weapons development.[401]

Fourth, US intelligence information on illicit chemical exports that is provided to Chinese officials is often inadequate for investigative purposes. Based on discussions with Chinese Foreign Ministry officials, US intelligence information is normally too vague to help Chinese officials to identify specific firms. Because the United States often provides the names of individuals and firms engaging in illegal activity using the pinyin rendering and with little more information, Chinese officials have had significant difficulty identifying the actual firms or persons given, the size of China's chemical industry.

Finally, there is a political dimension to the problem of China's CW-related exports. China rejects membership in the Australia Group (AG) on the grounds that it is not a multilateral treaty like the CWC, that it interferes in the operation of the CWC, and that it unfairly targets countries like Iran.[402] Chinese companies continue to export dual-use chemicals controlled by the Australia Group (AG), but not the CWC. This stance has resulted in the export of goods to Iran that the US opposes on the grounds they are covered in the AG. As a result, China's political opposition to the AG as a discriminatory and redundant regime has been the source of several bilateral disputes with the United States. These five problems suggest that, although the frequency of China's CW-related exports may be declining, the Chinese Government continues to face the difficult task of implementing and enforcing the laws its has adopted. Until the Chinese Government is able to establish an effective system for monitoring and controlling the export behavior of its chemical firms, then CW-related exports probably will continue.

Conclusions and Implications for US Policy

China's WMD proliferation activities have undergone a significant transition in the last twenty years. The geographic scope: the types of technologies; and the frequency of Beijing's nuclear, chemical, and missile exports have all declined over the last two decades. In the 1980s, Chinese firms were directly assisting military nuclear activities in a variety of countries all over the world, Chinese entities were marketing and selling complete ballistic and cruise missiles to several nations in the Middle East and South Asia, and in some cases these nuclear and missile exports involved transfers of critical technologies for indigenous production. Today, the nature of China's WMD-related exports has declined significantly as compared to the activity in the 1980s. Exports are limited to three countries (Iran, Pakistan, and, to a lesser degree, North Korea), these deals involve mostly dual-use nuclear, chemical, and missile technologies that at best indirectly assist WMD development, and the frequency of such exports appears to have slowed to a dribble. An additional element of the current situation is that some of these exports, particularly from the chemical industry, are the result of Chinese firms operating beyond government controls, not deliberate government policy decisions. China's current WMD proliferation activities are fundamentally different from those of a decade ago.

None of this is meant to suggest that China's current WMD-related exports are not a serious problem for US policymakers. Exports of WMD-related technologies to nations like Iran, Pakistan, and North Korea are particularly threatening to US national security interests. Any assistance to the WMD programs in these countries has the potential to threaten US forces stationed abroad and US friends and allies in East Asia and the Middle East. Exports to South Asia should be viewed as particularly dangerous, given their potential to accelerate ongoing nuclear and missile races, which could easily escalate into conflict.

Given these threats to US security, the challenge for US policymakers is to develop policies that address the current scope of the China proliferation activities, not the past problem. The current US burden is no longer to convince China to fully embrace the nonproliferation regime with all its treaties, agreements, control lists, and legal obligations. China has largely done this on a broad scale in the areas of nuclear exports, chemical exports, and, to a lesser extent, ballistic missiles. (See Appendix IV.) This objective was accomplished through a tactful mix of US diplomacy, unilateral pressures, and imposition of economic sanctions. As this paper has documented, in multiple instances in the 1980s and 1990s US intervention was instrumental in bringing about the cancellation or limitation of Chinese nuclear, chemical, and missile assistance to Algeria, Iran, Pakistan, and Syria.

Yet, these successes of US nonproliferation policy largely have gone unappreciated by Congress and the US media. Some seize on any Chinese military export as a nonproliferation violation without considering the type of transfer or the precise nature of China's commitments and bilateral differences about those pledges. Few acknowledge the narrowing of China's WMD proliferation activities, the expansion of its formal commitments, and the growth in government resources used to implement these pledges. During Congressional debates about China in 1997, three prominent Congressmen called China "the Wal-Mart of international nuclear commerce,"[403] and the 1999 Cox Committee Report characterized China as "one of the leading proliferators of complete ballistic missiles systems" based on its exports of missiles in the late 1980s and early 1990s. China's past proliferation transgressions are being used to evaluate Beijing's current and future behavior without regard for the US successes in limiting Beijing's WMD proliferation activities.

The current policy challenges presented by China's remaining WMD proliferation activities are subtler. On one level, the United States must encourage the Chinese Government to fully comply with and implement its nonproliferation commitments by cracking down on Chinese entities engaged in exports that violate the government's obligations and domestic Chinese law. This task is indeed daunting, given the number of enterprises and the dual-use nature of many of the exports.[404] Effectively resolving this problem probably will require deeper bilateral cooperation than has existed in the past.

On a second level, US policymakers must seek to curb China's authorized assistance (regardless of how limited) to Iran and Pakistan. Resolving this issue will not be easy and will require overcoming relatively significant, possibly irreconcilable, differences. Chinese and US policymakers share few foreign policy interests and national security concerns in their respective relationships with Iran and Pakistan. These differences are compounded by differing views on dual-use technology controls and the obligations imposed by such supply-side nonproliferation agreements as the MTCR, the AG, and the NSG. Developing common security perceptions of global proliferation developments may help both sides set appropriate expectations and address the domestic challenges Beijing faces in controlling exports of WMD-related technologies. This approach is particularly important in light of Beijing's linkage of proliferation issues, such as missile exports to Iran, to Sino-US bilateral relations.

These two challenges, combined with the narrowing of China's proliferation activities, raise questions about whether past policies can work effectively on this narrower range of problems. The effectiveness of such classic US diplomatic tools as sanctions and bilateral pressure to address the immediate issues of dual-use exports and unauthorized transfers is questionable. The legal basis for sanctions in the dual-use realm is highly ambiguous. There is little international consensus about many dual-use goods, legal determinations are often politically controversial, and the practical impact of sanctions on Chinese behavior is potentially negative. Furthermore, intensifying diplomatic pressure on China carries its own inherent risks. US policymakers must be careful not to damage China's current nonproliferation commitments in pursuing an absolute end to all of Beijing's WMD proliferation activities. Such an outcome is possible given the current climate in which Beijing closely links its positions on arms control and nonproliferation to the overall state of US-China relations, US arms sales to Taiwan, and, recently, US missile defense proposals. An understanding of these linkages is dangerously absent from US debates on China's proliferation activities.

To address the two policy challenges mentioned above, policy initiatives can be found in several areas. Stopping China's unauthorized WMD-related exports will require greater cooperation than has existed to date. Both nations must take steps to improve China's capacity to recognize and address this issue. For example, the United States and China could improve the quality of intelligence sharing on both sides and could expand the scope of bilateral dialogues on export control training. Resolving the second challenge is far more onerous because it is based on profound bilateral differences about national security interests and the limits of nonproliferation. Some initial steps could involve expanding the depth of bilateral dialogues to isolate the key policy differences between Beijing and Washington. Nongovernment institutions could be particularly effective in this area. Nongovernment exchanges open up channels of communication on sensitive issues and, in a broad sense, promote the growth of epistemic communities in China involved in arms control and nonproliferation research. The expansion of these communities is particularly important in improving China's institutional capacity to address the increasingly complex global arms control and nonproliferation agenda.

As US policymakers consider the range of options to address China's WMD proliferation activities, past successes and recent progress in narrowing the scope of this problem should not be forgotten. Future progress will require, on the one hand, good bilateral relations to develop deeper cooperation and, on the other, a willingness in both countries to manage the more complex proliferation questions resulting from fundamental differences between Washington and Beijing about foreign policy and nonproliferation. The proximate US goal should be to remain vigilant about monitoring China's behavior and to expand cooperation in order to address the new nonproliferation challenges described above while preserving existing cooperation.

Appendix I

China's Nuclear Technology Exports in the 1980s and 1990s

Country	Type of Assistance
Algeria	**Research Reactor** • 15-megawatt pressurized heavy-water research reactor; possible provisions of heavy water for the reactor; construction began around 1988; placed under IAEA safeguards in 1992. • Designs for construction of third stage of Algeria's Center for Nuclear Energy Research.
	Low Enriched Uranium • 20% enriched, sold in 1980s, no safeguards.
	Heavy Water • 50-60 metric tons (1981-85); no safeguards.

<table>
<tr><td rowspan="2">Argentina</td><td>Uranium Concentrate (U_3O_8)
1981-85, no safeguards.</td></tr>
<tr><td>Uranium Hexafluoride Gas (UF_6)
Early 1980s, 30 metric tons; no safeguards.</td></tr>
<tr><td>Brazil</td><td>Enriched Uranium
3%, 7%, 20% enriched; 200-kg total.
1984, no safeguards.</td></tr>
<tr><td rowspan="2">India</td><td>Heavy Water
1982-87; 130-150 metric tons.
No IAEA safeguards.</td></tr>
<tr><td>Low-Enriched Uranium
1995, for India's Tarapur reactors.
Supplied under IAEA safeguards.</td></tr>
<tr><td rowspan="6">Iran</td><td>Research Reactors
27-kilowatt subcritical, neutron source reactor; provided in 1985; currently under IAEA safeguards.
Zero-power reactor; commercial contract signed in 1991; currently under IAEA safeguards.
HT-6B Tokamak nuclear fusion reactor, located at Azan University.
20-megawatt reactor; contract signed in 1992, but the deal was canceled due to US pressure.</td></tr>
<tr><td>Power Reactors:two 300-megawatt electric reactors
Deal suspended in 1995 and canceled in 1997.
CIA verified project cancellation.</td></tr>
<tr><td>Calutrons (electromagnetic isotope separators, EMIS)
For Karaj and Isfahan facilities; commercial contract signed in 1989; under safeguards.</td></tr>
<tr><td>Uranium Hexaflouride (UF_6) Production Facility
Project canceled in October 1997.
CIA verified cancellation of deal.
China possibly provided blueprints for facility.</td></tr>
<tr><td>Zirconium Tube Production Facility
Assistance continuing.</td></tr>
<tr><td>Uranium Mining Assistance</td></tr>
<tr><td>Iraq</td><td>Ring Magnets
Exports of samarium-cobalt magnets for gas centrifuges, 1989-90.</td></tr>
</table>

Pakistan	**Nuclear Weapon-Related Assistance** • **Nuclear Weapon Design** -- Basic, Hiroshima-sized weapon.
	• **Nuclear Weapon Testing** --Possible inclusion of Pakistani observers at China's Lop Nur test facility (1989).
	• **Possible Provision of Tritium Gas** --1986, no safeguards. • Uranium Enrichment --Assistance to unsafeguarded Kahuta enrichment facility. --This assistance was a two-way street.
	• **Weapons-Grade Uranium for Two Devices** --Early 1980s, supplied without safeguards.
	Dual-Use Nuclear Assistance • **Power Reactor**: Chashma-1, 300 megawatts electric --Construction is continuing. --Under IAEA safeguards (INFCIRC/418). • Reprocessing Facility at Chashma --Possible construction assistance to unsafeguarded facility
	• **Research Reactors** --Miniature neutron source reactor (MNSR); supplied under IAEA safeguards (INFCIRC/393) in 1991. --Construction assistance with Parr-2 reactor, unsafeguarded.
	• **Ring Magnets** --About 5,000 to unsafeguarded A. Q. Khan Research Laboratory in Kahuta (1995).
	• **Plutonium Production Reactor at Khushab** --50-70-megawatt heavy-water reactor (unsafeguarded). --Construction assistance. --Provided special industrial furnace and high-tech diagnostic equipment (1994-95). • **Heavy water (D_2O)** --Up to 5 metric tons/year for safeguarded PHWR [Kanupp] research reactor. --Possibly diverted by Pakistan to the Khushab research reactor against Chinese wishes. • **Fuel Fabrication Services**

Appendix II

China's Missile Technology Exports in the 1980s and 1990

<table>
<tr><th>Country</th><th>Type of Assistance</th></tr>
<tr><td rowspan="5">Iran</td><td>Ballistic Missiles
8610/CSS-8.
M-9/DF-15 (China canceled the sale under US pressure).</td></tr>
<tr><td>Cruise Missiles
HY-1.
100 HY-2 (Silkworm).
HY-4/C-201.
C-601.
YJ-1/C-801 (sales halted in October 1997).
YJ-2/C-802 (sales halted in October 1997).</td></tr>
<tr><td>Assistance to Iran's Indigenous Missile Programs
Extensive production assistance for the 8610/CSS-8 missile.
Extensive production infrastructure for HY-2, C-801, and C-802 missiles (production assistance halted in 1997).
Possible assistance to the Shahab-3 ballistic missile.
FL-10 air-launched cruise missile.</td></tr>
<tr><td>Missile Fuel
Various propellant ingredients.
Ammonium perchlorate.</td></tr>
<tr><td>Missile Guidance and Control Technology
Guidance kits (mid-1990s).
Gyroscopes (mid-1990s).
Accelerometers (mid-1990s).
Test equipment for ballistic missiles (mid-1990s).</td></tr>
<tr><td rowspan="2">Iraq</td><td>Cruise Missiles (1980s)
HY-2 (Silkworm).
C-601.
YJ-1/C-801.</td></tr>
<tr><td>Missile Engine Testing Facility/Project 3209
Supply of standard parts for liquid-propellant engine, late 1980s.</td></tr>
</table>

	Missile Fuel • 10 tons of UDMH, late 1980s. • 7 tons of lithium hydride; 1989-90; exported by the China Wanbao Engineering Company (CWEC). • Ammonium perchlorate, 1994.
Libya	**Missile Fuel** • Lithium hydride.
Pakistan	**Ballistic Missiles and Launchers** • 34 M-11/DF-11 missiles; stored at Pakistan's Sargodha Air Force Base near Lahore; delivered in November 1992. • M-11 transporter-erector-launchers (TELs).
	Possible Assistance to Indigenous Missile Programs • Hatf-1, Hatf-2, and Hatf-3 ballistic missiles.
	Missile Fuel • Ammonium perchlorate, 10 tons seized in Hong Kong in 1996; Pakistan's SUPARCO was caught attempting to import the ammonium perchlorate from a company in Xian, China.
	Missile Guidance • Gyroscopes. • Accelerometers. • On-board computers.
	Assistance to Missile Production Factory • Rawalpindi, 40 km west of Islamabad. • Likely producing Pakistani version of M-11 missile. • Blueprints and construction equipment, possibly ongoing.
Saudi Arabia	**Ballistic Missiles** • 30+ DF-3 (CSS-2) missiles; deliveries began in 1988; and included construction of launch complex, training, and post-sale systems maintenance. • In 1997, Saudi Arabia requested from China possible replacements for the aging DF-3 missiles; China did not provide any replacements.
Syria	**Ballistic Missiles** • DF-15/M-9 missiles, Syria provided advance payments. • Canceled under US pressure in 1991; Syria possibly received test missile.
	Assistance With Indigenous Programs • 30 tons of ammonium perchlorate in 1992. • Technical exchanges.

Appendix III

Summary of China's Esport Control Regulations and Decrees

Date	Regulation/Decree	Description
17 June 1998	Regulations on Export Control of Dual-Use Nuclear Goods and Related Technologies	These regulations were adopted by the State Council to strengthen control over exports of dual-use nuclear goods and related technologies in order to "prevent the proliferation of nuclear weapons, promote international cooperation on the peaceful use of nuclear energy and to safeguard national security and public interest." The regulations define the terms "dual-use nuclear goods and related technologies" in an annex, which draws on the international technology lists used by the Nuclear Suppliers Group (NSG). China's Ministry of Foreign Trade and Economic Cooperation (MOFTEC) serves as the administrator of these regulations. All companies that want to export dual-use nuclear goods and related technologies must first register with MOFTEC and complete an export application. MOFTEC then reviews the application in consultation with the China Atomic Energy Agency (CAEA) and "relevant State Council Departments," including the MFA. If an application is approved, then MOFTEC issues an export license. This process represents a change from the September 1997 regulations that require the CAEA to take the lead in administering the

		export controls.
		The dual-use regulations also include a "catchall" clause that allows MOFTEC to cancel a sale at its discretion, as long as the State Council approves; the inclusion of this clause goes beyond most other dual-use regulations such as those used by the NSG.
14 June 1998	Decree No. 1 of the State Petroleum and Chemical Industry Administration (regarding chemical export controls)	This decree expands the existing scope of China's chemical export regulations to include 10 dual-use chemicals that could be used to make chemical weapons. The 10 dual-use chemicals covered by this decree are listed on the Australia Group and thus represent an initial effort by China to adhere to that regime.
22 October 1997 (took effect 1 January 1998)	Regulations on Export Control of Military Items	The regulations stipulate that Chinese military exports are consistent with three principles: (1) assist the recipient country's self-defense capability; (2) do not damage regional or global stability; (3) do not interfere in the recipient country's internal affairs.
		For an analysis of these regulation, see Evan S. Medeiros and Bates Gill, Chinese Arms Exports: Policy, Players, Occasional Paper, (Monterey, CA: Center for Nonproliferation Studies, July 1999).

11 September 1997	Regulations on Nuclear Export Control (dual-use items not included)	These regulations provide for strict control over the sale of nuclear technology to other countries. This law states that "the state will carry out strict management and control of nuclear exports and will strictly fulfill its international obligation not to spread nuclear weapons." The rules require State Council approval for all such sales, and "prohibits providing help to nuclear facilities not subject to the supervision of international atomic agencies and will not provide exports, personnel, technical exchange or cooperation to those facilities." The CAEA, under the new Commission for Science, Technology, and Industry for National Defense (COSTIND), serves as the administrator for these regulations; this laws references all the technologies listed in the NSG control lists.
29 August 1997	Circular on strengthened chemical export controls	China's Ministry of Chemical Industry, Ministry of Foreign Affairs, MOFTEC, and the General Administration of Customs (GAC) jointly issued a circular strengthening controls of chemical-related exports; the circular stated that chemical-related imports and exports must only be handled by corporations authorized by the Ministry of Chemical Industry and MOFTEC; such corporations must obtain a license to import or export chemical materials, technologies, and equipment; in addition, authorized corporations must obtain special approval from the Ministry of Chemical Industry to export chemical materials to countries that are not signatories to the Chemical

		Weapons Convention (CWC). The regulations also specify that an end-user certificate is required before a chemical can be shipped to a non-CWC signatory.
May 1997	Circular on Strict Implementation of China's Nuclear Export Policy (a directive to government ministries and nongovernment entities on nuclear exports)	The circular provides broad-based guidance on nuclear exports. It states, "The nuclear materials, nuclear equipment and related technology, as well as non-nuclear materials for reactors and nuclear-related dual-use equipment, materials and relevant technologies on China's export list must not be supplied to or used in nuclear facilities not under IAEA safeguards. No agency or company is allowed to conduct cooperation or exchange of personnel and technological data with nuclear facilities not under IAEA safeguards."
March 1997	Supplement to December 1995 Chemical Export Control Regulations	Issued in preparation of China's April 1997 ratification of the CWC.
27 December 1995	Regulations on Controlled Chemicals	These regulations include a Schedule of Chemicals based on the regulations and schedules of chemicals contained in the CWC; the regulations provide for strict control on the production and transfer of chemicals listed in its Schedule; consistent with the CWC, the Regulations divide the controlled chemicals into four categories: (1) chemicals that can be used as chemical weapons; (2) chemicals that can be used as precursors in the production of chemical weapons; (3) chemicals that can be used as main raw materials in the production of chemical weapons; (4) discrete organic chemicals excluding explosives and hydrocarbons.

12 May 1994	Foreign Trade Law	This law gives the state the power to regulate imports and exports; China's export control regulations are based on this clause; under Articles 16 and 17, China can restrict or prohibit the import and export of goods for reasons of "national security and social benefits"; the government should restrict trade based on its obligations to international treaties and conventions; Article 18 requires the creation of control lists; Article 19 covers licensing--items with "special requirements" (i.e., those related to international treaties and conventions) require export licenses; such items include heavy water, military and dual-use chemicals, and materials related to toxin production.
1 January 1993	Temporary Rules on the Management of Export Goods	Created four categories of controlled goods: (1) 38 products vital to the national economy to remain under state production and export controls. (2) 54 commodities listed under "voluntary export quota controls" that require permits to be exported to key countries or regions. (3) Passive quota control goods (mainly textiles) whose export is subject to the quota agreements between China and the importing countries. (4) 22 goods subject to general export control and which require export licenses. The general export control list (4) includes heavy water, rare-Earth metals, and dual-use chemical

		items; no nuclear materials or equipment besides heavy water appear on the list; bearings and computers are the only dual-use items listed.
1991-92	Several reforms	Clarification of export licensing responsibilities and procedures.
1986	Directive of the Ministry of Foreign Trade and Economic Cooperation	Approved by the State Council, this directive stated that all technology exports must be compatible with China's overall foreign policy and national security interests, and that any exports of technology that violate these interests would be banned.
1985-88	About seven decrees	Provided details on license application rules, approval procedures, and institutional jurisdictions.
3 June 1980	Provisional measures on the export license system relating to dual-use exports	Dual-use exports (?)
1980	Temporary Provisions of Export Licensing System	Reestablished an export licensing system; established license application procedures, requirements, and institutional responsibility.
December 1950	Provisional Rules of Foreign Trade Administration	China's first export control law; required all importers and exporters to have licenses issued by central or provincial foreign trade authorities.

Appendix IV

Chinese Participation in International Export Control Regimes

Regime	**Chinese Participation**	**Dates of Participation**

Australia Group	No; declined May 1997 US invitation to join	NA
Missile Technology Control Regime	No; pledged adherence to original 1987 guidelines	November 1991; classified, written assurance provided to the US in February 1992
Joint US-China statement on missile proliferation	Accepted "inherent capability" concept; agreed to a complete ban on exports of all ground-to-ground missiles prohibited by MTCR	4 October 1994
Joint US-China statement	Agreed to "build on" the 1994 joint statement; reaffirmed their respective commitments to the MTCR "guidelines and parameters"	29 October 1997
US-China Summit Statement	Agreed to "actively study" MTCR membership; no bilateral discussions since November 1998	27 June 1998
Nuclear Suppliers Group	No; invited to join; stated adherence in principle to the NSG control lists (INFCIRC/254 Parts 1 and 2)	NA
Wassenaar Arrangement (on Export Controls for Conventional Arms and Dual-Use Goods and Technologies)	No; urged to join by US	NA
Zangger Committee (NPT Nuclear Suppliers Committee)	Yes	Attended as observer in May 1997; joined 16 October 1997

Chinese Proliferation of Missiles and Weapons of Mass Destruction: Issues for US Policy

Shirley Kan

We are here to examine the proliferation of weapons of mass destruction (WMD) and missiles by the People's Republic of China (PRC) because of the threat it continues to pose to US national security interests. This paper does not review in detail the PRC's proliferation activities over the years, which have included transfers to Saudi Arabia, Pakistan, Iran, and North Korea.[405] The discussion here addresses the salient issues for US policy to counter threats to US national security interests posed by the

PRC's proliferation of WMD and missiles that could deliver them. First, a policy that maximizes gains for US interests would be grounded in a correct assessment of the nature of this PRC threat. Second, US policy would require leadership both domestically and internationally to execute an effective mix of policy options. This paper will discuss the possibilities and limits of a number of unilateral, bilateral, and multilateral policy options.

This paper contends that, despite the efforts of successive administrations (since at least the Reagan administration), an important gap remains between US and PRC perceptions about weapon proliferation. The United States has viewed WMD proliferation as a critical problem that threatens its national security interests and historically has led international efforts to curb proliferation. However, the PRC sees WMD nonproliferation less as its national interest and more as useful leverage in its top foreign policy priority--relations with the United States. As leverage in a realpolitik and hostile world, weapon proliferation is an issue that the PRC employs in affirmative and negative dimensions. At the same time, US leverage in securing PRC commitments to WMD nonproliferation has dissipated, even as the divide widens in Washington over the strategy for dealing with Beijing.

Competing US and PRC National Interests

Some in the administration (particularly the State Department) and others argue that the PRC has increasingly recognized the value of WMD and missile nonproliferation for its national interests. They point to the steps that the PRC has taken to support the international nonproliferation regimes.

Since 1992, Beijing--facing significant US, Japanese, and other pressures--has taken several steps to advance its nonproliferation commitments. China unilaterally promised to abide by the Missile Technology Control Regime (MTCR) in February 1992 and reaffirmed that commitment in its October 4, 1994 statement. However, the PRC is not considered a "member" or "partner" of the MTCR. The MTCR is not an international agreement and has no legal authority. It is a set of voluntary guidelines that seeks to control the transfer of missiles that are inherently capable of delivering at least a 500-kg (1,100-lb) payload to at least 300 km (186 mi).

China acceded to the Nuclear Nonproliferation Treaty (NPT) on March 9, 1992. The NPT does not ban peaceful nuclear projects. China signed the Chemical Weapons Convention (CWC) in January 1993. In November 1995, China issued its first public defense white paper, which focused on arms control and disarmament. On May 11, 1996, the Chinese issued a statement promising to make only safeguarded nuclear transfers. China, on July 30, 1996, began a moratorium on nuclear testing and signed the Comprehensive Test Ban Treaty (CTBT) in September 1996. The CTBT has not entered into force. On April 25, 1997, China deposited its instrument of ratification of the CWC. The CWC entered into force on April 29, 1997.

Premier Li Peng issued new nuclear export control regulations on September 10, 1997. On October 16, 1997, China joined the Zangger Committee. The Chinese issued new export control regulations on dual-use nuclear items on June 17, 1998.

Nevertheless, others in and outside the administration, especially in Congress, contend that the PRC's troubling transfers continue to threaten US national security interests. The Director of Central Intelligence (DCI), in June 1997, submitted a required report to Congress stating that, during July-December 1996, China was "the most significant supplier" of WMD-related goods and technology to foreign countries.[406] The DCI's latest report (issued in July 1999) on the last half of 1998 named

China (along with Russia and North Korea) as a "key supplier" of such technology, having transferred supplies to Pakistan, Iran, and North Korea.[407]

India conducted nuclear tests on May 11 and 13, 1998, citing China's nuclear ties to Pakistan, and Pakistan followed with nuclear tests on May 28 and 30, 1998. The PRC, Pakistan's military and nuclear supplier, failed to avert the tests and did not cut off nuclear aid or impose other sanctions. The DCI reported in February 1999 that China provided "extensive support" in the past to Pakistan's WMD program, and "some assistance continues."[408]

In a public speech on September 17, 1998, Robert Walpole, the National Intelligence Officer for Strategic and Nuclear Programs, assured us that China or Russia currently are unlikely to sell an intercontinental ballistic missile (ICBM) or a space launch vehicle to convert to an ICBM, but warned that this situation may change over the long term. On February 2, 1999, DCI George Tenet testified to the Senate Armed Services Committee that "both the Chinese Government and Chinese firms have longstanding and deep relationships with proliferant countries, and we are not convinced that China's companies fully share the commitments undertaken by senior Chinese leaders."

In early 1999, press reports revealed that the Clinton administration has suspected since 1995 that China acquired in the 1980s the design for the most advanced miniature US nuclear warhead (W88) from Los Alamos National Laboratory.[409] If China acquired the W88 design, that would help explain the series of Chinese nuclear tests leading up to its moratorium on nuclear testing and willingness to sign the CTBT in 1996.

On April 21, 1999, the DCI took the unusual step of publicly confirming that the Intelligence Community concluded that "China obtained by espionage classified US nuclear weapons information that probably accelerated its program to develop future nuclear weapons." The damage assessment ominously cautioned that the proliferation threat has increased, saying that the PRC could now pass US nuclear weapon secrets to other countries, although whether China has done so is unknown. The assessment warned that, since the Chinese have more modern US nuclear weapon information, they "might be less concerned about sharing their older technology." The House Select Committee on US National Security/Commercial Concerns with the People's Republic of China (PRC), also known as the Cox Committee, released its unclassified report on May 25, 1999, replete with concerns about technology transfers to China, including nuclear weapon information.[410]

There are other indications of division with the US Government over policy toward China and assessments of the problem of PRC weapons proliferation. The White House agreed to hold twin summits with the PRC in October 1997 and June 1998, advancing the notion of Presidents Clinton and Jiang Zemin of building a "constructive strategic partnership," and the Administration promised to issue certifications to implement the 1985 Nuclear Cooperation Agreement as the centerpiece of the 1997 summit. The November 1998 East Asia Strategy Report of Secretary of Defense William Cohen declined to include that characterization of US-PRC relations and criticized continuing Chinese missile and chemical proliferation activities. On January 28, 1998--just two weeks after Presidential certifications were issued on China's nonproliferation credentials--DCI George Tenet testified that "China's relations with some proliferant countries are long-standing and deep" and that "the jury is still out on whether the recent changes are broad enough in scope and whether they will hold over the longer term."

Some have questioned whether China has assisted North Korea's missile program, which included the surprising test-firing of a three-stage, medium-range Taepo Dong 1 ballistic missile on August 31, 1998. One could argue that Chinese national interest is not to promote advances in North Korea's missile program, since that increased threat has galvanized US and Japanese support for development of theater ballistic missile (TMD) systems, which China opposes. Nonetheless, the National Security Agency (NSA) is said to have reported on March 8, 1999, that China sold specialty steel for use in North Korea's missile program.[411] In June 1999, US intelligence found that Chinese entities transferred accelerometers, gyroscopes, and precision grinding machinery to North Korea.[412] The DCI confirmed publicly for the first time in July 1999 that "North Korea obtained raw materials for its ballistic missile programs, especially from firms in China" in the second half of 1998.

After the mistaken bombing of the PRC Embassy in Belgrade in May 1999, one of Beijing's first reactions was to suspend discussions on international security and arms control with Washington, even as Acting Under Secretary of State John Holum was preparing to visit China.

On April 8, 1999, after a meeting with visiting Chinese Premier Zhu Rongji, President Clinton acknowledged that they discussed issues of disagreement, including "limiting the spread of weapons of mass destruction," and Premier Zhu reportedly promised that China will soon ratify the CTBT. However, the PRC still has not ratified the CTBT, and President Jiang Zemin's reported assurances in Paris in October 1999 did not include the timetable of ratification "soon." After the US Senate's rejection of the CTBT, the PRC is even less likely to ratify the treaty.

In short, the PRC has both issued certain nonproliferation assurances as well as continued to spread dangerous technology and condone even nuclear weapon proliferation. Beijing's deficient commitment to weapons nonproliferation has given rise to competing assessments and increasingly public divisions within the US Government. The United States and the PRC have competing visions of the world order, and to reserve premature assumptions that Beijing has adopted weapon nonproliferation as one of its national interests or that, over time, Beijing will learn nonproliferation principles and practices would be prudent. The PRC will continue to calculate the gains of cooperation (concession) or noncooperation (retribution) on weapon nonproliferation as a function of the state of relations with the United States. Weapon proliferation accords Beijing with important leverage against Washington that it will not likely surrender. US policy will continue to face this challenge into future administrations and the 21st century.

US Policy Options

Chinese proliferation as a policy issue concerns the priority of this issue relative to other US national interests (i.e., other security issues, human rights, and trade), the Administration's response, including the enforcement of nonproliferation laws, and possible legislation to reduce the danger. Congress has been concerned about the appropriate US response to Chinese transfers that may have violated international agreements and/or contradicted US laws. The benefits and limitations of a number of US policy options are discussed below.

Trade

Satellite Exports. Allowed by export licenses and presidential waivers of post-Tiananmen crackdown sanctions (in PL 101-246), the United States, since 1988, has exported satellites to be launched by China Great Wall Industry Corp. (the same company sanctioned for missile proliferation). The National Security Council, in a Secret memo on bilateral talks leading up to the summit in June (dated March 12, 1998 and printed in the *Washington Times*), proposed to expand space cooperation with Beijing, increase the number of satellites that China can launch, issue a blanket presidential waiver of sanctions, and support China's membership in the MTCR--in return for effective Chinese export controls on missiles. However, Congress investigated in 1998 whether exports of satellites to China has indirectly assisted China's ballistic missile and space programs, and satellite exports have become a controversial issue.[413]

Nuclear Cooperation. As agreed during the US-China summit in October 1997, President Clinton, on January 12, 1998, signed certifications (as required by PL 99-183) about China's nuclear nonproliferation policy and practices to implement the 1985 Nuclear Cooperation Agreement. According to President Clinton, the agreement serves US national security, and environmental and economic interests, and "the United States and China share a strong interest in stopping the spread of weapons of mass destruction and other sophisticated weaponry in unstable regions and rogue states--notably, Iran." The President also waived a sanction imposed after the Tiananmen crackdown (in PL 101-246).

Congressional review ended on March 18, 1998, and the agreement is now implemented. US firms may apply for Export-Import Bank financing and licenses from the Nuclear Regulatory Commission and DOE to export nuclear technology to China, and foreign firms may apply to re-export US technology. Members pursued several options to affect the implementation of the agreement. On November 5, 1997, the House passed a bill with an amendment sponsored by Rep. Gilman that would extend Congressional review for implementation of the agreement from 30 to 120 days and provide for expedited review procedures. As amended by Rep. Gilman, the National Defense Authorization Act for FY 1999 requires the President to notify Congress "upon" granting licenses for nuclear exports to a non-NATO country that has detonated a nuclear explosive device.

Also, at the summit in Beijing in June 1998, the Department of Energy (DOE) and the Chinese State Planning Commission signed an agreement on peaceful nuclear cooperation, including bringing Chinese engineers and scientists to US national laboratories, universities, nuclear reactor facilities, and other institutions. Some are concerned, however, about security at US labs and universities. On October 6, 1998, the House National Security Subcommittee on Military Procurement held a hearing on foreign visitors to the labs. Sec. 3131 of the National Defense Authorization Act for FY 1999 makes permanent a ban on activities with China in cooperative stockpile stewardship. The Cox Committee and the Intelligence Community have expressed strong concerns about PRC acquisition of US nuclear weapon secrets.

Some in Congress, the nonproliferation community, and elsewhere have been skeptical that Chinese policies changed sufficiently to warrant the certifications and that they are in US interests. First, past Chinese assurances have proven unreliable, and concerns have persisted about China's nuclear, missile, and chemical-weapon-related transfers (especially to Pakistan and Iran). The closed hearings also reportedly uncovered concerns about continuing sales even after the certifications. China did not promise to stop nuclear cooperation with Pakistan and did not make a public pledge to stop nuclear assistance for Iran. Also, China has not shown a satisfactory track record on nuclear export controls nor adopted all international nonproliferation standards (by joining the Nuclear Suppliers Group). Second, there were concerns that any potential sanctions would hurt US businesses involved with the China National Nuclear Corporation. Third, some were concerned that China could retransfer US technology to countries seeking nuclear weapons technology and indirectly use the technology in China's nuclear weapons program. Last, some are skeptical of any huge potential for US exports, saying that China aims to expand foreign competitors for its business and adopt US technology in its own designs to reduce imports. Indeed, *Nucleonics Week* reported on March 4, 1999, that US firms no longer expected China to order new foreign reactors soon.

Supporters in the administration, particularly the Departments of State and Energy, US nuclear industry, and others have argued that nuclear technology offers a source of leverage to advance US goals and the agreements with China so far should be "pocketed." China indicated ambitious plans to expand its nuclear power generation and needed Western technology. US nuclear cooperation presented a positive incentive for the Chinese nuclear industry to stop sales that contribute to nuclear proliferation. Referring to China's May 11, 1996 commitment, President Clinton stated in a speech on China on October 24, 1997, that "China has lived up to its pledge not to assist unsafeguarded nuclear facilities in third countries." Some added that conditions for US-China nuclear cooperation should not be changed in the middle of negotiations. Also, supporters argued that French, Canadian, and Russian companies were already selling nuclear technology to China. Washington would have control over US technology exports. US companies said that they were losing out on more than $1.6 billion in annual US nuclear exports to China and that China was a potentially large market for reactors, equipment, and technology. DOE said that China will account for one-third of the increase in the world's nuclear power in the next 20 years. US companies, such as Westinghouse Electric Corp. and Bechtel Power Corp., were seeking approvals for exports as well as Export-Import Bank loans. In 1998, China had 2,100 megawatts of nuclear-power-generating capacity and contracts to increase that capacity by 2005 to 10,100 megawatts. China planned to have 20,000 megawatts of nuclear power by 2010, or 4 percent of electric generation (from less than 1 percent today).

The administration urged China to adopt "comprehensive, nationwide regulations on nuclear export control." China responded by implementing a set of regulations (not a law) on nuclear export controls signed by Premier Li Peng on September 10, 1997. The regulations permit nuclear exports to only facilities under IAEA safeguards. There were concerns, however, that the China Atomic Energy Authority (CAEA)--in charge of nuclear export controls, was headed by the president of the China National Nuclear Corporation, with competing interests in nuclear exports. Also, whether China's nuclear weapons labs (and their contacts with Pakistan) were covered was unclear. The Foreign Ministry lacked a routine role in reviewing exports, and the regulations lacked an enforcement record. China also joined the Zangger Committee on October 16, 1997. China issued new export control regulations on dual-use nuclear items on June 17, 1998.

China, however, has refused to require full-scope safeguards (intended to prevent diversions to nuclear weapon programs) and to join the Nuclear Suppliers Group. Moreover, *Nucleonics Week* reported on July 1, 1999 that the State Department has still failed to acquire Chinese agreement to prevent diversions of US technology exports to Pakistan. Critics say that an important source of US leverage was lost with the presidential certifications.

Sanctions. Policy debates concerning Chinese technology transfers have often centered on the question of whether to impose unilateral sanctions as required by various US laws. Although certain Chinese transfers may not violate any international treaties, US sanctions may be required under US laws. Congress has passed numerous laws to set US nonproliferation policy and enforce nonproliferation treaties and guidelines with unilateral sanctions in response to violations. Underlying the question of whether sanctions should be used are disagreements about the most effective approach for curbing dangerous Chinese sales and promoting US interests. While the Soviet threat dominated assessments of foreign and defense policy, the elimination of that threat fostered sharp debates about the primacy of security interests over business or other foreign policy interests. The President issued a July 29, 1998 executive order (E.O.) that strengthened some authority in E.O. 12938, but also gives the Secretary of State more flexibility and discretion in not imposing sanctions.

Those who argue for the imposition of US sanctions cite the legal obligation of the executive branch to implement and enforce US laws passed by Congress. They also place a greater priority on nonproliferation as a national interest and view the strict enforcement of laws as vital to stemming proliferation. They refer to reports that China continues to transfer dangerous technology in defiance of the nonproliferation regimes and note the lack of Chinese participation in some significant international groups, such as the Nuclear Suppliers Group. This school of thought believes that Chinese transfers may pose a threat in the long term and that a necessary military response to resulting threats against Americans or our allies would be terribly costly--as in the 1991 Persian Gulf War. They also argue that the narrow interests of an individual firm or industry should not determine national security policy. Some who argue for a tough approach say that China has made commitments to nonproliferation after facing US pressures and is more likely to restrain its proliferation activities if there are concrete and costly consequences tailored to penalize specific Chinese violators. Moreover, they assert that, not only are national security interests at stake, but US credibility is diminished if the US policy of opposing proliferation is not strictly carried out. They add that international nonproliferation regimes have proven to be inadequate, and until they are strengthened, US laws are vital to enforcing compliance with the regimes. In this way, the United States has played the critical leadership role for a long time and should push to capitalize on decades of effort. Some are concerned that if US commitment to peace and stability in Asia and the Middle East is perceived to have weakened, arms races would result when states seek to boost their defensive capabilities.

Those who argue against the imposition of unilateral sanctions tend to focus on the harm to US trade or business interests. Advocates for certain industries or companies lobby against policy actions deemed harmful to US businesses. They argue that the United States needs to stay "commercially engaged" in China to influence Chinese policies, especially over the longer term. US policy since the 1970s has been one of "engagement," to bring China into the world community with subsequent acceptance of the international "rules of conduct." Those arguing against the use of sanctions often say that sanctions are too broad or are not warranted, and refer to the progress China has made since 1992 in joining nonproliferation regimes. They also argue that this improvement needs to be sustained by a "strategic dialogue." They add that cultivating relationships with China's military leaders is important, because they have important influence over arms sales. When sanctions were imposed, the dialogue tends to focus on lifting sanctions, rather than how to stop proliferation. This side of the debate argues that bilateral and multilateral options may be more effective and would not affect American businesses in an unequal way.

The Clinton administration has apparently tended to side with opponents of using sanctions. It avoided imposing sanctions on the PRC for nuclear weapon proliferation. In early 1996, some in Congress called for sanctions after reports said that China sold unsafeguarded ring magnets to Pakistan in 1994-95, apparently in violation of the NPT and US laws, including the Arms Export Control Act and Export-Import Bank Act (as amended by the Nuclear Proliferation Prevention Act of 1994). On February 5, 1996, the *Washington Times* first disclosed intelligence reports that the China National Nuclear Corporation, a state-owned corporation, transferred to the A.Q. Khan Research Laboratory in Kahuta, Pakistan, 5,000 ring magnets, which can be used in gas centrifuges to enrich uranium.

On May 10, 1996, the State Department announced its decision to not impose sanctions against China and Pakistan, citing a new agreement with China. Administration officials said China promised to provide future assistance only to safeguarded nuclear facilities, reaffirmed its commitment to nuclear nonproliferation, and agreed to consultations on export control and proliferation issues. The administration also said that Chinese leaders insisted they were not aware of the magnet transfer and that there is no evidence that the Chinese Government had willfully aided or abetted Pakistan's nuclear weapons program through the magnet transfer. Thus, the State Department announced that sanctions were not warranted, and Export-Import Bank considerations of loans for US exporters to China were returned to normal. (Later that year, Congress closed what the State Department apparently found as a loophole in the law by adding language on "persons" in the Export-Import Bank Act.)

On May 11, 1996, China's foreign ministry issued a statement that "China will not provide assistance to unsafeguarded nuclear facilities." In any case, China since 1984 has declared a policy of nuclear nonproliferation and requirement for recipients of its transfers to accept IAEA safeguards. China formalized this policy by acceding to the NPT in 1992.

Moreover, since the Clinton administration began, it has been faced with intelligence reports that the PRC transferred complete M-11 short-range ballistic missiles to Pakistan. On August 24, 1993, however, the administration imposed lesser category II sanctions on the PRC for transferring M-11 equipment (not whole missiles) to Pakistan and agreed in October 1994 to waive those sanctions, after Beijing promised not to export ground-to-ground missiles "inherently capable" of delivering a 500-kg warhead 300 km. (Missile technology was not mentioned.) The administration has not imposed missile proliferation sanctions on the PRC since then.

Nonetheless, Gordon Oehler, soon after stepping down as head of the CIA's Nonproliferation Center, testified on June 11, 1998, to the Senate Foreign Relations Committee that in November 1992, "the Chinese delivered 34 M-11s to Pakistan." On September 9, 1999, the CIA confirmed for the first time in a public report that "Pakistan has M-11 SRBMs from China" and they may have a nuclear role.[414] The State Department responded on September 14, 1999, that it requires a "high standard of evidence" and has not yet concluded that category I sanctions are warranted, despite the intelligence judgment. (Category I sanctions would deny licenses for exports of Munitions List items, among other actions, and Congress in 1998 transferred satellites back to the Munitions List.) Reports say that sanctions were not imposed for transfers of complete M-11s, because the missiles remain inside crates at Sagodha Air Base.[415] Others say that the Administration has avoided making any determinations in the first place. In any case, China has not faced sanctions for its reported transfers of complete M-11 missiles to Pakistan, despite the State Department's study of the issue for the last seven years.

Confirming long-suspected Chinese transfers contributing to chemical weapon proliferation, the Administration, on May 21, 1997, imposed sanctions on two Chinese companies, five Chinese citizens, and a Hong Kong company for chemical-weapons-related transfers to Iran. US sanctions, affecting US Government procurement and imports, were imposed under the Arms Export Control Act and Export Administration Act (as amended by the Chemical and Biological Weapons Control and Warfare Elimination Act). Sanctions were not imposed on the Chinese or Hong Kong governments, because the State Department said that it had no evidence that those governments were involved in the transfers.

However, the administration did not impose sanctions under the Iran-Iraq Arms Nonproliferation Act, because the transfers in question apparently occurred before February 10, 1996, the date when provisions on WMD proliferation took effect. Despite news and intelligence reports that the PRC has proliferated chemical weapons since February 1996, new sanctions have not been imposed. In July 1998, the DCI reported that, in 1997, Iran acquired CW-related material "primarily" from Chinese firms. The DCI reported in July 1999 that Chinese entities continued to be "significant suppliers" of chemical-weapons-related items to Iran in the second half of 1998.

Trade Status. In the 1990s, Congress has annually debated whether to link conditions to normal trade relations (NTR) (formerly most-favored-nation status) for China. Because China has an increasing and significant trade surplus with the United States and the Chinese economy depends on the US market, some believe that trade is a powerful policy tool to advance vital US goals. President Clinton has separated renewal of normal trade status from proliferation issues, arguing that trade is too broad a policy tool that would hurt US firms. Congress has not passed legislation to deny normal trade status for China. It is also doubtful that conditions would be attached to the PRC's enjoying permanent NTR status or entry into the World Trade Organization (WTO).

Import Controls. To avoid broad sanctions or steps that may affect US companies, some have proposed controls on imports of products produced by Chinese military or defense-industrial companies suspected of contributing to WMD proliferation. Import controls have been included as possible sanctions in response to missile proliferation (Section 73[a][2][C] of the Arms Export Control Act). Many, however, are concerned about negative impacts on trade.

Export Controls. Export controls are an important policy tool, because US technology provides one source of leverage over Beijing. For example, the Reagan administration, in 1987, froze export control liberalization because China sold Silkworm anti-ship missiles to Iran. After the Cold War, US export restrictions have been reduced to focus on items that contribute significantly to the development and production of WMD. Some in Congress are concerned about US technology reaching hostile states with WMD programs through China. Congress may strengthen controls over missile-related technology. US military sales to China have not been allowed since sanctions were imposed after the 1989 Tiananmen crackdown, but there is increasing demand to export dual-use technology that could enhance China's military capabilities.

Nonproliferation Efforts

Nonproliferation Regimes

Another policy approach is to strengthen the international nonproliferation regimes. Such efforts have two prongs: encouraging Chinese support for strengthening the regimes to enforce compliance and filling gaps in China's participation. Some say that including China would capitalize on its desire to be treated as a "great power" and to be perceived as a responsible world leader. In addition, China might be more cooperative if it helped to draw up the "rules." Others, however, argue that China's participation would obstruct efforts for tighter export controls, derail arms control efforts, link them to the Taiwan issue (e.g., the Mideast arms control talks), or weaken provisions (e.g., the CTBT).

For nuclear nonproliferation, the UN Security Council has recognized the limits to the effectiveness of the NPT/IAEA safeguards system (as shown by Iraq's and North Korea's advanced, clandestine nuclear weapons programs) and has tried to strengthen the IAEA's verification authority. To strengthen the Biological Weapons Convention (BWC), negotiators are drafting a verification protocol for on-site inspections to monitor compliance.

The United States and others might encourage China to join the MTCR (as a member after it establishes a record of compliance and effective export controls), Nuclear Suppliers Group (NSG), Australia Group (on chemical and biological weapons), and Wassenaar Arrangement (military and dual-use export controls). Indeed, the National Security Council in a Secret memo, dated March 12, 1998 (printed in the March 23, 1998 *Washington Times*), proposed in a "China missile deal" to expand space cooperation with Beijing, increase the number of satellites that China can launch, issue a blanket presidential waiver of post-Tiananmen sanctions on satellite launches, and support China's membership in the MTCR--in return for effective Chinese missile export controls.

However, membership in the MTCR would exempt China from certain sanctions (unless the laws on missile nonproliferation are amended), provide it with intelligence, give it a potentially obstructionist role in decisionmaking, and relax missile-related export controls to China. At the summit in Beijing in June 1998, China did not agree to join the MTCR but said it is "actively studying" whether to join. In Washington on January 12, 1999, China's chief arms control official, Ambassador Sha Zukang, signaled opposition to the MTCR by proposing that it be replaced with a multilateral Anti-Ballistic Missile Treaty. Indeed, in 1999, Congress passed a law placing conditions on the PRC's membership in the MTCR.

China joined the Zangger Committee (on nuclear trade) in October 1997. But China is the only major nuclear supplier to shun the 35-nation NSG, which requires "full-scope safeguards"(IAEA inspections of ***all*** other declared nuclear materials and facilities in addition to the facility importing supplies to prevent diversions to weapon programs). Such a requirement would have important implications for the PRC's continuing nuclear cooperation with Pakistan.

Regional Security Talks
Chinese support may be sought for regional arms control groups, such as multilateral talks for South Asia. In 1991, President Bush initiated the Arms Control in the Middle East (ACME), or Permanent Five, talks to seek bans on nuclear bomb materials and ballistic missiles in the Middle East. After Bush's decision, announced on September 2, 1992, to sell Taiwan 150 F-16 fighters, China suspended its participation in the talks. The ASEAN Regional Forum (ARF) has become an important multilateral security group in Asia. Some say that major nonnuclear powers, such as Japan, should be included.

Foreign and Defense Policies

Comprehensive Engagement
The administration resumed high-level exchanges and pursues "comprehensive engagement" with China to advance US security goals, including nonproliferation. President Clinton granted Jiang Zemin two summits in eight months: in Washington, on October 29, 1997, and in Beijing, on June 29, 1998. The summit in Beijing produced an agreement on nontargeting nuclear weapons, and Joint Statements on South Asia and on biological weapons. Also, China refused to join the MTCR but said it is "actively studying" whether to join. Critics say that little was achieved and China should not be in the MTCR. The Clinton administration participated in the first "track 2" arms control dialogue with China in Beijing on September 24-25, 1998.

Missile Defense
Missile defense is another possible response to the problem of missile proliferation. Regional theater missile defense (TMD) systems are said to have a key role in the strategy to counter the threat of missiles and WMD. China is opposed strongly to US deployment of missile defense systems or cooperation with Japan or Taiwan. China is concerned that missile defense programs would bring an arms race, weaken its deterrence capabilities, and forge closer US-Taiwan military cooperation akin to an alliance. As required by the FY 1999 National Defense Authorization Act, the Defense Secretary submitted a report in May

1999 on TMD systems that could be transferred to Japan, South Korea, and/or Taiwan.

Taiwan

China has increasingly tried to link missile nonproliferation to the Taiwan issue, particularly US arms sales to Taiwan. On January 8, 1997, Secretary of State-designate Madeleine Albright responded to Senator Craig Thomas that she opposed any such linkage. Nevertheless, during President Clinton's visit to China in June 1998, the administration considered, then disagreed on, a Chinese request for a US pledge to deny TMD technology with Taiwan, if China promised to stop missile proliferation with Iran.[416]

International Lending and Japan

Congress may seek to link US support for loans made by international financial institutions to China's nonproliferation record. The Iran-Iraq Arms Nonproliferation Act requires US opposition to multilateral loans for sanctioned countries (Section 1605[b][2]). However, US influence is limited, and the World Bank and the Asian Development Bank have resumed and increased substantial lending to China. Moreover, as part of the sanctions imposed after the 1989 Tiananmen crackdown, the United States has supported only international loans for basic human needs in China.

Coordination with Japan is important, since it provides the most significant bilateral aid to China and was the only country to use aid to pressure China to stop nuclear testing. In May 1995, Tokyo suspended the small, grant portion of its aid program in China to protest Chinese nuclear testing, and Tokyo restored the aid (worth about $56 million) only after Beijing began a moratorium on nuclear testing. The US-Japan Joint Declaration on Security Alliance for the 21st Century (signed on April 17, 1996) cited agreement on coordination to prevent the proliferation of WMD and their means of delivery. Some argue that Japan, as nonnuclear power, should be rewarded with greater international status, such as a permanent seat on the UN Security Council.

Conclusion: US Leadership

In conclusion, a common strategy supported throughout and executed at the highest levels of the US Government is needed to counter the threat of weapon proliferation posed by the PRC and other countries. Domestic leadership is required to narrow the divide within the administration and between the administration and Congress. First, an example of mixed signals is the Pentagon's November 1998 East Asia Strategy Report, which criticized continuing Chinese missile and chemical proliferation activities but nonetheless listed weapon nonproliferation as eighth on a list of nine elements of the strategy. Instead, the Department of Defense, speaking the language of national security, could be a useful voice on nonproliferation as it pursues military relations with the People's Liberation Army (PLA). Indeed, during his visit to Beijing in January 1998, Defense Secretary Cohen secured some assurances from the PRC President on stopping transfers of anti-ship cruise missiles to Iran. Second, the State Department's avoidance of sanctions as required by law and as called for by public intelligence reports continue to raise questions about the Clinton administration's credibility in safeguarding US national security interests. Many are concerned that the administration may negotiate away important benefits for Beijing, with few lasting gains.

An example of a proposal to strengthen leadership in the US Government is the "Deutch report." On July 14, 1999, the Commission to Assess the Organization of the Federal Government to Combat the Proliferation of Weapons of Mass Destruction, led by former DCI Deutch, made recommendations for reorganizing the government to counter the "grave threat" of WMD proliferation. It cited Chinese proliferation activities as contributing to that threat and called for Presidential leadership, a new National Director for Combating Proliferation, better policy implementation, and creation of a new budget category.

In addition, concerted US leadership in the world is needed, especially since multilateral efforts would be more effective against a PRC wary of international isolation. US leadership must be maintained in multilateral nonproliferation efforts. Confusing messages were sent when the State Department sought a way out of sanctions for transferring ring magnets, when President Clinton certified the PRC's nonproliferation practices so an export agreement could be implemented and a summit could claim a centerpiece, and similarly when the United States signed the CTBT, but the Senate was able to reject the treaty in October 1999.

US policy options are limited by years of not using certain highly publicized sources of leverage (including proliferation sanctions and most-favored-nation trade status), while expending the leverage provided by the nuclear cooperation agreement. Even comprehensive engagement and summitry have failed to produce lasting gains for nonproliferation goals or stable bilateral relations. As US-PRC relations will continue to be rocky, especially over Taiwan and missile defense, the outlook for PRC cooperation in weapon nonproliferation will be unfavorable for US national interests. While effective bilateral relations are important for securing PRC cooperation in weapon nonproliferation, US national interests ought not be negotiated away for short-term gains.

Chinese Views of Weapons of Mass Destruction

Michael D. Swaine

This chapter examines Chinese views regarding the possession, use, and transfer of weapons of mass destruction (WMD), including nuclear, chemical, and biological weapons and their principal means of delivery. These views are derived from an examination of Chinese statements and practices concerning WMD as well as assessments provided by knowledgeable experts on China and WMD issues. This chapter does not present a detailed analysis of China's WMD force structure, deployments, or modernization program. Such features are discussed only insofar as they shed light on Chinese viewpoints and beliefs toward WMD. The chapter begins with a summary of four major factors influencing Chinese attitudes toward WMD. It then presents an assessment of China's basic view since 1949 regarding the use, possession, and transfer of WMD. This section is followed by a discussion of several modifications in China's basic viewpoint as a result of several major developments occurring largely since the seventies. The chapter concludes with some speculations on the possible future evolution of Chinese views toward WMD possession, use, and transfer.

Major Factors Influencing China's Attitude Toward WMD

China's basic viewpoint toward weapons of mass destruction has been influenced by four basic factors:

(1) geostrategic realities; (2) historical experience; (3) leadership perceptions and beliefs; and (4) technological, organizational, and economic capabilities and limitations.

China's approach to WMD is greatly conditioned by the basic geostrategic environment confronting the Chinese state. The most significant and enduring features of this environment are: (a) the existence of a very long and in many places geographically porous border; (b) the presence along or near this border of many nation states, some possessing relatively sophisticated military forces; and (c) in recent decades, the nearby presence of two large nuclear weapons powers (Russia and the United States) and a proto-nuclear power (India), all of which have either threatened or fought with China since 1949.[417] These basic features have required the construction by China of a military force sufficient to deter large-scale conventional and WMD threats and attacks, to defend Chinese territory against an actual invasion should deterrence fail, and generally to sustain Chinese political and military influence along the periphery. Moreover, as discussed in greater detail below, shifts in the specific disposition and type of geostrategic threats posed to China since 1949 by major WMD-armed powers (and in particular Russia and the United States) have exerted an important influence on the possession and potential use by China of weapons of mass destruction, whereas alterations in the larger international environment relating to WMD issues (e.g., the emergence of a robust set of WMD-oriented arms control regimes) have affected China's approach to WMD possession and transfer in particular.

China's historical experience in the modern era (i.e., since the mid-19th century) has served to enhance the sense of insecurity and resulting vulnerability created by China's geostrategic environment as well as China's desire for great power status. Specifically, China has been the object of armed intervention, subjugation, and humiliation by foreign industrial powers at various times during the past nearly one hundred and fifty years. These experiences have created an acute and enduring sensitivity to perceived foreign "bullying" and intimidation and resulted in a strong need to neutralize such threats. In addition, China's longstanding position as the preeminent power in East Asia has served to intensify Chinese sensitivity to foreign threats and slights while strengthening the desire for renewed international respect and equal treatment for China as a major power in the international community. WMD obviously can play a role in both neutralizing perceived threats and attaining great power status.

Chinese leadership perceptions and beliefs have exerted a significant influence over China's rhetorical stance toward WMD possession, use, and transfer, as well as more substantive elements of WMD doctrine and force structure. Chinese leaders believe that the threat of WMD use has been employed by larger, more developed powers such as the former Soviet Union and the United States to intimidate and blackmail weaker, smaller powers and generally to maintain the dominant influence of such larger powers within the international system.[418] Thus, weapons of mass destruction are viewed by Chinese leaders as a major stimulus to great power rivalry and global instability. Of even greater importance, the Chinese leadership believes that China has been a primary target of WMD threats and deployments by the superpowers since the fifties and sixties. In particular, the United States leveled nuclear threats against China and, in the view of some Chinese, employed chemical and biological weapons against Chinese troops during the Korean war,[419] while the Soviets indirectly threatened the use of nuclear weapons against China in the sixties. In addition, both countries have targeted China with strategic nuclear weapons and deployed tactical nuclear (and possibly, in the case of the former Soviet Union, chemical and biological) weapons along China's periphery.[420] Finally, China was subjected to biological weapons use by Japan during WWII and large quantities of chemical weapons abandoned by Japanese troops remain in China.

Arguably the greatest impact on China's viewpoint toward WMD possession has been exerted by basic technological, organizational, and economic factors. China's low industrial and technological base, limited finances, and early reliance on Soviet weapons designs, organizational structures and systems engineering have combined to restrict the size and sophistication of China's WMD systems, especially its nuclear inventory. At the same time, as will be discussed in greater detail below, changes in the nature of the superpower threat as well as major increases in advanced technologies in the areas of warhead yield, surveillance, detection, targeting, and long-range precision delivery systems have together increased China's vulnerability to conventional and WMD attack and raised the likelihood of the limited use of WMD on the battlefield. Such developments, combined with China's economic and technological limitations, have also led to a distinctive approach to and reliance upon ballistic and cruise missiles as non-WMD conventional weapons.

China's Basic Approach to WMD Possession, Use, and Transfer

The above factors have combined to produce China's basic approach to WMD possession, use, and transfer. This approach has remained fairly constant over time, although developments in recent decades (discussed in the following section) have produced some modification of views on specific issues. Three distinctive features of China's basic viewpoint toward weapons of mass destruction have been evident since the fifties: 1) rhetorical support for the complete prohibition of nuclear, biological, and chemical (NBC) weapons; 2) the possession of a limited WMD capability in the nuclear arena (and possibly in the chemical and biological arenas) for self-defense purposes, combined with a supposed no-first-use (NFU) doctrine governing nuclear weapons; and 3) the selective proliferation of nuclear (and possibly chemical) weapons technologies for what are perceived as vital strategic objectives.

As suggested above, monopoly control over weapons of mass destruction by the superpowers is viewed by the leadership of China as a clear threat to Chinese security, a source of regional and global instability, and a potential precipitant of war within the international community. As a result of such perceptions, China officially has stated that it supports, as the ultimate goal of disarmament, the complete prohibition and thorough destruction of all nuclear weapons and other weapons of mass destruction.[421] Beijing also repeatedly declares that it opposes arms races of whatever type and any use of WMD or threats to use WMD against other states. In recent years, China also has declared often that it does not advocate or encourage nuclear proliferation and does not help other countries develop nuclear weapons (more on this point below).[422] Moreover, China consistently has advocated the complete prohibition and thorough destruction of chemical, biological, and space weapons. It claims that it does not develop, produce, stockpile, or possess chemical or biological weapons and opposes the production and deployment of such weapons by any country and their proliferation in any form by any country. China officially has denied ever having acquired or retained chemical or biological weapons or their delivery systems. Although China has been accused of exporting chemical weapons-related materials and technology to countries of concern in the developing world, it repeatedly has denied these charges. China claims that it has formulated extremely stringent measures to control its chemical exports.[423]

In line with this overall position, China is a party to most of the major international agreements concerning the control and/or abolition of nuclear, chemical and biological weapons, including the Non-Proliferation Treaty, the Comprehensive Test Ban Treaty, the Geneva Protocol, the Biological Weapons Convention (BWC), and the Chemical Weapons Convention (CWC).[424]

At the same time, Chinese leaders believe that, given the continued presence of WMD in the international community as well as China's general historical experience in the modern era, China must possess WMD capabilities to deter superpower blackmail and threats, to reduce the likelihood of instability and war, and generally to heighten China's regional and global status and political influence.[425] Nuclear weapons are of particular importance in this effort.[426] Thus WMD capabilities essentially have been viewed by Chinese leaders, from the strategic perspective, as defensive political instruments necessary to counter threats and deter attacks and to support China's great power aspirations, and not as offensive, first-strike or warfighting instruments of any type.[427] And, in the view of most Chinese, the possession of WMD capabilities (especially nuclear capabilities) also provide China with superior weight and influence (some would say status and respect) as a great power within the international community.[428]

This set of views, when combined with the above-mentioned technical and economic limitations confronting China as a developing country, together explain the acquisition by China of a small yet survivable, retaliatory nuclear weapons capability in the form of a low number of nuclear-armed intermediate-range ballistic missiles (IRBMs) and intercontinental ballistic missiles (ICBMs), an aging long-range nuclear bomber force capable of delivering a hundred or so nuclear bombs to distant targets, and a single nuclear missile submarine (SSBN) armed with a dozen nuclear-tipped missiles. These forces are intended to hold at risk a small number of key population centers and major forward-deployed military assets of a more powerfully nuclear-armed adversary, i.e., the United States or Russia, and to caution other nuclear or proto-nuclear powers such as India against contemplating the threat or use of weapons of mass destruction against China.[429]

This capability constitutes a so-called credible "limited, self-defense counterattack" force that can undertake small-scale nuclear retaliation at a time and against targets of Beijing's choosing. Such a strategy often is described by the Chinese as following the general principle of *houfa zhiren* (to gain mastery by striking only after the enemy has struck first).[430] In more technical terms, this so-called minimum deterrence doctrine generally assumes that China would absorb an initial nuclear attack rather than undertake a launch under attack (LUA) or a launch on warning (LOW).[431] Perhaps most important, its deterrent effectiveness hinges on the inability of an adversary to destroy all of China's WMD facilities in a first strike. Given the small size of China's strategic nuclear arsenal as compared to the arsenals of both the United States and Russia, China has been unwilling to participate in strategic arms limitation discussions with either or both powers.

The small, defensive nature of China's nuclear force and China's general opposition to nuclear blackmail and intimidation are reinforced by the public enunciation of a supposed commitment never to use nuclear weapons first in a conflict and never to use or threaten to use nuclear weapons against nonnuclear states or nuclear free zones.[432] Hence, China formally opposes offensive-based nuclear deterrence doctrines and extended nuclear deterrence guarantees, and is against the deployment of nuclear weapons outside national territories.[433] The Chinese explicitly oppose doctrines based on "war-winning" nuclear war strategies,[434] in favor of the above summarized self-defense stance purportedly designed to oppose and check the outbreak of a nuclear war.

This so-called NFU principle is valued for its political effect, both on the superpowers and toward lesser powers. Specifically, Beijing intends to show its opposition to the use of nuclear weapons by any power, in an attempt to politically coerce or subjugate other nations. This stance reinforces, in the public arena at least, the impression that China does not pose a WMD threat to the superpowers. The latter objective is particularly important, given the absolute WMD superiority of the superpowers over China. The NFU principle also is intended to support the above-mentioned effort at the total abandonment of nuclear weapons, by indicating China's apparent refusal to develop the type of large, offensive, warfighting WMD arsenal possessed by Russia and the United States.

Despite China's rhetorical stance regarding chemical and biological weapons, Beijing probably sees the value of possessing a small inventory of chemical and biological weapons, or the essential components of such weapons, as a deterrent against potential chemical and biological threats or attacks. This stance seems especially likely given the prevalent Chinese belief that China has been the target of chemical and biological threats or attacks by the superpowers in the past, and that the superpowers (and perhaps other lesser powers) continue to maintain some chemical and/or biological weapons.[435] In fact, available evidence suggests that China indeed might maintain a small chemical and biological weapons inventory as part of its overall "limited, self-defense" approach to potential WMD threats.

In the area of chemical weapons, China reportedly has funded a chemical warfare program since the 1950s and has produced and weaponized a variety of agents, apparently as part of a defensive chemical warfare program designed to deter any potential chemical attack against China. Chinese military forces also conduct defensive chemical warfare training and are prepared to operate in contaminated environments.[436] China has held both nuclear and chemical weapons exercises since the 1960s. Contrary to Beijing's claims, the United States Government believes that China has a mature chemical warfare capability, including R & D, production and weaponization capabilities.[437] Moreover, in September 1997, in compliance with the declaration requirements of the CWC, China submitted a confidential declaration reportedly stating that it had formerly possessed chemical weapons sites. China has not publicly declared whether a chemical weapons stockpile formerly existed.[438]

Regarding biological weapons, the United States Government believes that China possessed an offensive biological weapons program prior to 1984 when it became a party to the BWC and maintained an offensive biological warfare program throughout most of the 1980s. There are strong indications that China probably continues to maintain its offensive program today.[439] In 1993, reports indicated that US intelligence believed that China was conducting biological research at two civilian research centers run by the Chinese military.[440] These facilities were reportedly known to have produced and stored biological weapons. In the view of many outside experts, China probably has not been in compliance with its BWC obligations.

China's above-basic stance toward weapons of mass destruction does not totally exclude the possibility that Chinese leaders might be the first to use such weapons in a crisis, especially within a limited military theater; nor does it mean that China's leaders would never transfer NBC weapons to other powers. The concept of preemptive military action within a limited theater (i.e., at a sub-strategic level), to deter a major conventional attack or to prevent a major escalation of a lesser attack is usually applied by the Chinese to the conventional arena. For some Chinese at least, however, this notion apparently has a potential application to the WMD arena as well. In particular, some Chinese strategists apparently believe that Beijing would contemplate the initial use of theater-oriented NBC weapons in a crisis if the leadership perceived that China was about to be attacked by such weapons.[441] This possibility is made more likely because many Chinese apparently do not accept automatically that a limited nuclear conflict would escalate to a general nuclear war.[442]

Despite its present-day public commitment to the objectives of the nonproliferation movement, China has at times seen the utility of transferring nuclear weapons to valued political allies as strategic stabilizers. During the Maoist era, China sought to obtain nuclear weapons from the Soviet Union and generally advocated the proliferation of nuclear weapons among socialist states, as part of the general effort to oppose "imperialist aggression."[443] Yet the only unambiguous example of actual, deliberate Chinese involvement in the transfer of NBC weapons of mass destruction for national policy ends began in the post-Mao era and served much narrower regional strategic interests, i.e., the creation of a strategic counterweight to India in South Asia through the transfer of nuclear-weapons-related designs, technology and equipment to Pakistan.[444] This effort was undertaken to establish a friendly Islamic state along China's southwest flank and, more important, to provide Islamabad with a small, defensive nuclear capability that would divert India's energies and attention to dealing with its regional rival, hopefully without provoking a nuclear confrontation in South Asia. Thus, China has been willing to engage in limited levels of nuclear proliferation to serve what it regards as critical strategic objectives.

Modifications in China's Basic Approach

The above basic Chinese view toward weapons of mass destruction has undergone some modifications in recent decades as a result of four major events: the end of the Maoist era; the emergence of a more active and effective international arms control environment; changes in the military threat posed by the Soviet Union and the United States; and the advent of new and more varied WMD capabilities by potential adversaries. Taken together, these factors have served to alter some important elements of China's basic viewpoint toward WMD use in particular and also have exerted some influence on views toward WMD transfer. Specifically, they have led to: 1) a more pragmatic and sophisticated assessment of the role of WMD in protecting China's security (along with improvements in the quality of China's nuclear inventory); 2) an increased emphasis on the development and deployment of multirole ballistic missiles; 3) greater restraints on WMD transfers; and possibly 4) a growing consideration of substrategic WMD use under limited war conditions.

The End of the Maoist Era

Maoists believed, as do Chinese leaders in general, that such socialist states as China need to acquire WMD capabilities (and especially nuclear weapons) for defensive purposes, to break the superpowers' "nuclear monopoly" and deter superpowers from war or threats of war.[445] Hence, although they stood publicly for the eventual abolition of all WMD, Maoists certainly recognized the need for a WMD-based defensive deterrence capability, especially after China had received nuclear threats from the United States in the early fifties.[446] Maoist theory, however, also tended to downplay the power of weapons of mass destruction and the significance of such weapons as a key factor influencing a state's calculations regarding the initiation and prosecution of armed conflict. In particular, Maoists did not see weapons of mass destruction as possessing a special power to prevent an attack or to dominate a battlefield, although they were viewed as tools of superpower dominance in the larger international political arena.[447] Instead, Maoist strategists stressed in their writings the role of revolutionary political struggle, human willpower and motivation, the use of stern warnings and defiance of an adversary, and visible military movements to deter and defeat an enemy.[448] In short, Maoists did not want an unrealistic fear of nuclear war to prevent support for national liberation struggles.[449]

Maoists thus believed that Western nuclear deterrence theory and general efforts to reduce tensions between the superpowers placed an excessive emphasis on technology and weapons over the human factor and were a form of appeasement to imperialist aggression.[450] In line with this approach, they also criticized efforts by the superpowers to limit the spread of nuclear weapons as an attempt by the superpowers to establish a nuclear monopoly to dominate and intimidate other states. And they believed that such WMD-based intimidation by the superpowers, combined with aggressive competition between the superpowers, could lead to war.[451]

This largely ideological viewpoint toward the role of WMD in creating or ensuring inter-state peace, stability, and conflict prevented the development of more realistic and explicit doctrines governing nuclear weapons possession and use.[452] Hence, Mao's passing and the subsequent decline of Maoist influence opened the door to more pragmatic and technology-driven approaches to WMD threats and countermeasures.[453] Specifically, during the post-Mao era, a more explicit and realistic recognition gradually emerged of the capabilities and hence the range of threats posed by nuclear, chemical, and biological weapons, including the potential vulnerability of China's small WMD arsenal to a decapitating first strike. This development permitted a more deliberate consideration of a relatively diverse WMD inventory (including a triad of land-based missiles, submarine-launched missiles, and bombers, as well as theater and tactical weapons) and the doctrines for their use, although these changes did not alter the basic Chinese emphasis on a defense-based notion of WMD deterrence. (i.e., maintenance of a retaliatory WMD force that is primarily countervalue in orientation).[454]

The Rise of International Arms Control Regimes

International efforts to stop nuclear testing, limit fissile materials production, end the proliferation of WMD capabilities (including technologies, warheads, and delivery systems), and ban chemical and biological weapons increased significantly during the seventies, eighties, and nineties, thus resulting in the emergence of a wide range of arms control regimes in these and other areas. Such international efforts, combined with the passing of the Maoist view of arms control as "sham disarmament" designed to increase the dominant position of the superpowers, led to China's active participation in most arms control regimes, as indicated above.[455]

Although much of China's involvement in these regimes has amounted to defection and free riding,[456] the significant increase in global attention to and support for arms control efforts, along with increases in the number of specific arms control regimes, together have served to limit the size and diversity of China's WMD capabilities. In particular, these developments arguably have limited China's ability to develop a wider range of warhead designs and posed the possibility of limiting or reducing China's existing nuclear and WMD stockpiles, not just its WMD production. They also have arguably lowered the ability and the willingness of China's leaders and lower-level elites to transfer WMD to other countries, either as a function of national policy or as a result of unsanctioned business activities.[457]

Changes in the Superpower Threat

During the 1950s, the perceived threat of US theater nuclear attack with tactical weapons was so acute that some Chinese reportedly contemplated the possibility of acquiring and employing tactical and theater nuclear weapons.[458] Though largely nascent at that time, this attitude has gained strength since the late sixties and seventies as a result of several developments. In particular, the intensification of tensions with the Soviet Union and the resulting deployment of large numbers of relatively sophisticated Soviet armored formations and tactical nuclear weapons along China's periphery in the sixties, seventies, and eighties raised the possibility of a massive conventional and nuclear assault on Chinese territory in a limited war scenario.[459] China had little defense against such an assault beyond either: a) a protracted war of attrition that pitted large numbers of inferior armed Chinese infantry against Soviet units possessing overwhelming conventional firepower; or b) escalation of the conflict to a strategic nuclear confrontation, where China also was enormously inferior.

By the 1990s, the collapse of the Soviet Union had lowered greatly the threat of a Russian attack on Chinese territory. Chinese fears of a limited, yet potentially overwhelming, conventional and/or WMD attack by a more powerful foreign adversary, however, did not dissipate as a result. During the decade, the United States gradually emerged, in the view of many Chinese, as a new and, in some ways, more lethal threat to China's security. The end of Sino-American strategic collaboration, the violent suppression of prodemocracy demonstrators by the Chinese Government in June 1989, and growing Sino-US friction over Taiwan had combined during the nineties to increase significantly the level of tension in China's relations with the United States. Moreover, the performance of US military forces during the Gulf war showed that Washington had the technical ability to wreak enormous damage on an opponent within a limited theater of operation using conventional weapons (more on this point below).[460] Serious Chinese concerns over the possibility of a limited yet overwhelming US attack on Chinese territory, however, only arguably emerged as a result of the recent Kosovo war. This conflict indicated to many Chinese that the United States was willing and able to intervene militarily in the internal affairs of a sovereign state, without the approval of the United Nations, and to devastating effect.[461] Hence, despite the collapse of the Soviet Union, China's sense of vulnerability to a limited yet overwhelming conventional attack did not diminish as the decade progressed. One might also add that, despite the Soviet collapse and the US removal of tactical nuclear weapons from forward-deployed forces, China's leaders also remain concerned over the possible continued presence of tactical nuclear weapons near China's borders.

Together, these developments for the first time gave greater salience to the potential utility for China of possessing and deploying theater or tactical weapons of mass destruction in an actual warfighting mode, to deter overwhelming conventional attacks, and to avoid escalation of a limited conflict to the strategic level.[462]

Technical Changes and Shortcomings

Many technical changes relevant to WMD possession and use served to reinforce the general trends cited in the previous section. Specifically, by the sixties and seventies, the advent of lower yield, tactical nuclear weapons, improvements in battlefield chemical and biological weapons, and the emergence of new doctrines of flexible response and sub-strategic conflict with limited escalation potential led to a growing Chinese awareness of the possible use of WMD in a variety of limited theater conflicts. In addition, enormous technical advances in the areas of surveillance, detection, targeting, and long-range precision delivery systems (as seen during the Gulf war[463] and even more markedly during the Kosovo war) combined with more recent movement by the United States toward a limited national ballistic missile defense system and the possible deployment of such systems in East Asia, together increased China's vulnerability on *both* the strategic and substrategic levels and further raised the overall likelihood of the limited use of WMD on the battlefield. Moreover, on the strategic level, the end of the bipolar US-Soviet confrontation arguably increased China's overall vulnerability by making possible the ability of either Russia or the United States to target more weapons on China if necessary.

China's continued (indeed, enhanced) sense of vulnerability to conventional and WMD attacks at both the strategic and substrategic levels, along with its continuing inability to develop and deploy such long-range conventional and WMD strike assets as fourth-generation fighter-bombers[464] and nuclear missile submarines, together have led to a greater reliance upon one area of weapons technology in which China has shown considerable prowess: missiles. China's general attitude toward the possession and use of ballistic missiles differs significantly from that of the United States and other Western countries.[465] In particular, for the Chinese, ballistic missiles are not viewed essentially as weapons of mass destruction but rather as highly versatile delivery systems for both WMD and conventional warheads. In some scenarios, they are treated as relatively cheap equivalents to such more advanced and versatile delivery systems as attack aircraft, or even as a type of very-long-range artillery. For many Chinese, therefore, ballistic missiles can serve as either conventional warfighting instruments, or as delivery systems for both conventional and WMD deterrence weapons, depending upon their range and the size and type of warhead employed. As a result of this broad, essentially non-WMD definition, China has in the past been willing to transfer to other countries various types of (especially short or medium range) missiles, especially those intended for conventional use. This willingness also has resulted from increased emphasis on weapons exports as a means of generating business profits of the reform era. Yet in recent years, the Chinese Government has shown a much greater willingness to restrict the transfer of ballistic missiles, especially those with intermediate- or long-range capabilities. At the same time, since the mid-nineties, the Chinese leadership also increasingly has emphasized the development and deployment of short-range ballistic missiles as conventional tactical and theater-oriented delivery systems. This development has occurred primarily in support of a larger strategy of coercive diplomacy toward Taiwan. For the Chinese leadership, none of these activities fall within the realm of WMD. Indeed, China has frequently stated that the focus of WMD nonproliferation efforts should be on the restriction of WMD per se, not on delivery systems.[466]

The above technical developments, as well as the changes that occurred in the nature of the threat posed by the superpowers, together led, in the seventies and eighties, to Chinese efforts to reduce the vulnerability of its small, defensive force through the deployment of solid-fueled, mobile delivery IRBM and ICBM systems and, more recently, the development of a nascent MIRV capability to penetrate ballistic missile defense systems, if necessary. Beijing also undertook efforts to acquire a more effective (i.e., larger and more capable) SSBN force.[467] In addition, as suggested above, in the last few years an increasing number of Chinese have come to recognize the need to develop and deploy a variety of more sophisticated theater and tactical weapons, including small-yield battlefield and theater nuclear warheads and short- and intermediate-range ballistic and cruise missiles capable of delivering both conventional and WMD warheads.

All of these developments suggest a gradual movement from China's previous "minimum deterrence" WMD force structure to a more versatile WMD inventory including sufficient counter-force and counter-value tactical, theater, and strategic forces to deter conventional, theater, and strategic nuclear conflict, and to control escalation and compel the enemy to back down if deterrence fails.[468] Such a force structure, much less the more sophisticated "limited deterrence" doctrine to support it, however, require a wide variety of components, including high levels of warhead accuracy, a more diverse range of delivery systems in larger numbers, combat troops trained to utilize such systems, and more robust early warning, detection, surveillance, and targeting capabilities, to identify the source of attacks and to locate and destroy military facilities and large conventional and WMD force concentrations. A capacity for rapid response and the ability to concentrate firepower quickly and massively would be required to defeat enemy forces early and decisively. Although China is attempting to acquire at least some of these elements (e.g., greater warhead accuracy and a more proficient early warning and C^3I capability), others (e.g., combat troops trained to employ theater and tactical nuclear weapons) are nowhere in evidence. In short, the Chinese do not at present possess the capacity to implement this vision, owing to economic, technical, organizational, and arms control restraints. Hence, stating that China is at present actively engaged in developing a warfighting-oriented, limited deterrence WMD force structure and doctrine, even at the theater level, probably is premature.[469] China apparently remains, for the present, wedded to a defensive-oriented, nonwarfighting notion of WMD deterrence.

Summary and Future Developments

To summarize, China's view toward weapons of mass destruction includes the following six elements:

- Rhetorical support for the complete prohibition of nuclear, biological, and chemical (NBC) weapons, allegedly in support of the notion that such weapons increase the risk of war and are often employed by larger powers to bully smaller powers and to generally dominate the international system.
- Recognition of the need for China to maintain a small, retaliatory, counter-value-oriented WMD capability in the nuclear (and possibly in the chemical and biological) area, to prevent efforts at WMD-based blackmail and intimidation by other powers, and to deter WMD attacks. For many Chinese, possession of such capabilities also lends China the respect and status of a major power.
- Enunciation of a no-first-use (NFU) doctrine governing nuclear weapons, presumably to indicate Beijing's opposition to all attempts to use nuclear weapons to politically coerce or subjugate other powers, to reinforce, in the public arena, the impression that China does not pose a WMD threat to larger WMD powers, and to support the objective of total abandonment of weapons of mass destruction.
- Recognition of the necessity to selectively transfer nuclear (and possibly chemical) weapons technologies to other countries (e.g., Pakistan) to serve vital strategic interests, along with, in recent years, a greatly reduced ability and willingness to transfer WMD equipment and technologies for other purposes.
- Since the end of the Maoist era, a more explicit and realistic recognition of the capabilities and hence the range of threats posed by nuclear, chemical, and biological weapons, including the potential vulnerability of China's small WMD arsenal to a decapitating first strike, thus permitting a more deliberate consideration of a relatively diverse WMD inventory and the doctrines for their use. In recent years, this approach has included a growing consideration of substrategic WMD use under limited war conditions.
- The treatment of ballistic missiles not as weapons of mass destruction per se, but as relatively cheap and versatile delivery systems for both WMD and conventional purposes, combined with both a greater willingness to restrict the transfer of larger, longer range missiles and an increasing emphasis on the development and deployment of short-range ballistic missiles as conventional tactical and theater-oriented weapons.

What, if any, changes might occur in China's viewpoint toward the use, possession, and transfer of weapons of mass destruction in the next decade or so? The above examination suggests that Chinese views could undergo significant changes in five basic areas:

First, and foremost, China's leadership might increasingly be pressured to jettison, or at least significantly downplay, its No First Use stance toward nuclear weapons use. This change could occur largely as a result of Beijing's continued sense of vulnerability to a devastating theater (i.e., substrategic) conventional attack by the United States using a variety of long-range, precision assets against which it has few if any effective existing countermeasures other than nuclear weapons. In such a context, Chinese leaders and strategists might conclude that effective deterrence against such an attack can be provided only if China possesses a genuine capability and willingness to initiate a tactical or theater WMD strike first, for either preemptive purposes, or in response to an initial conventional attack at that level. This approach, in turn, would imply the emergence of a true limited deterrence-based WMD force structure and doctrine.

Second, and closely related to the previous point, continued increases in the number and variety of Chinese ballistic missiles capable of carrying conventional warheads could lead the Chinese leadership to adopt a "local war" strategy designed to threaten or employ large numbers of conventionally armed short- and intermediate-range missiles against both nuclear and non-nuclear-weapon states in a theater environment, coupled with a warning of potential escalation to nuclear attack.[470] This approach would constitute a conventional variant of the aforementioned limited deterrence approach to theater-level conflict.

Third, over the long term, China's leaders might expand significantly the size, versatility, and capability of their strategic nuclear arsenal, primarily in response to a growing sense of vulnerability to a decapitating first strike by the United States resulting from both technical improvements in the detection, targeting, and warhead accuracy of the US nuclear arsenal and the deployment by the United States (and perhaps by Japan) of a national ballistic missile defense system.[471] This policy could result in China's emergence as a more significant nuclear adversary of the United States. Although China might approximate elements of a limited deterrence force on the strategic level, however, Beijing, for technical, organizational, economic, and perhaps political reasons, is unlikely to acquire an offensive, first-strike capability.

Fourth, China is likely to show increasing restraint toward the transfer of WMD capabilities (including long-range missile systems) to non-WMD states during the coming decade, largely owing to the continuation of existing positive trends that serve to limit China's ability and willingness to undertake such transfers. China's leaders, however, could become more willing to transfer WMD capabilities over the longer term if the United States and China become genuine strategic adversaries. Under such circumstances, Beijing's vital strategic interests are likely to extend beyond their present limits to include the acquisition of greater influence over a larger number of areas and countries, in competition with the United States. The Chinese leadership might thus calculate that its interests would be served by cultivating and maintaining a range of strategic allies through the provision of WMD-related military assistance. Fortunately, however, such an outcome is by no means on the horizon.

Fifth, China's leadership might seek to acquire the ability to employ WMD warheads in space, as part of an effort to counter a space-based US national ballistic missile defense system that, from the Chinese viewpoint, poses the danger of neutralizing their relatively small strategic nuclear arsenal.[472] Such a course, however, will likely remain a remote possibility for a long time to come, given: a) the cheaper and relatively more feasible alternatives that China probably would have at hand to counter a US missile defense system (as indicated in point three above); b) China's general public stance against the miniaturization of space; and c) the likely pressure on China that would emerge from the international community if Beijing were to undertake such a course of action.

Weapons of Precise Destruction: PLA Space and Theater Missile Development

Mark A. Stokes

Introduction

The People's Republic of China (PRC) is developing one of the most daunting conventional theater missile challenges in the world. Theater missiles and supporting space assets are emerging as one of the most important political and operational tools of the People's Liberation Army (PLA). A large arsenal of highly accurate and lethal theater missiles serves as a "trump card" (*shashoujian*), a revolutionary departure from the PLA of the past. The PLA's theater missiles and a supporting space-based surveillance network are emerging not only as a tool of psychological warfare but also as a potentially devastating weapon of military utility.[473]

Theater ballistic and land-attack cruise missiles, supported by space-based reconnaissance, appear very likely to emerge as a cornerstone of PLA warfighting early in the 21st century. A growing sector of the PLA believes strategic attack through theater missile strikes are the best way to even out the playing field when fighting against a technologically superior force. The concept of strategic attack involves pitting one's strengths against an enemy's weakness, waging an asymmetrical strategy using overwhelming offensive capabilities. Theater missiles offer a lethal means of striking targets that most directly relate to the ability of the opponent to sustain operations. According to PLA National Defense University officials, "The guiding strategic principle of China's new era military is active defense (*jiji fangyu*), of which the required essence is offensive operations against theater targets."[474]

Beijing's drift toward a force dominated by offensive theater missiles could have significant implications for regional stability. In the most likely scenario for their use, the PLA's growing arsenal of highly accurate and lethal theater missiles, and a preemptive doctrine could give Beijing a decisive edge in any future conflict with Taiwan. An overwhelming offensive advantage could intensify the existing cross-Strait arms race, reduce Beijing's willingness to compromise on cross-Strait issues, increase the chances that force could be used short of an outright Taiwan declaration of *de jure* independence, and prompt Taiwan to shift toward a tactically offensive doctrine. At the extreme, an overwhelming PLA offensive advantage could force Taiwan to pursue a punitive deterrent option.

Drivers

This paper will first address drivers that are influencing the PLA force planners who view space assets and theater missiles as integral to 21st century operations. The next section outlines Chinese efforts to field a space-based reconnaissance architecture that would support theater missile targeting. The paper then outlines research and development aimed at fielding a large arsenal of ballistic and land-attack cruise missiles. The following section details operational concepts associated with a PLA theater missile campaign, to include organizational issues, information denial, and the Second Artillery's phased approach to theater warfighting. The paper concludes with a discussion of the operational and political implications of an offensive-dominated force structure, as well as potential countermeasures.

A number of drivers are propelling Beijing toward reliance on theater missiles and supporting space assets. These include: 1) lessons from the Gulf war and subsequent US and Russian literature on the revolution in military affairs (RMA); 2) a doctrinal shift toward offensive preemption, surprise, and deep strikes against strategic and operational targets; 3) use of Taiwan as a preeminent force planning scenario; and 4) prevention of foreign intervention in a Taiwan scenario through an area denial strategy.

Lessons from the Gulf War

China's interest in deep attack was sparked in large part by lessons from the Gulf war and subsequent US and Russian literature on the RMA. The US performance in the Gulf war demonstrated to the Central Military Commission (CMC) the preeminence of the offensive, especially airpower and long-range precision strike. In a December 1995 meeting, the CMC concluded that "ground fighting can only enhance the results of battle." Lessons from the Gulf war have been reinforced by calls to meet its challenges of 21st century warfare through selected exploitation of the RMA.[475] Chinese commentators note areas for exploitation include precision strike, strategic maneuver, and space combat.[476]

Emerging Operational Concepts

The Gulf war and the RMA have sparked a fundamental reassessment of the PLA's approach to warfare. Operational concepts articulated in a wide range of PLA publications serve as an important driver propelling the PLA toward theater missiles and supporting space assets. Key to future conflicts around the PRC's periphery will be achieving a rapid political resolution through rapid establishment of information dominance (*zhixinxiquan*) and air superiority (*zhikongquan*) in the opening phases of a conflict.[477] The concept of "rapid war, rapid resolution" (*suzhan, sujue*) requires a series of crippling strikes directed against vital points (*dianxue*) of the enemy's defense infrastructure. These critical nodes include civilian and military command and control facilities; intelligence, surveillance, and reconnaissance nodes; and important airfields and air defense sites. This concept does not require annihilation of the enemy or occupation of his territory, only a paralyzing "mortal blow" (*zhiming daji*), "winning victory with one strike" (*yizhan, ersheng*).[478] From the Chinese perspective, "gaining the initiative by striking first" (*xianfa zhiren*), is one of most effective means of offsetting the technological and logistic advantages that a more advanced military power would bring to the fight. The emerging doctrine requires a high degree of secrecy, mobility, an accurate concentration of firepower, and surprise.[479]

Use of Taiwan as a Primary Force Planning Scenario

Since the collapse of the Soviet Union, Taiwan appears to have become a primary testing grounds for the PLA's emerging operational concepts. Military force planners around the world generally rely on illustrative planning scenarios to guide the development of doctrine, research and development (R&D), and acquisition. Until the early to mid-1990's, China did not appear to be fostering an ability to take Taiwan by force. Nor did the PRC deploy more than a symbolic land, sea or air force presence within 300 miles of Taiwan. Now, however, PLA modernization--and theater missile development in particular--is motivated in large part by the desire to use decisive military force as a means to deter Taiwan independence sentiment and strengthen the PRC's hand in a re-established cross-Strait dialogue. The focus on Taiwan may reflect a view within the PLA that force may eventually have to be used.

With Taiwan as the primary driver, the PLA has three general operational requirements. First is the capacity to bring Taiwan to its knees quickly through paralysis of Taipei's ability to conduct military operations. Critical to this effort is establishment of information dominance by neutralizing Taiwan's intelligence, surveillance, and reconnaissance assets and paralyzing its command and control network.

Information dominance enhances the conditions necessary to control the airspace over Taiwan. Theater ballistic and land-attack cruise missiles, used in parallel with electronic warfare, special operations, and offensive counterair operations, can play a crucial role in the rapid establishment of information and air superiority. Control of the information environment and the skies above the Taiwan Strait--if not enough to force a resolution in itself--could create the conditions necessary for dominance of seas and facilitate an amphibious invasion, if necessary.[480] The PLA must also hedge against strikes against its own critical assets and facilities.

Prevention of Foreign Intervention

At the same time, the PLA must deny foreign forces the ability to intervene either through a quick resolution of the conflict or through complicating their ability to enter the area of operations. Since the US deployment of two aircraft carrier battle groups off the coast of Taiwan in March 1996, PLA planners probably assume the United States would intervene in a future Taiwan scenario. PLA writings indicate Beijing is pursuing the kinds of capabilities intended to deter or prevent intervention by outside powers, such as the United States. The PLA has carefully studied US military weaknesses and has identified vulnerabilities in US force projection, including reliance on space systems, weaknesses in aircraft carrier battle groups, and air expeditionary forces.[481]

The most fundamental requirement for denying the United States the ability to intervene in a Taiwan conflict would be an expanded capacity for intelligence, surveillance, and reconnaissance. Monitoring US deployments could enable PLA targeting of critical nodes in the Western Pacific in order to complicate or delay US intervention in a Taiwan scenario. Successful use of overwhelming force through preemptive strikes to quickly resolve the Taiwan issue could preclude US intervention by presenting Washington and the international community with a *fait accompli*.

Space Support for Theater Missile Operations

Under CMC guidance, China's space and missile industry is working toward the fielding a constellation of reconnaissance systems that could support the PLA with near-real-time intelligence early in the next century. PLA observers view exploitation of space assets as crucial for 21st century warfare. Theater operations must be supported by a surveillance architecture for strategic intelligence, targeting, and battle damage assessment (BDA). Effective theater missile operations need to see deep. Before any targets can be struck, they must be identified as targets, precisely located, and defenses accurately assessed so that they can be hit without prohibitive losses. This requires information from a variety of space-based, airborne, and ground-based sensors. Through its existing air- and ground-based reconnaissance network, the PLA currently has the ability to monitor activities within line of sight of its borders--approximately 200 nautical miles.[482] To expand its battlespace awareness, however, the PLA must develop the means to monitor activities in the Western Pacific, South China Sea, and Indian Ocean. Space assets could enable the monitoring of naval activities in the Pacific and Indian Oceans and the South China Sea and could track US Air Force air expeditionary force (AEF) deployments into the region. Space-based reconnaissance systems also provide the images necessary for mission planning functions, such as navigation and terminal guidance for land-attack cruise missiles.

China Aerospace S&T Corporation (CASC) is developing at least four space-based systems that would expand PLA battlespace awareness and support strike operations farther from Chinese shores.[483] Space operations are the responsibility of the PLA General Armaments Department (GAD) China Launch and Tracking Control General (CLTC).[484] Although only a small percentage of space-derived ISR assets will be near-real time, the number and diversity of sensors could provide frequent revisit times and complementary data on significant military targets on Taiwan and in the Western Pacific.[485]

By the 2005-2010 time frame, China's space-based surveillance architecture could have at least four components: 1) synthetic aperture radar (SAR) satellites for all-weather, day/night monitoring of military activities; 2) electronic reconnaissance satellites to detect electronic emissions in the Western Pacific; 3) mid-high-resolution electro-optical satellites for early warning, targeting, and mission planning; and 4) a new generation of high-resolution recoverable satellites for intelligence and analysis. According to Chinese sources, SAR and electronic reconnaissance satellites would serve as important components of an ocean monitoring (*haiyang jianshi*) network for detecting and tracking naval activities, to include carrier battle groups and submarines. Development of a space-based surveillance architecture has in large part been funded under the special 863 program budget.[486]

Radar Imaging Satellites

Work on an indigenous synthetic radar (SAR) satellite (*hecheng kongjing leida weixing*) began in the 1980s. Under the 863 Program, China's space industry and oceanographic research organizations began preliminary research on an SAR satellite in 1987. The program moved into the applied R&D phase in 1991. After successful fielding of an airborne SAR system,[487] China's State Science and Technology Commission (SSTC) and the PLA's Commission of Science, Technology, and Industry for National Defense (COSTIND) approved the finalized design and associated high-speed data transmission system in May 1995.

Production of the first-generation SAR satellite is included in the 9th Five-Year Plan (1996-2000). China's first radar imaging satellite, designated the Haiyang-1 (HY-1), is slated for launch in the year 2000. The HY-1 will be based on a small satellite bus that will serve as a common bus for a range of future satellite constellations, to include an integrated SAR/EO small satellite constellation. The HY-1 and major subsystems passed a design finalization review recently and a test model is supposed to be delivered by end of this year. Preliminary research has already begun on a more sophisticated second-generation SAR satellite system.[488]

Although SAR satellites have civilian applications, Chinese journals note their principle purpose is to support national defense. The PLA and other parts of the state apparatus view radar satellite imagery as a critical modernization program. Unlike electro-optical systems, GSD Second Department advocates note that space-based SAR systems can see through clouds, rain, and fog in order to detect and track ships and submarines in shallow waters.[489]

China has arranged to receive down-linked radar satellite imagery to help establish a foundation for radar satellite imagery exploitation. The PRC has entered contractual agreements to obtain commercial radar satellite data from a number of foreign vendors. China began receiving SAR data from ERS-1 and JERS-1 satellites in 1994 and from Canada's RADARSAT in 1997. Included in the arrangement was training of imagery analysts.[490]

Electronic Reconnaissance Satellites

Electronic reconnaissance satellites (*dianzi zhencha weixing*) appear to be the second component of an ocean monitoring network. Strong indications exist that China has resurrected an electronic reconnaissance satellite program that has been dormant for over twenty years. The PLA experimented with electronic reconnaissance satellites, euphemistically called "technical experimental satellites" (*jishu* *shiyan weixing*), in the mid-1970s under the 701 Program of the Shanghai Bureau of Astronautics. Technical writings indicate the Shanghai Academy of Spaceflight Technology (SAST), the successor of the Shanghai Bureau of Astronautics, has resurrected the program and intends to field a space-based electronic reconnaissance system. At least one SAST design under evaluation is a constellation of small electronic reconnaissance satellites that can ensure precise location data and survivability.[491]

Electro-Optical Reconnaissance Systems

In addition to its ocean reconnaissance systems, China's remote sensing community is working feverishly to deploy space-based electro-optical (EO) remote sensing platforms. CASC and China's electronics industries have made notable progress in charged couple devices (CCDs), a technology that is essential to the development of real-time EO imaging systems.[492] Fielding of EO satellites would enable Beijing to beam images back to ground stations directly from space.

The Ziyuan-1 (ZY-1), a joint venture between the PRC and Brazil, will serve as China's first EO reconnaissance satellite. Launched in October 1999, the ZY-1 will have a two-year lifespan and will incorporate a data transmission system to beam images back to earth. The ZY-1, operating at an altitude of 778 km, is expected to have only a 20-meter resolution, but will add to China's experience base in EO imaging systems.[493]

Furthermore, CASC spokesmen have announced their intention to field a tactical small satellite imaging constellation and associated mobile ground receiving stations. The tactical imaging system, slated for launch in the next two years, will consist of four EO and two SAR satellites. The EO component is likely to use the same bus as the HY-1 and is designed to have a five-meter resolution when operating in a 700-km orbit.[494]

Small satellite constellations are an important aspect of China's operational concept for space warfare. Clearly recognizing their military implications, Chinese defense officials advocate small satellite development to reduce vulnerability of fixed launchsites. Chinese engineers are examining the utility of using mobile, solid-fueled launch vehicles, such as a modified DF-21 or DF-31.[495] Reduced size and complexity allows for faster R&D and manufacturing time, and production in significant numbers. In a contingency situation, tactical imagery satellites can be launched on demand, with mobile launch platforms increasing survivability. Multiple small satellites can be launched on a single-launch vehicle. Furthermore, enemy attacks on small satellite constellations will encounter greater targeting difficulties and be costly. Destruction of one satellite will have minimal effect on the overall functioning of the architecture.[496]

The FSW-3

China has launched more than a dozen film-based recoverable satellites (*fanhuishi weixing*, or *FSW*) since 1975. These systems stayed in orbit for up to 16 days and were used to obtain imagery of Taiwan and nations around China's periphery, determine coordinates of facilities that were potential targets of Chinese missiles, and to map Chinese territory. China's most recent generation of reconnaissance satellite, the Fanshihui-2 (FSW-2), displayed ability to maneuver in orbit. Reconnaissance satellites have generally been launched from Gansu's Jiuquan Space Launch Center.[497] China's next-generation recoverable satellite--the FSW-3--is expected to have a resolution of 1 meter. This satellite may have been could be launched as early as late 1999.[498]

Ground Processing

China's ground-processing capacity is rapidly progressing. Chinese engineers are working to improve ultra-high-speed data processing, storage, and transmission systems, as well as computer, data compression, and networking technology to be able to handle real-time, high-resolution imagery from multiple satellites. Essential for the efficient transmission and processing of satellite-derived imagery is data compression technology, which CAST is attempting to master.[499] The PLA has fielded a real-time image storage system as well as an imagery dissemination system that is linked to China's national integrated telecommunications network. The system will allow subscribers to search and rapidly download images.[500] In 1996, the PLA installed a digitized high-resolution imagery processing system, the BGC-161.[501]

China is receiving foreign assistance. In 1992, Italy's Telespazio signed an agreement worth $8 million to provide Olivetti image-processing computers and software. Telespazio assigned technicians to train Chinese photo interpreters for up to three years. China's procurement of foreign sources of imagery also includes options for training.[502]

Despite significant investment in reconnaissance systems, China still may have a limited near-real-time targeting capability. Reconnaissance satellites must be within line of sight of a ground station to download its imagery data. Targets on Taiwan could be imaged and immediately beamed back to a ground station on the mainland. Satellites imaging targets farther out from China's borders in the Western Pacific, however, probably would need to store their images and wait until the satellite returns to within line of sight of the Chinese mainland.

Future deployments of a sea-based imagery receiving station, a data relay satellite (DRS), or establishment of ground stations abroad would enhance China's extended range near-real-time targeting capability.[503] A Chinese DRS architecture under development is expected to include at least two geostationary satellites that could provide 85 percent coverage of the ***e***arth and support five to 10 satellites at the same time.[504]

R&D, production, and deployment of satellite systems is expensive. However, much of the R&D budget for China's space program comes from the State Council science and technology budget, not from PLA coffers.[505] With a price tag of between 5 and 12 million US dollars per satellite, the cost of satellite development in China is significantly less than in the US or Western Europe.[506] In addition to funding from the 863 Program, R&D of space systems is subsidized by revenues from commercial space launches and the sale of satellite systems abroad. International cooperative efforts with Russia, Ukraine, Belarus, France, Germany, Italy, and Brazil cut costs even more.[507]

Theater Missile Developments

A space-based reconnaissance system will be a key element of the PLA's emerging theater missile strike force. In March 1996, the Central Military Commission reportedly convened an enlarged meeting and developed a plan to develop seven weapons on a priority basis. Four of those weapons are directly related to building a deep-strike capability. At least one of the objectives was fielding of China's first-generation land-attack cruise missile by the year 2000.[508]

Dependence on theater missiles reflects a failure of China's aviation industry to provide the types of aircraft that normally would carry out this mission.[509] Although they can carry only one-sixth the payload of an air-to-ground strike fighter, ballistic missiles have a strong psychological deterrent effect, and are increasingly accurate, mobile, and stealthy. Advocates argue that ballistic and land-attack cruise missiles are relatively cheap, while aviation technology is increasingly sophisticated and expensive. Air mobilization is time consuming and relatively easy to detect. Strikes against targets in denied areas require a measure of air superiority. Theater ballistic missiles, however, can be rapidly mobilized with a high degree of secrecy. They are much harder to counter due to their fast reentry speeds and short flight times.[510]

Second Artillery Conventional Theater Missile Organization Chart

Theater Ballistic Missiles

Ballistic missiles are emerging as the backbone of conventional PLA theater operations. Drawing profound lessons from the Gulf war, the PLA views conventional ballistic missiles as a crucial aspect of China's emerging deep attack (*zongshen daji*) strategy.[511] CASC appears to be producing a substantial number of conventional theater ballistic missiles with ranges stretching from 300 to 2,000 km. In fact, a 1998 Department of Defense report asserted that China's space and missile industry probably will have the capacity to produce as many as 1,000 ballistic missiles in the next decade.[512] At an estimated cost of US $500,000 or less per missile, CASC would be able to produce up to 1,000 ballistic missiles at a total cost of $500 million.[513] CASC's key producers of ballistic missiles--China Academy of Launch Technology and the 066 Base in Hubei Province--are leveraging foreign technology in order to achieve tremendous advances in accuracy. At the same time, they are diversifying the payloads of their ballistic missile to increase their lethality. CASC and the PLA are also examining a wide range of countermeasures to ensure their theater ballistic missile force remains viable as active theater missile defenses are introduced into the Asia-Pacific region. The PRC is concentrating on three conventional theater ballistic missile systems: 1) the DF-15 short-range ballistic missile (SRBM); 2) the DF-11 SRBM; and 3) the DF-21 medium-range ballistic missile (MRBM).[514]

DF-15 Short-Range Ballistic Missile System. The DF-15 (CSS-6) is a solid-fueled, 600 km SRBM manufactured by the China Academy of Launch Technology (CALT). The DF-15's payload reportedly has an attitude control mechanism that permits steering corrections from separation to impact.[515] The detachable warhead offers a much smaller target than a SCUD, and its potential maneuverability would complicate missile defense radar tracking, computations, and interception. With a unitary, high-explosive warhead, the DF-15 could create a crater has large as 30 to 50 meters in diameter.[516] Assuming a nominal trajectory at a range of 500 km, the DF-15 would reach an altitude of about 120 km, achieve a re-entry speed of about 2 km per second and have a flight time of only six or seven minutes.[517] Some reporting indicates the DF-15 currently has a 100-meter circular error of probability (CEP).[518] To diversify its theater ballistic missile inventory, a 1,200-km-range version of the DF-15 is reportedly under development.[519]

DF-11 Short-Range Ballistic Missile System. The DF-11--better known by its export designator, the M-11 (CSS-7)--also is a solid-propellant, road-mobile SRBM with an estimated range of 300 km. This missile, however, has not yet entered the PLA's inventory. An improved, longer range version of the DF-11 may be under development.[520] The main advantage of the DF-11 over the DF-15 is its ability to carry a larger payload. Some sources credit the 300-km version with an 800-kg warhead and a 150-meter CEP.[521] The DF-11 is manufactured by the CASC's 066 Base, also known as the Sanjiang Space

Corporation, based in Hubei Province. The DF-11's 300-km range presents challenges for active missile defenses due to its brief flight time of three minutes. Because its flight would remain within the atmosphere, upper tier systems would be unable to engage the 300-km DF-11.[522] Details on the longer range version are unavailable.

DF-21 Medium-Range Ballistic Missile System. One other missile system that could be brought to bear against Taiwan is the solid-fueled 2,000-km DF-21 (CSS-5), equipped with a 600-kg warhead. Research and development on the DF-21 began in 1967, had its first successful test in 1985, and deployed into an experimental regiment as early as 1991. With a circular error probable (CEP) of 700 meters, the DF-21 currently is equipped for nuclear missions only. Indications are, however, that a terminal guidance system is under development for the DF-21 that could permit highly accurate conventional strikes.[523] The DF-21 reentry speed is fast enough to preclude successful intercepts by lower-tier missile defense systems. Because of its warhead size and the inability of lower tier missile defense systems to engage longer range MRBMs, incorporation of a terminal guidance system could have significant military implications.

Technical Trends

Several efforts are under way to increase the accuracy and lethality of China's theater ballistic missiles. These include: 1) terminal guidance; 2) a diverse mix of conventional payloads; and 3) missile defense countermeasures.

Terminal Guidance. The most significant development in China's theater ballistic missile program is the development of terminal guidance systems which, according to Chinese writings, meet a CEP requirement of 25 to 40 meters.[524] CASC engineers point to three options in ballistic missile terminal guidance. First, terrain matching terminal guidance (*dixing pipei mozhidao*) makes use of digitized stored images (electro-optical or radar) and match them against the images acquired in the seeker. CALT began preliminary research on terrain-matching terminal guidance as early as 1977.[525] Radar matching was used on the US Pershing-II and optical matching is currently used on a Russian variant of the Scud-B. Chinese engineers note that critical technologies for terrain matching terminal guidance include large-scale and very-large-scale integrated circuits (LSIC/VLSIC).[526]

A second means for terminal guidance is a millimeter wave seeker (*maomibo xun*). CALT engineers have carried out a number of feasibility studies on terminal guidance technologies, to include millimeter wave and infrared.[527] Millimeter wave seekers are compact, lightweight, have high spatial resolution, a robust antijamming capability, and are all-weather. Critical technologies include LSICs, microcomputers, and digital information management systems for target discrimination and tracking. Chinese engineers, however, note that MMW seekers are relatively expensive.[528]

A final option for terminal guidance is exploitation of the global positional system (GPS). GPS-assisted guidance system usually includes a GPS receiver, a ring laser gyro (*huanxing jiguang tuoluo*), and microcomputer. There are indications China has already mastered use of GPS for mid-course corrections. At least two tests of an on-board GPS trajectory reference system had been conducted as of 1995.[529] Use of GPS for terminal guidance requires frequent and highly precise updates from navigation satellites. Potentially in support of this effort, China is installing a differential GPS network (*chafen quanqiu dingwei xitong*) along its eastern seaboard that could enhance the accuracy of the PLA's SRBM force.[530]

Finally, CASC institutes have close relations--some officially sanctioned and some not--with counterparts in the former Soviet Union. Chinese engineers have approached Russian institutes for ballistic missile guidance and control technology and have hired a number of Russian scientists as technical advisors.[531]

Conventional Payloads. Evidence suggests that China intends to design up to six different payloads for its theater ballistic missiles. Today, the PLA's conventional theater ballistic missiles are armed with only unitary blast fragmentation warheads. To diversify its missile payloads, CASC writings indicate prioritization of three categories of specialized warheads for use against air defense sites, radar, airfields, semi-hardened C***4***I centers, and ports: 1) submunition (*zimudan*) payloads; 2) electromagnetic pulse warheads (*dianci chongzhong dantou*); 3) penetrating warheads (*zuandi dantou*); and 4) fuel-air explosive warheads (*youqi* or *leibao dantou*).[532]

Submunitions. A submunition warhead contains a number of small devices or "bomblets" designed for specialized roles. These warheads usually detonate at a preset altitude of several hundred meters so as to spread the munitions out to an optimal pattern size. Submunition warheads are far more efficient against targets susceptible to blast and fragmentation than unitary warheads of the same weight. As of 1996, CALT was testing a guided submunition (*jiandan zimudan*) package for blast and fragmentation effects; and penetrating submunitions (*qinche zimudan*) for cratering runways. More advanced packages under development include terminally guided sensor fused submunition warheads.[533] There are also indications of CBU-78 GATOR-like minelaying submunition development.[534]

Electromagnetic Pulse Warhead (EMP). PLA writings indicate that fielding of an antiradiation EMP warhead is a high priority. An antiradiation warhead, specifically a high-powered microwave (HPM) device, is viewed as a "natural enemy" (*tiandi*) of more technologically advanced militaries and an "electronic trump card" (*dianzi shashou*).[535] Due to challenges related to weaponizing a device with enough power, HPM warheads would initially be effective only against radiating targets within the immediate area of impact--radar and communications centers would be the prime candidates. As the technology progresses, HPM warheads could achieve wider effects.[536] The developers of the DF-1--known as the 066 Base--have demonstrated the most interest in HPM warheads.[537]

Penetration Warheads. Chinese engineers note that an increase in CEP to better than 50 meters would permit the use of penetration warheads (*zuandi dantou*) that would dig deep into such semihardened facilities as command and control centers, intelligence collection facilities, and weapons storage facilities that are housed in concrete bunkers. CALT warhead engineers have tested a range of high-strength steels and other material and structural technologies that would dig into critical hardened facilities.[538]

Fuel-Air Explosive Warhead. There are also indications that the DF-15 may carry a fuel-air explosive (FAE) warhead. FAE warheads offer greater explosive power at a weight approximately 50 percent less than conventional explosives. Pound for pound, FAE weapons are three to five times as destructive as high-explosive warheads. For example, a 500-kg FAE warhead would destroy most aircraft and injure all personnel within 250 meters of the impact point. Chinese designers have studied the use of FAE warheads since the 1970s and tested the effectiveness of an FAE as early as 1976 by detonating a US device that had been captured by the Vietnamese and transferred to Beijing.[539]

Missile Defense Countermeasures

The PLA places a premium on ensuring its ballistic missile force would be able to penetrate future active theater missile defenses. PLA and defense industry analysts are examining a range of more sophisticated

TMD countermeasures that could reduce the effectiveness of active missile defense systems.

Saturation. The simplest means of overcoming a missile defense architecture is by saturating it with a large number of missiles. Given enough ballistic and land attack cruise missiles, any system can be saturated by overwhelming a missile defense systems' area of coverage. Saturation generally requires a large number of missiles, timed to arrive together in order to bunch effectively for ground defense saturation. PLA General Armament Department engineers have evaluated Patriot saturation rates and are confident that their theater ballistic missiles can reach their targets.[540]

Maneuvering Reentry Vehicles. More sophisticated countermeasures could reduce the effectiveness of active missile defenses short of the brute force saturation approach. For example, the CASC is developing the capabilities that would permit conventional ballistic missile reentry vehicles to maneuver in their terminal phase. Missile designers believe maneuvering is not only essential for the terminal guidance packages but are also a means to complicate ballistic missile defenses. Through modeling and simulation, CASC has determined that maneuvering is a viable means to reduce land-based, lower-tier TBMD probability of kill rates.[541] In support of this research effort, China allegedly acquired PATRIOT technology to calibrate an auxiliary propulsion system on the DF-15 reentry vehicle to enable the payload to outmaneuver a PATRIOT system as it reenters the atmosphere.[542] Missile designers have also demonstrated a special interest in the speed control maneuver (*sudu kongzhi jidong*) used in the 1,800-km Pershing-II.[543]

Shaping, Stealth, Decoys, and On-Board Jammers. CALT warhead designers already have lowered the DF-15 and DF-11 signature through shaping of the warhead. A warhead designer can lower the signature of a reentry vehicle further by reducing the infrared signal or by incorporating stealth design technologies to reduce the radar cross section. Use of balloons can also mask the shape of reentry vehicles, and chaff (*jinshu botiao*) can be released with the reentry vehicle in an attempt to hide the target behind a cloud of radar-reflecting metal strips. Chinese engineers have tested chaff packages. Other measures under investigation include electronic and infrared countermeasures on board reentry vehicles, as well as carrying out hard kills against enemy TMD radar through the use of antiradiation missiles.[544] CASC missile engineers have tested active jammers that can broadcast a signal designed to interfere with a radar's ability to detect the target object or corrupt the signal in such a way as to cause the radar to receive a false echo.[545] National University of Defense Technology analysts have examined electronic countermeasure packages on board theater ballistic missiles as a means to counter millimeter wave and infrared seekers on missile defense interceptors.[546] In 1995 and 1996, the Chinese allegedly tested DF-21 endo-atmospheric decoys.[547]

Laser Cladding. Looking ahead to the potential deployment of boost phase intercept systems such as the airborne laser (ABL), Chinese engineers are developing a coating for ballistic missiles that could complicate use of missile defense high-power lasers. Using their own indigenously developed high-powered lasers, Chinese institutes have tested various coating materials to protect the outer shell of ballistic missiles, a process known as laser cladding (*jiguang rongfu*).[548] Laser cladding, together with the spinning of theater ballistic missiles, may not make ballistic missiles immune to boost-phase missile defense systems but could increase required lasing time, thus reducing the number of laser shots available per ABL mission.

Multi-Axis Attacks. The Second Artillery and CASC have conducted modeling exercises and simulations to test China's ability to break though the wide range of projected TMD deployments. Modeling has focused on large raid sizes, using combinations of surface-to-surface, air-to-surface, and sea-to-surface theater missile systems. After computer simulations and modeling exercises, CASC is confident that its theater ballistic missiles can neutralize opposing land-based, lower-tier systems.[549]

Depressed Trajectories. Chinese missile analysts view depressed trajectories (*yadi guidao*) as another option to counter space-based and exo-atmospheric, upper tier missile defense systems. A 1,200-km-range ballistic missile on a nominal trajectory will normally reach an altitude of 400 km rendering the missile vulnerable to upper tier missile defenses for a substantial portion of the flight. Launching a missile at a depressed trajectory, however, could allow the missile to achieve only a 100-km altitude, which limits the ability of exo-atmospheric upper systems to engage the missile. Testing and modeling has been done on the DF-3 (CSS-2), which normally has a range of 2,780 km, with a maximum altitude of 550 km. With depressed trajectory, the DF-3 travels 1,550 km at 100-km altitude.[550]

Land-Attack Cruise Missiles

To augment its theater ballistic missile arsenal, China is creating a new generation of cruise missiles able to penetrate defenses and strike critical targets with precision and increased firepower. Fielding of land-attack cruise missiles (LACMs) may prompt expansion of missions of the PLA's Second Artillery and Navy. Increasing availability of cheap navigation and guidance systems and digital mapping technology have increased the incentives and reduced the time required to field an LACM.

Cheaper and more accurate than ballistic missiles, LACMs appear to have a relatively high development priority. The size and flight profile of ground-, air-, and sea-launched cruise missiles can stress the capabilities of even the most modern air defense systems. Chinese research and development of LACMs is being aided by an aggressive effort to acquire foreign cruise missile technology and subsystems, particularly from Russia. The first LACM to enter production probably would be air-launched and could be operational early in the next century.[551]

The heart of China's LACM missile development lies within CASC's Third Academy, headquartered just southwest of Beijing. More than 14,500 technicians and workers ply their trade in ten research institutes and two major factories. The following discussion of China LACM development focuses on: 1) the underlying rationale for LACM development; 2) specific LACM systems that may come on line within the next five years; 3) the mission planning process; and 4) general technical trends influencing China LACM development.

Why Land-Attack Cruise Missiles?. LACMs have a number of advantages over ballistic missiles or manned aircraft. China's first-generation LACM is likely to be up to twice as accurate as their theater ballistic missiles. Successful exploitation of GPS, indigenous and/or foreign-procured remote sensing data, and digital mapping technology could permit the fielding of an LACM with a CEP of 16 meters or better. LACMs are cheaper to produce, generally thought to be one-third the cost of ballistic missiles. For example, if one assumes an SRBM unit cost of $500,000, then the unit cost of an LACM could be as little as $175,000. Chinese defense industrial observers note that developing an arsenal of cruise missiles could have a 9:1 ratio over the cost of defending against them. As the president of the Third Academy has pointed out, the cost of producing cruise missiles is 20 to 30 percent less in China than it is in other countries.[552]

Cruise missiles offer other appealing features as well. Use of GPS allows launchers to forgo presurveyed launchsites, permitting the missile to disperse to a greater range of launch sites. Ground-launched

LACMs can be quite survivable. With a low takeoff weight, they tend to be more easily transportable than theater ballistic missiles. The infrared launch signature would be less than that of a ballistic missile, decreasing warning time and increasing survivability. Unlike ballistic missiles, land-attack cruise missiles could be loaded onto ships and fired at land targets that may not have been anticipated.[553]

LACMs pose serious challenges for air defenses. Due to the ***e***arth's curvature, ground-based radar can detect a low-flying cruise missile only about 32 km away. In comparison, an aircraft flying at 10,000 feet can be detected when it is about 240 km away. Newer missiles are incorporating stealth features that would make them even less visible to radar and infrared detectors.

PLA LACM Programs. In accordance with standard Third Academy R&D practices, China's future family of land-attack cruise missiles probably will be based on airframes that have already been fielded.[554] Chinese and Western sources indicate at least three families of cruise missiles may be under evaluation for a land-attack mission: 1) the Silkworm; 2) the multipurpose Yingji-8 missile; and 3) an antiradiation missile that Western sources have designated as the YJ-91.[555]

The Land-Attack Silkworm. China's first LACM is expected to be a Silkworm derivative. This system, designated the XY-41 as early as 1989, will be smaller, more mobile, and more accurate than ballistic missiles such as the DF-15, but carry the same size warhead (500 kg). The XY-41 is a variant of the HY-4 antiship cruise missile.[556] The Silkworm derivative could be air- or ground-launched and reportedly will have a range of 300-400 km, indicating an upgrade to the HY-4's turbojet engine.[557] Some Western reporting asserts that CASC is getting foreign assistance in development of an integrated INS/GPS system and in warhead technology.[558]

Ground-launched LACMs would be subordinated to the Second Artillery. Based on existing organizational structures within the Second Artillery and in coastal Silkworm units, a ground-launched LACM brigade likely would be divided into four battalions, with each battalion having four company-sized fire units with one launcher per fire unit. A first-generation LACM brigade could adopt an organization structure similar to today's typical HY-4 fire unit--four towed launchers, a firing command vehicle, a truck-mounted microwave relay, and auxiliary power truck. The HY-4 is launched via a solid rocket booster before a turbojet engine takes over for the duration of the flight. The missile cruises at about Mach 0.8 and maintains an altitude of between 70 and 200 meters.[559]

The YJ-8. A second system reported by Western sources as being adapted for land-attack use is the smaller Yingji-8 (YJ-8). The Exocet-like YJ-8 series adopts a solid propellant that decreases the size and weight of the system to enable a more diverse set of launching modes. With the solid motor, however, the YJ-8's range is limited to 42 km or less. A YJ-8 follow-on, designated the YJ-82, utilizes the same basic airframe but uses a small turbojet engine instead of a solid motor that extends the airframe's range to 120 km. The alleged land-attack version of the YJ-8--reportedly the turbojet variant--would incorporate integrated GPS and TERCOM guidance. Western sources indicate the Third Academy may be extending its range to at least 300 km and claim that GPS-aided navigation--augmented by terrain contour matching--could result in cruise missiles like the YJ-8 to achieve an accuracy of up to 10 meters. The YJ-8's smaller warhead (165 kg), however, would limit the missile's utility.[560]

A Chinese Antiradiation Missile. The PLA and China's space and missile community has also devoted a significant degree of attention to development of cruise missiles with passive seekers to counter enemy radar systems. Like ballistic and other cruise missiles, antiradiation missiles are considered as a *shashoujian* for priority development. Western sources have designated China's new family of antiradiation missiles as the Yingji-9 (YJ-9), a system influenced by Russia's Kh-31P and/or Israel's STAR-1 ARM systems. There are persistent rumors of PLA procurement or joint production arrangement on the Kh-31P, which Chinese engineers note was specifically developed to counter the US AWACS, PATRIOT MPQ-53 radar, and AEGIS SPY-1D phased-array radar. China's defense industrial complex, specifically the Third Academy with support from the Harbin Institute of Technology, is aggressively pursuing deployment of a long-range antiradiation missile.[561] Some Western sources allege an extended-range version of the YJ-9 may have a range of 400 km.[562] Chinese research indicates China's first-generation antiradiation missile will be air launched.[563]

Mission Planning. Mission planning exploits navigation aids and flight management computers to permit LACMs to fly along precise, preprogrammed routes. This generally involves use of a land-attack navigation system, including exploitation of US NAVSTAR GPS and Russia's GLONASS, a radar altimeter, an inertial measurement unit, and a sophisticated flight management computer. Because mission planning requires a knowledge of the shape of the terrain and obstructions found along the cruise missile's intended flight path, satellite imagery and geographic information systems (GISs) play an important supporting role.[564]

Much of this technology is available commercially off the shelf.[565] Commercial imagery is adequate to plan routes with relative positional accuracy on the order of tens of meters. China's indigenous remote sensing program and future commercial sources will provide even more precise data. A number of commercially available mission planning software programs can manipulate sources of imagery for robust mission planning for military purposes.

There are two major mission-planning processes: en route and terminal. Both are heavily reliant on intelligence. For the en route planning process, General Staff Department (GSD) intelligence and cartography/mapping offices probably would identify enemy air defenses to avoid and generate en route terrain data. Routes would be validated and waypoints en route to the target loaded into the LACM computer.[566] Because of the requirement for large databases and computer operations, the mission-planning process likely would be centralized in Beijing and then transmitted to the theater operations command center.

An important en route mission-planning technology under development in terrain contour matching (TERCOM). A prerequisite for TERCOM (*dixing pipei zhidao*) is the generation of electronic maps from high-resolution satellite images. TERCOM uses a radar altimeter to measure terrain features along its flight path and correlate these measurements with internally stored digital maps. The Third Academy has been conducting preliminary research into TERCOM since at least 1988.[567] There is some indication China is examining integrating combined GPS/GLONASS receivers on board their missiles as well.[568]

For terminal planning, the most advanced PLA system under development is digital scene matching area correlation (DSMAC) system. DSMAC updates the position of the missile by matching a stored image to a series of images sensed in flight. The planning required is substantial and complex. A PLA targeteer probably would obtain a photograph of the targeted area and would generate DSMAC scenes for programming into the cruise missile's flight computer. The DSMAC images are prepared from satellite photographs of the target. Higher resolution images allow for more accurate updates and a better CEP. PLA GSD intelligence analysts would identify targets of interest and then either pull the image from the library or task China's remote-sensing community to procure the image. PLA GSD targeteers would then select aimpoints to exploit the most vulnerable aspect of a command and control facility or airfield. The photograph would be transformed into a digital image and loaded onto the LACM computer. Third Academy engineers believe en route and terminal mission planning systems can ensure a CEP of 16 meters or less.[569]

The mission-planning process can take up to several hours. The PLA's deep-attack strategy, however, does not necessarily require a rapid mission-planning process because most targets on Taiwan would be strategic and static in nature. If an indigenous near-real-time space remote-sensing systems were available, GSD would task the satellite operators for the imagery. The GSD could also order quick-turnaround imagery from a foreign provider, such as Russia, Israel, or France.

Deployment of an LACM capability is likely to spark a shift in organizational responsibilities. As previously mentioned, the Second Artillery appears to be a primary procurement agent for ground-launched LACMs.[570] An air-launched Silkworm LACM is likely to use PLA Air Force subordinated B-6s. If the YJ-8 is fielded as an LACM, tactical fighter-bombers such as the FB-7 would serve as the primary platform. There are indications the PLA Navy may be seeking to expand its mission to include conventional missile strikes against land-based targets from the sea.[571]

Technical Trends. China's Third Academy intends to upgrade its cruise missile production capacity, extend the range and speed of their cruise missiles, diversifying its choices of terminal guidance systems, and lower their radar-cross-section.

Production Trends. The Third Academy is upgrading its ability to design and manufacture highly complex cruise missiles. They are integrating the use of virtual reality (*xuni xianshi*) in cruise missile development and are using increasingly sophisticated supercomputers to design the missiles. Third Academy manufacturing centers have imported some of the world's most advanced engineering workstations, and three-, four-, and five-axis computer numerically controlled machine tools.[572] CASC's world-class simulation facility in western Beijing also aids cruise missile development by theoretically reducing testing requirements by 40 to 60 percent and shortening overall development time by 30 to 40 percent.[573] Acquisition of advanced Western systems also could reduce production time--Chinese engineers have reportedly had access to an intact Tomahawk that fell into Afghanistan territory in August 1998.[574]

Propulsion Systems. Engineers also are working on better propulsion systems that can increase the lethal range and/or speed of the cruise missile. Faster cruise missiles reduce an adversary's reaction time. In one of China's most significant aerospace programs, the PLA General Armament Department (GAD) and the Third Academy are designing a supersonic combustion ramjet engine (scramjet, or *chaoran chongya fadongji*) that can propel a missile at hypersonic speeds of between Mach 4 and 10.[575] Engineers also are working toward more efficient turbojet and turbofan engines and motors to significantly extend the range of its cruise missiles. The anticipated range of China's first generation of land-attack cruise missiles would be limited to about 300 to 400 km. To be able to hit targets in Japan using a ground-launched system, however, the Third Academy would have to produce a missile with a 1,250 to 1,500-km range (750 km for Okinawa).[576]

Radar Signature Reduction. With foreign assistance, China's defense industrial complex also is striving to reduce the radar-cross-section of their cruise missiles.[577] The aerospace industry has produced radar absorbing material that targets the frequency range in which most acquisition radar operates (2-18 GHz).

Although this material would not provide complete protection from radar detection, it could reduce the detection range of defensive radar. Engineers assert that radar absorbing material, used in combination with contour shaping, can reduce the effective range of radar by 75 percent.[578] Radar-absorbent materials and relatively high speed reduces warning time available to defenders and compresses their timeline for detecting, tracking, identifying, and engaging the inbound missile.

Infrared Signature Reduction. Third Academy officials are also working to increase the survivability of their land-attack cruise missiles by reducing its infrared (IR) signature. This objective could be achieved by the addition of an IR reduction tail cone that is designed to mix cool air that has traveled down the length of the airframe with hot air emitted from the jet exhaust. This addition would improve the survivability against IR sensors and IR homing missiles. Engineers are attempting to reduce the signature on cruise missile propellants, and conceal location of mobile land-attack cruise missiles.[579]

Other Terminal Guidance Systems. Other terminal sensor technologies under development include passive imaging infrared, CO_2 laser radar, millimeter wave, and synthetic aperture radar terminal sensors, as well as various composite systems. R&D into passive imaging infrared sensors is focused on matching a stored computerized image with a real infrared image detected by the missile.[580] Third Academy engineers already have laid the technical foundation for a CO_2 laser guidance system, to include the target recognition components.[581] Chinese aerospace engineers believe synthetic-aperture radar, millimeter-wave radar, and infrared imaging, and laser radar guidance could result in an accuracy of one to three meters.[582]

The Conventional Second Artillery

The PLA entity most responsible for deep-strike missions against vital strategic and operational targets is the Second Artillery (*dierpaobing*). Since its establishment in the 1960s, the Second Artillery's mission has been limited to nuclear counterstrikes. Following the conclusion of the Gulf war, however, Chinese planners diversified the Second Artillery's mission to include conventional strikes against high-value strategic targets. The Second Artillery's adoption of a conventional strike role marks one of the most significant developments in PLA modernization. This discussion of the conventional Second Artillery outlines: 1) its organizational structure, 2) the vital role of information denial in Second Artillery operations, and 3) the conventional theater missile campaign doctrine and operations.

Organization

The Second Artillery, with an estimated 90,000 personnel, consists of headquarters elements, six launch bases (*jidi*), one engineering design academy, four research institutes, two command academies, and possibly an early-warning unit.[583] As key operational strike units, brigades are likely assigned only one type of missile to facilitate command and logistics. The Second Artillery headquarters and subordinate bases oversee warhead and missile storage facilities; maintenance units; and special warhead/missile transportation services.[584]

The 80302 Unit, headquartered in the mountain resort town of Huangshan, Jiangxi Province, is the Second Artillery's most important base for conventional long-range precision strikes against Taiwan.[585] The Huangshan base includes both nuclear and conventionally armed theater missiles. During a wartime situation, multiple conventional brigades would be subsumed into a conventional theater missile corps (*juntuan*) consisting of a corps command post, a corps logistics command post, and a number of subordinate theater missile brigades each with different types of theater missiles. The corps command post would consist largely of command authorities from Beijing and Huangshan.[586]

The corps/base also oversees a set of "equipment assurance units" (*zhuangbei baozhang budui*) which includes a missile/warhead storage unit (*zhuangbei jishu qinwu budui*), a transfer station (*zhuanyunzhan*), and a repair depot (*tezhuang xiulicang*). Other corps/base support elements include a reconnaissance unit (*jizhen dadui*); a surveying/mapping unit (*cehui dadui*); a computer center (*jisuan zhongxin*); a weather center (*qixiang zhongxin*); a communications regiment (*tongxintuan*); an ECM regiment (*dianzi duikangtuan*); and an engineering regiment (*gongchengtuan*). Additional engineering, air defense, and antichemical units can be assigned as needed.[587]

A typical conventional theater missile brigade has a staff consisting of a headquarters, political, logistics, and equipment technology (*jizhuangbu*) departments. Brigade elements include a mobile brigade command post, a central depot (known as a "technical position" or *jishu zhendi*), a transfer point (*zhuanzai changping*), and an assigned set of pre-surveyed launch sites (*fashe zhendi*), as well as a set of reserve (*daiji*) launchsites. A conventional missile brigade also has a set of "equipment assurance subunits" (*zhuangbei baozhang fendui*).[588] Brigades have at least four firing battalions (*fasheying*), with each battalion assigned at least three or four companies.[589] Companies subordinate to the launch battalion likely would be assigned at least one launcher, an electric power generation vehicle (*fadianche*), a surveying vehicle (*cekongche*), a communications command vehicle (*tongxun zhihuiche*), and a missile transport vehicle (*daodan yunshuche*). Battalions and companies would be assigned a zone within which to operate.[590]

Information Denial and the Theater Missile Campaign

Key to the success of a theater missile campaign is concealing the forward deployment of brigade elements. Surprise can be achieved only through denial of foreign human and technical intelligence assets. To ensure a high degree of concealment, the Second Artillery has approached information denial in three ways: 1) communications security; 2) passive and active counterspace measures, and 3) a supporting space tracking network.

Secure Communications. Denying a potential adversary the ability to monitor communications and other electromagnetic emissions is a top priority. Beijing is examining a wide range of technologies to reduce vulnerabilities of its communications to interception or jamming. Beijing has issued directives to strictly implement communications security (COMSEC) measures.[591] Introduction of fiber-optic communications significantly increases its communications security. Engineers are studying the application of spread spectrum and frequency hopping technology for Beijing's satellite tracking and control network, as well as more secure satellite communications methodologies.[592] China is also investing in more complex encryption (*mimaxue*) algorithms.[593]

Passive Counterspace Measures. The doctrinal requirement for preemption and secrecy is also leading the PRC toward development of passive and active counterspace measures. The PLA is emphasizing passive counterspace operations in an attempt to deny foreign reconnaissance satellites with information on its disposition of forces and R&D programs. Writings from the Academy of Military Sciences (AMS) indicate the PLA has a concerted effort to defeat opto-electronic, infrared, and radar reconnaissance systems. Specific measures include the exploitation of natural camouflage, and deception (*qipian*), to include distribution of false indicators and intelligence.[594] Chinese R&D into camouflage, concealment, and deception is explicitly intended to counter air- and space-based reconnaissance platforms.[595] In 1992, COSTIND and CASC established camouflage standards for missile development in order to counter foreign optical, infrared, and radar satellite systems.[596] PLA engineers also have published technical papers on methods to reduce infrared signature of underground facilities.[597]

Another approach to countering space systems is through electronic countermeasures. The GAD and China's electronics industry appear to be developing a jammer to counter radar satellites.[598] PLA affiliated publications assert that China is capable of damaging optical reconnaissance satellites through the use of high-powered lasers.[599] Such measures would deny an adversary use of a satellite, but not destroy the platform itself, perhaps avoiding escalation of the conflict. As a side note, GAD and CASC are also moving toward fielding jammers intended to complicate use of communications satellites and NAVSTAR GPS.[600]

Active Counterspace Measures. The PRC also is examining more lethal measures to negate foreign satellites, if necessary. Open-source literature strongly suggests that a Chinese direct-ascent, anti-satellite (ASAT) program may be in the model development stage in which the space industry is identifying various design proposals for seekers and propulsion systems. Chinese writings indicate R&D of ASAT systems is intended to discourage attacks on their own space systems. Technical papers demonstrate some of the greatest obstacles in developing an active counterspace capability is with development of a homing kill vehicle and associated terminal guidance. Specific systems under evaluation, and simulation, include infrared, radar, and impulse radar terminal guidance.[601] Chinese engineers have also conducted studies to counter satellite decoys as well.[602]

Space Tracking Network. The key to passive and active counterspace operations is a space-tracking network that can monitor satellites passing overhead. China currently can detect and track most satellites with sufficient accuracy for targeting purposes.[603] The PLA is modernizing and expanding its tracking network, which is operated by the PLA General Armament Department's China Launch and Tracking Control General (CLTC). CLTC is adding overseas links in Chile and the South Pacific island of Kiribati, and has contracted with France for access to data from its space-tracking network.[604] China Academy of Sciences' astronomical observatories in Nanjing and Kunming feed into the CLTC network, providing orbital prediction data. CAS and CLTC are upgrading their network of high-resolution telescopes, augmented by laser tracking devices. China's space community claims an ability to detect objects in space down to 10 inches.[605] The CLTC space tracking network likely supports the Second Artillery through alert messages indicating that foreign reconnaissance satellites are passing overhead.[606]

The Phased Campaign

A PLA theater missile campaign could take a number of forms. An initial option would be to use theater missiles as a show of force, similar to the missile exercises of 1995-96. US reaction to the last limited show of force, however, may have demonstrated that this option is not viable. If the PLA indeed desires to deny US intervention through a *fait accompli*, a slow, gradual limited use option would permit a buildup of US forces in the region. PLA operational concepts call for large-scale, preemptive operations. Preemptive theater missile strikes, carried out in conjunction with airstrikes and special operations, are intended to create favorable conditions for dominance in all dimensions of theater warfare.

A theater missile campaign would support achievement of the "three superiorities" (*sanquan*)--information dominance (*zhixinxiquan*); air superiority (*zhikongquan*); and sea superiority (*zhihaiquan*).[607] Strikes supporting the quest for information dominance would target the civilian and military leadership, semihardened command and control centers, weak links in Taiwan's defense information infrastructure, key intelligence collection facilities, and electronic warfare facilities. PLA conventional ballistic and land-attack cruise missiles would attempt to paralyze (*tanhuan*) Taiwan's command and control system by to cutting off fielded military forces from the civilian and military leadership in Taipei. Antiradiation missiles would be employed against key radar installations.[608]

To achieve air superiority, the PLA would target key air defense sites and airfields. The PLA would seek to damage Taiwan Air Force runways, taxiways, weapons storage facilities, airfield command posts, and fuel depots to complicate generations of sorties. Strikes against airbase runways and taxiways are referred to as an "airbase blockade" (*fengsuo jichang*). The objective would be to shock and paralyze air-defense systems to allow a window of opportunity for follow-on PLAAF strikes and rapid achievement of air superiority. Air superiority is key to establishing a no-fly zone; enabling freedom of action on the ocean for a blockade; or to permit greater freedom of action for physical occupation of the island, if necessary.[609]

To achieve sea superiority, PLA writings indicate prioritization of strikes against naval ports. The key objective will be to strike naval facilities in the opening phases of conflict as a means to prevent projection of naval power and resupply of strategic resources by sea. "Strike opportunities" exist when ships are concentrated in port or when they are moving along known transit routes en route to the theater of operations.[610]

Unsubstantiated reports indicate that a phased campaign could require at least 400 theater missiles distributed in as many as seven conventional missile brigades.[611] To maximize firepower for the most likely scenario, most probably would be based in the Nanjing Military Region or chopped to the Taiwan theater of operations joint command during a crisis. PLA writings indicate that approximately 50 percent of its total theater missile inventory would be used in the initial strike phase. Western sources believe the PLA may deploy as many as 650 SRBMs opposite Taiwan over the next several years.[612]

The theater command center (*zhanyi zuozhan zhongxin*) would direct the missile campaign as one component of a joint strike force that also would include air forces, ground-force artillery and tactical missiles, electronic attack assets, and special operations.[613] Coordination will be carried out via a firepower coordination cell (*huoli xietiaozu*) within the theater command center.[614] PLA officers envision a four-phase theater missile campaign: 1) operational preparations phase (*zuozhan zhunbei jieduan*); 2) campaign mobility phase (*zhanyi jidong jieduan)*; 3) missile strike phase (*daodan tuji jieduan*); and 4) enemy counterattack phase (*kangdi fanji jieduan*).[615]

Operational Preparations Phase. After a CMC determination on the appropriate course of action (*juexin*), the operational preparation phase most likely would include development or review of a mobility plan, increased security, and closer monitoring of foreign satellites and air/naval activity in the Western Pacific. Working in conjunction with the theater command, missile reconnaissance officers and planners probably would review or develop targeting folders. General Staff Department and theater intelligence staff would exploit existing intelligence and/or task space-based imaging assets for updates to support targeting. The firepower coordination cell within the theater command center would prioritize detected targets in keeping with the guidance of higher command for the conduct of the theater campaign and determine the most effective method of dealing with those targets. The theater command would de-conflict strikes so that firepower is not wasted, a complicated and time-consuming process. Also, theater commanders would modify preplanned targeting of targets that have changed over time.[616]

Campaign Mobility Phase. During the campaign mobility phase, brigade elements would deploy to the area of operations in a well-disguised fashion. Rail is the normal way of moving launchers and missiles from brigade garrison to a staging area or transfer assembly point (*zhuanzai changping*).[617] The individual launchers would then disperse to pre-surveyed launch sites (*zhendi*) within the battalion's assigned area of operations, not far from rail lines or highways.[618] A mobile command and control center would coordinate launches. Rapid reaction (*kuaisu fanying*) is essential, requiring a quick calculation of position, orienting the missile, inputting targeting data, and scattering in a very short period of time. Chinese writings indicate that units intend to launch within 40 minutes after arrival to the pre-surveyed launch sites.[619] To reduce reliance on pre-surveyed launch sites, however, the PLA appears to be integrating GPS onto their mobile launchers.[620]

Communication between firing units and upper echelons probably would be carried out through a mix of mobile SATCOM, mobile digital microwave, and/or fiber optics. Because of its high level of security and reliability, the Second Artillery is trying to hardwire as much of their operational infrastructure as possible with fiber optics.[621] For security reasons, any wireless transmissions are to be limited to eight seconds or less. Operational orders would be transmitted through an automated command and control (C2) system due to the complexity and timeliness requirements of conventional theater missile operations. PLA officers note the requirement to integrate the Second Artillery's automated C2 system with that of the joint theater command's automated C2 system.[622]

Missile Strike Phase. During the missile strike phase, Second Artillery units would support joint theater operations by striking strategic and operational centers of gravity. Missile firings would be coordinated with other strike assets and directed against critical nodes (*yaohai*) within an enemy's infrastructure. Chinese writings indicate that after an initial salvo, launchers could move to new pre-surveyed launchsites within that brigade's assigned area of operations.[623] At least three raids are feasible if one assumes availability of 400 theater missiles for the phased campaign.[624] The PLA intends to carry out synchronized launches from a wide range of azimuths in order to stress active missile defenses and associated battle management systems.[625] A range of space-based, airborne, and battlefield intelligence systems are needed to adjust firepower.[626]

The PLA has indicated prioritization of three target sets: 1) air and missile defense sites; 2) airfields and surface-to-surface missile sites; and 3) command, control, communications, computer, and intelligence (C^4I) facilities. Neutralizing ground-based air defenses, airfields, and C^4I facilities through multiple theater missile raids would present a window of opportunity for follow-on airstrikes to consolidate air superiority over the island. PLA missile strikes against airfields could deny outside powers the ability to rush additional military equipment or military supplies to the island.[627] Some PLA-affiliated analysts speculate that parallel strikes against airfields, air defense sites, and other critical targets could permit PLA air superiority over the skies of Taiwan in as little as 45 minutes.[628]

Ground Based Air and Missile Defense. PLA writings identify ground-based air and missile defense units as primary targets. The critical node within an air or missile defense fire unit most likely would be its radar and command van. If no missile defenses existed, and CASC is able to meet the PLA's accuracy requirement of 20 to 45 meters, then only three to five missiles would be necessary to cause significant damage to key nodes within a fire unit with a high degree of confidence. To neutralize active theater missile defense units, PLA writings indicate use of coordinated strikes from multiple directions, using a combination of ballistic missiles, decoy drones, land-attack cruise missiles, and/or antiradiation missiles.[629] Radar and command vans could be subject to special operations attacks and electronic countermeasures. Because their re-entry speed precludes engagement by endo-atmospheric interceptors, conventional DF-21 MRBMs would be especially effective in neutralizing lower tier missile defense fire units. Guided submunition or an FAE payload likely would be the warheads of choice.[630]

Airfields and Surface-to-Surface Missile (SSM) Sites. Another critical target for PLA ballistic and land-attack cruise missile strikes in a Taiwan scenario would be airfields and SSM sites. Senior Second Artillery officers write in internal journals that "attack opportunities" (*tuji de shiji*) will also exist against "intervening superpower" forces as they build up airpower in the region.[631] Airfields that could support offensive strike operations against the mainland would be the first priority. An "airfield blockade" would seek to damage runways, taxiway surfaces, and other critical nodes within an airbase. The PLA would need large numbers of theater missiles for a complete "airfield blockade." However, the PLA would need only a handful to impede Taiwan's ability to generate sorties. Strikes against runways likely would be particularly effective in temporarily pinning down much of the Taiwan Air Force.[632] Any runway damage would slow aircraft operations, simply because it takes time to determine the location and extent of the damage. Destruction of such key facilities as airbase command centers, control towers, fuel depots, power generation facilities, and maintenance hangars would have a serious effect on air operations. Casualties to pilots and maintenance crews could be especially traumatic. Use of runway mines and targeting of unprotected rapid runway repair equipment would complicate recovery operations.[633] Warheads of choice for runway damage would include penetrator submunitions.[634]

To aid in its training, the PLA has constructed a mockup of one of Taiwan's key airfields. The mockup of Chingchuankang (CCK) airfield near Taichung includes an exact replica of the runway layout, taxiways, fuel storage, aircraft shelters, and revetments. The replica, located in a key training area in Gansu, 120 km north of Jiayuguan, is intended for both theater missile exercises and airstrikes.[635]

Leadership Facilities and C^{4}I Centers. The PLA could strike at the heart of Taiwan's political and military leadership to impede the command and control of its forces. Early warning and technical intelligence collection sites could be subject to ballistic and antiradiation missile strikes and electronic countermeasures. Such political and military leadership facilities, as the Presidential Palace and MND Headquarters, are soft targets that would require fewer than five missiles to destroy each with a high degree of confidence. Fuel air explosive warheads are considered the optimal choice for strikes against softer political and military targets. Semihardened command and control and intelligence centers would require penetration warheads.[636]

Foreign Intervention. The PLA has indicated a willingness to use highly accurate SRBMs, MRBMs, and LACMs against US assets, to include key bases in Japan and aircraft carriers operating in the Western Pacific. Chinese researchers have conducted extensive feasibility studies of the use of theater ballistic missiles against aircraft carriers. Analysts have noted how such a capability would require four components: ocean surveillance (*haiyang jianshi*); mid-course guidance (*zhongduan zhidao*); terminal guidance (*moduan zhidao*); and applicable control systems to maneuver the reentry vehicle to the target. PLA proponents have proposed the use of GPS for midcourse inertial corrections and the use of a millimeter wave seeker for terminal guidance.[637] Aware of the vulnerability of millimeter wave seekers to jamming, PLA engineers are surveying ECCM techniques to ensure effectiveness of terminally guided ballistic missiles.[638] In addition to aircraft carriers, other targets would include regional airbases, naval facilities, and key C^{4}I and logistic nodes, as indicated by Chinese writings.[639]

Counterstrike Phase. For the counterstrike phase, PLA planners rely on survivability as a critical aspect of their theater missile force. In ensuring their survivability, designers believe three systems in particular pose the greatest challenges to the survivability of China's theater missile force: the F-117A, J-STARS, and AWACS. The most important step to ensure survivability is counter-reconnaissance (*fanzhencha*), that is, denying foreign air and space assets the ability to detect missile garrisons, storage facilities, and units in the field. Counter-reconnaissance measures include decoy launchers and missiles that must match the optical, infrared, and radar characteristics of real systems. The Second Artillery also intends to use natural masking, radiation reflectors, deception, and communications security. Chinese camouflage is explicitly intended to counter US air- and space-based reconnaissance platforms.[640]

There are indications that each theater missile brigade will have an organic electronic countermeasures regiment equipped with specially designed equipment, which automatically activates an integrated system of radar jammers, lasers, chaff, flash bombs, and smoke. According to one report, the system was developed in large part to counter air-to-ground munitions delivered by aircraft such as the F-117A.[641]

Conclusion

A space-based surveillance architecture, the transition to a force structure dominated by theater missiles, and adoption of operational principles that stress preemption and surprise have serious implications for regional stability. An alleged arsenal of over 650 SRBMs--augmented by additional conventional MRBMs and LACMs--could provide Beijing with a conclusive edge in a future Taiwan Strait conflict. Such a force also could hold US forces in the Western Pacific at risk, should a decision be made to intervene.

China's growing presence in space is intimately related to the PLA's emerging capacity for theater strike operations. Reconnaissance satellites are important for strategic and operational intelligence, indications and warning, and targeting. Space imagery is also needed to support battle damage assessments. Digitized satellite imagery is crucial for land-attack cruise missile mission planning. In addition, space systems could enable the detection, tracking, and targeting of US forward-deployed assets operating in the Western Pacific Ocean. The same space-tracking network that manages China's space assets is crucial for operational security during a theater missile campaign.

Operational Implications

China's emerging capacity for deep strike missions has a number of operational implications. First, theater missiles serve as critical enablers for dominance in other spheres of warfare. Of most significance is the relationship between theater missiles and the rapid achievement of air superiority. Consistent with emerging PLA doctrine of "rapid war, rapid resolution," a successful PLA theater missile campaign could strip Taiwan of its ability to effectively conduct air operations in a matter of hours (or minutes, according to PLA propaganda). Strikes against key air defense units and airfields would result in a temporary suspension of Taiwan air operations, creating a more permissive environment for PLA Air Force operations over the island. Air superiority, like the missile strikes, is not an end in itself. Lessons absorbed from the Gulf war and the air campaign in Yugoslavia, however, have demonstrated that air superiority enables other missions to take place with reduced costs and greater efficiency.[642]

Furthermore, theater missile operations also could quickly degrade Taiwan's capacity for naval warfare and ground operations. Fifty percent of the PLA's theater missile arsenal is to be dedicated toward the opening phase of conflict. Remaining missiles probably would be held in reserve to support naval and ground operations. Theater missile strikes against harbors and piers would complicate naval operations. Strikes against key bridges and staging areas would impede Taiwan Army counter-landing operations.

Furthermore, China's expanding network of space sensors and long-range strike assets could pose a fundamental challenge to the US ability to project power into the Western Pacific Ocean. Increasingly accurate and lethal theater missiles could raise the costs of US intervention in conflicts around the periphery of China. Space-based reconnaissance assets could facilitate detection of US air and naval deployments into the area of operations. The PLA clearly understands US vulnerabilities that arise from dependence on in-theater ports, airfields, logistic facilities, and C^2 nodes. Successful fielding of terminally guided theater ballistic missiles could pose challenges to aircraft carrier battle groups, especially if operating within range of China's large inventory of 600-km-range SRBMs.[643]

Political Implications

Developing a capacity for theater missile operations has political implications as well. Taiwan has enjoyed a defensive advantage over the mainland for many years. Adequate warning time and a robust defense has enabled Taiwan to blunt PLA air, naval, and ground assaults long enough to allow the international community to adjust to the situation, decide on a course of action, take diplomatic action, and/or flow forces to the region if necessary. A successful theater missile campaign--combined with information operations and air strikes--however, could enable Beijing to quickly strip Taiwan of its warfighting capacity.

To maintain the political and military viability of its new "trump card," Beijing has launched a coordinated foreign policy and propaganda campaign to shape the existing debate within the United States on defensive measures intended to counter theater missiles. Beijing generally poses six arguments against missile defenses, including an assertion that defenses will cause an arms race.[644] Beijing's campaign against missile defenses exploits existing biases by some within the United States against missile defenses. A mutually supporting dynamic exists between PRC officials and US critics whose views on missile defenses are founded on traditional nuclear stability paradigms.

The Taiwan Strait case, however, may be unique in that it is the first theater in which highly accurate *conventional* ballistic missiles dominate the strategic landscape. PRC officials, echoed by many within US governmental and academic circles, argue that defenses against the growing PLA conventional theater missile threat would be destabilizing since they would spark an arms race.[645] A number of studies, however, have demonstrated that, in the conventional context, defenses generally have not been the cause of arms races. Conventional arms races are sparked or intensified by a rapid buildup of offensive capabilities.[646]

The misplaced focus on missile defenses within academic and policy communities in the United States has resulted in neglect of at least three dangers presented by Beijing's growing arsenal of increasingly accurate and lethal theater missiles. *First*, the conventional wisdom is that force would be used against Taiwan only in the event the government legally declares the island as an independent political entity. Overwhelming offensive capabilities, however, increase the chances that force could be used short of a *de jure* declaration of independence. Confidence in a quick military victory could lower the perceived cost of conflict and thus increase Beijing's incentives to use force. At a minimum, a decisive PLA advantage in offensive capabilities would increase risks of greater PRC bellicose behavior in the cross-Strait relationship. In addition, the ability to strip Taiwan of its capacity for military operations--in effect a first-strike capability--raises dangers of preemptive war.[647] The PLA preemptive strike doctrine is also destabilizing since it decreases warning time that could allow for diplomatic intervention. An overwhelming offensive advantage may also reduce Beijing's incentives for arms control and confidence-building measures, and reduce their willingness to compromise in future cross-Strait dialogue.

Second, reduced costs for military action could lead to another unintended consequence of the theater missile buildup--a Taiwan punitive deterrent to raise the costs of PLA military action. At least one punitive deterrent is Taiwan's own theater missile capability. A Taiwan ballistic or land-attack cruise missile would serve as a political tool to raise the costs of PRC military action. Even more ominous is that a severe collapse in its sense of security could prompt Taiwan to renew efforts to develop a nuclear device. Some think Taiwan has the capacity to develop nuclear weapons quickly if the need should arise. Within the last two years, an open debate has arisen in Taiwan regarding the utility of developing weapons of mass destruction.[648]

Third, as Taiwan's national security community debates the need for a deterrent, the magnitude of the theater missile challenge may increase domestic pressure for tactically offensive counterforce operations, to include preemptive strikes. Theoretical studies have demonstrated that maintenance of an exclusively defensive force posture against an overwhelming offensive force is prohibitively expensive.[649] Tactical offenses in support of a strategically defensive doctrine are more cost effective. As the PLA theater missile threat evolves, Taiwan strategists may adopt operational concepts outlined in US Department of Defense *Joint Pub 3-01.5* that states "the preferred method of countering enemy theater missile operations is to attack and destroy or disrupt theater missiles prior to their launch." This notion comes as no surprise to the PLA Second Artillery, an organization whose doctrine rests on the assumption that their phased campaign would be answered with Taiwan or US counterattacks.

Theater Missile Countermeasures

A preemptive strategy that relies on an overwhelming offensive force is not only destabilizing, but may be risky from a warfighting perspective. The outlook described above is admittedly pessimistic and worst case. The posited aim of a PLA air and missile campaign is strategic paralysis, with the expectation being that "paralysis" must somehow equate to "surrender." Things may not work that way. With proper preparations, Taiwan, or any other adversary, could recover from initial attacks. Observers have asserted that Taipei would fold after the impact of a single missile on Taiwan. However, lessons from World War II, the Vietnam war, and elsewhere have shown that strategic attacks could harden rather than diminish resolve.[650]

Taiwan could take steps to reduce the operational effectiveness of the PLA theater missiles and supporting surveillance assets. The theater missile problem is already forcing the Taiwan military to modernize in a way that it would not have otherwise. The only way to effectively counter a large-scale theater missile threat is through jointness and innovative warfighting concepts commonly associated with the RMA. Assuming requisite changes and investments are made, the PLA's ability to achieve a decisive victory over Taiwan is not assured.

Perhaps the most important countermeasure is a survivable C^4I architecture and robust passive defenses. Passive defense includes: 1) tactical warning; 2) reducing the effectiveness of PLA targeting through operational security, deception, and mobility; 3) reducing vulnerability through hardening, redundancy and robustness, dispersal, and effective civil defense; and 4) recovery and reconstitution. In addition, the PLA's successful fielding of sophisticated terminal guidance systems would be accompanied by a new set of vulnerabilities. GPS, and optical, radar, and millimeter wave seekers can be jammed, as could the PLA's future space reconnaissance assets.[651]

Furthermore, the complexity of a theater missile campaign presents opportunities for "induced friction." The challenges presented by an overwhelming capacity for offensive operations would naturally prompt defenders to prevent the launch of theater missiles. This concept would be carried out by attacking elements of the overall system, including such actions as destroying launch platforms, reconnaissance, surveillance, and targeting platforms; command and control nodes; missile stocks; and transport infrastructure. Strikes against selected nodes in a theater missile brigade could have significant systemic effects that could reduce the frequency or intensity of theater missile strikes.

The effectiveness of theater ballistic and land-attack cruise missiles strikes also could be reduced through active missile defenses. Exclusive reliance on active defenses, however, would be cost prohibitive and only partially effective against the type of theater missile threat that Taiwan is expected to face. The most serious challenge to active defenses may be the tyranny of geography--Taiwan is close enough to the mainland to allow the PLA to launch from a wide range of azimuths. Multi-axis theater ballistic missile attacks could stress even the best battle management and command, control, and communication systems, especially if combined with air and LACM strikes, electronic attack, and special operations.[652]

In the end, however, the optimal solution lies in creating incentives for Beijing to moderate its theater missile deployments. The first step is recognizing the destabilizing nature of the PLA theater missile buildup. Although urging PLA restraint in deploying theater missiles opposite Taiwan is a worthwhile endeavor, we should not be overly sanguine about the chances for success. Theater missiles are an integral part of the PLA's overall modernization objectives. As long as the PLA seeks to develop the kind of force that could give the PRC a decisive military advantage over Taiwan, then the ability to freeze or roll back theater missile deployments will be limited. Nevertheless, greater effort must be made to convince the civilian leadership in Beijing that the large-scale deployment of offensive weapons would adversely affect regional stability and that resolution of sovereignty disputes through other than peaceful means is not a viable option.

Key Indicators of Changes in Chinese Development and Proliferation of Weapons of Mass Destruction

Kenneth W. Allen

The People's Republic of China (PRC) initiated its nuclear weapons program during the 1950s as a result of its political and military rivalry with the United States. Since then, the Chinese Government has consistently used its nuclear weapons and ballistic missile technology as a political lever against the United States.[653] Although China has become a signatory to several international nonproliferation treaties, this paper contends that in the future China will continue to proliferate nuclear weapons and missile technology for political and economic reasons. Moreover, this essay cites key proliferation indicators and provides a methodology to recognize these indicators.

The PRC Government has consistently stated that China's cooperation with other countries in the field of nuclear energy is exclusively for peaceful purposes. In 1986, a Ministry of Foreign Affairs (MFA) spokesman stated, "The PRC does not advocate, encourage, or engage in nuclear proliferation, nor does China assist other countries in developing nuclear weapons."[654] A decade later, an MFA spokesman reiterated that, "China, as a responsible state, has never transferred equipment or technology for producing nuclear weapons to any other country, nor will China do so in the future."[655] Since the 1970s, Beijing has concluded agreements with as many as fourteen countries on the peaceful use of nuclear energy.[656]

In response to international concerns about the PRC's proliferation of weapons of mass destruction (WMD) over the past decade, Beijing has become progressively involved in several international nonproliferation agreements and has promulgated various domestic export control regulations. These agreements include the following:

- Joined the International Atomic Energy Agency (IAEA).
- Acceded to the Nuclear Nonproliferation Treaty (NPT).
- Signed and ratified the Chemical Weapons Convention (CWC).
- Made statements on fissile material production.
- Made statement on making only safeguarded nuclear transfers.
- Signed Comprehensive Test Ban Treaty (CTBT).
- Joined Zangger Committee.[657]

During the late 1980s, China and the United States clashed over conventional missile proliferation when Beijing began selling antiship missiles to Iran and DF-3/CSS-2 ballistic missiles to Saudi Arabia. By the early 1990s, the gap between the two nations widened as Beijing began providing DF-11/M-11 missiles and components to Pakistan.

As tensions mounted in the Taiwan Strait in late 1995, Beijing issued its first *White Paper on Arms Control and Disarmament*. The twenty-page paper, released during the negotiating endgame of the CTBT and while China was conducting nuclear tests, attempted to defuse concerns about a "China Threat" and accusations that Beijing was supplying weapons of mass destruction or related technologies to friendly neighbors (i.e., Pakistan and Iran). In July 1998, Beijing published its first defense white paper, *China's National Defense*.[658] These two reports summed up China's commitment to conventional arms control by stating:

China respects the right of every country to independent or collective self-defense and to acquisition of weapons for this purpose. China practices strict control of the transfer of conventional military equipment and related technologies and observes the following principles: The export of weapons must help the recipient nation enhance its capability for legitimate self-defense; it must not impair peace, security, and stability of the relevant region and the world as a whole; and it must not be used to interfere in the recipient state's internal affairs. In October 1997, the Chinese Government published the *Regulations of the People's Republic of China on the Control of Military Products Export*. China has been consistently responsible regarding the transfer of missiles. China is not a member state of the

Missile Technology Control Regime (MTCR) and has not joined its formulation and revision, but the Chinese Government promised to observe the guidelines and parameters of the MTCR in February 1992.[659]

In October 1994, China reaffirmed its promise. In line with the above policy, China has exercised strict and effective control over the export of missiles and related materials and has never done anything in violation of its commitments.[660]

China as a WMD Proliferator

Despite of China's pronouncements denying WMD proliferation, the US Central Intelligence Agency (CIA) reported in August 1996 that "China was the worst proliferator of equipment and technology associated with WMD."[661] In 1998, the CIA reported:

China was continuing to take steps to strengthen its control over nuclear exports by promulgating new export control regulations covering the sale of dual-use nuclear equipment, as well as the export of equipment and materials associated exclusively with nuclear applications. China also pledged in late 1997 not to engage in any new nuclear cooperation with Iran and to complete work on two remaining nuclear projects--a small research reactor and a zirconium production facility--in a relatively short period of time. During early 1998, Chinese entities provided a variety of missile-related items and assistance to several countries of proliferation concern. Chinese entities also sought to supply Iran and Syria with CW-related chemicals. China has provided extensive support in the past to Pakistan's WMD programs, and some assistance continues.[662]

This paper assumes that China will continue to proliferate WMD as a matter of official policy, regardless of what international agreements have been signed. In addition, certain organizations will attempt to circumvent the government's policies and export regulations by providing WMD technology and equipment to proliferating countries.

As described in other reports at this conference, since the early 1980s, China has tried secretly to provide nuclear technology and/or missiles to several countries, including Pakistan, Iran, Syria, Algeria, North Korea, and Saudi Arabia. China's relationship with Iran also includes alleged cooperation on chemical weapons. The following work describes several driving factors within China's foreign, domestic, and economic policies for this proliferation activity.

Foreign Policy Considerations

I assume that China will continue to support its longstanding relations with Pakistan and Iran by providing WMD technology and equipment for existing programs, as well as for new programs in the future. For example, an August 1999 *Reuters* article states, "China has signed an $11 million deal to improve Iran's anti-ship missiles, raising questions about its 1998 vow not to supply Tehran with cruise missiles or related technology."[663]

The PRC's relations with the Republic of China (ROC) on Taiwan also have been a factor in China's WMD proliferation. During the 1980s, the PRC's competition with the ROC for diplomatic recognition with several key states, such as South Africa, Saudi Arabia, and Israel, probably contributed to Beijing's calculations concerning its proliferation activity. Today, however, the ROC does not have diplomatic relations with any states of similar stature where the PRC could use WMD proliferation as an enticement to switch recognition.[664]

Unenforceable Compliance

Although the Chinese Government still officially sanctions some proliferation with countries like Pakistan and Iran, it does have and will continue to have problems implementing and monitoring compliance from certain suppliers. The best case in point is the sale of 5,000 ring magnets to the A.Q. Khan Research Laboratory in Kahuta, Pakistan, sometime after 1994. The ring magnets, which can be used in gas centrifuges to enrich uranium, were sold for $70,000 by the China National Nuclear Corporation (CNNC), a state-owned corporation. CNNC reportedly sold the ring magnets directly to the laboratory without receiving approval by higher authorities because the items were not covered by the Ministry of Foreign Affair's (MFA) export control list or the dollar value required for notification. In addition, although China and Pakistan were members of the International Atomic Energy Agency (IAEA), the laboratory was not an IAEA-safeguarded facility.[665]

As China moves further toward a market economy and defense-related state-owned enterprises (SOE) are required to sell more goods abroad in order to survive, they will be tempted to circumvent the growing list of export regulations and sell restricted WMD technology and equipment secretly to other countries. The decentralization of economic decision making to the factory level and increasing levels of technology available will further add to the enticement to sell their goods for hard currency.

Indicators of WMD Proliferation

There are various macro-level indicators that can provide clues to China's proliferation of WMD. These indicators include political relations with various countries, particularly the United States and India, and economic factors. China's relations with the United States can be viewed as a barometer of Beijing's WMD relations with other countries. Therefore, when Sino-US relations are on a downward trend, Beijing is more likely to circumvent prior agreements as leverage with Washington. At the same time, loosening of economic controls on individual organizations, which must sell goods to survive, provides greater opportunities for these organizations to become involved in unauthorized sales of WMD goods and services.

Sino-Iranian Cooperation

The PRC's relations with Iran provide a good example of how China's foreign, domestic, and economic policies combine to promote WMD proliferation. Initial relations in the early 1980s were based on economic factors: Iran was willing to provide hard currency for technology, weapon systems, and the research and development conducted in China for new weapon systems to meet Iranian specifications. Since then, China's need for imported oil has been a factor in their relations. Relations were also important domestically for China, as Beijing reportedly sought assurance from Tehran for Iran's non-interference with Xinjiang's restive Muslim population. As United States arms sales to Taiwan have become more contentious during the1990s, Beijing has tried to link its arms sales to Tehran with Washington's arms sales to Taipei.

The PRC often signs joint-venture contracts with foreign countries for weapon systems that are not necessarily intended for use within the People's Liberation Army (PLA). With the Iran-Iraq war providing a potential arms market, China began developing tactical missiles, such as the M-9 and M-11, for export in 1984 with the hope that the PLA would become interested in the program later.[666] At that time, China had the technical expertise and facilities and was in search of hard currency, while Iran had the money but was not able to develop and produce new missiles. Since then, China has reportedly provided complete M-11 systems, technology, and components to Pakistan. Although this economic and military relationship was good for Beijing and Tehran, it conflicted with Washington's national security interests in the Gulf region. The United States alleges that the M-11 exceeds the MTCR guidelines. Although China has denied the reports and has verbally agreed to abide by the MTCR guidelines, Beijing has not become a signatory to the agreement and allegedly continues to provide Pakistan with M-11 components.

During the 1990s, Washington's pressure on China and Iran to cease their energy cooperation has actually worked to strengthen the relationship between Beijing and Tehran. Although US companies had already been barred from importing Iranian oil since 1987, the United States conducted a campaign during 1995 that focused on disrupting Iran's energy sector further by banning American companies from purchasing oil for resale to third parties. Washington also put pressure on other such countries as Japan and Azerbaijan to cease economic cooperation on Iranian energy projects. This pressure, which came at the same time President Clinton authorized Taiwan's President Lee Teng-hui to visit his alma mater at Cornell, provided a backdrop for Beijing to increase its energy cooperation with Tehran. Whereas China needed to import greater amounts of oil, Iran needed Chinese nuclear energy technology for civilian and military uses.[667] Moreover, the PRC has consistently tried to justify its military equipment sales to Iran by citing US military sales to Taiwan. Therefore, for all these reasons, China and Iran's independent relations with the United States, as well as complementary energy requirements, will continue to provide a good indicator of the continuing cooperation between Beijing and Tehran on WMD proliferation.

China's Five-Year Plan

China's five-year plans provide the framework for the PRC's official political and economic policies. A careful review of these plans gives valuable clues about China's priorities in several areas, including military spending, R&D, and weapons acquisitions. For example, the current ninth five-year plan (1996-2000) identifies several areas where China can cooperate with foreign countries in conventional weapons and WMD. The plan also gives guidance for economic growth, whereby companies and ministries must meet certain growth targets.

The current plan encourages defense companies to develop military technologies for the PLA through joint ventures with foreign investors and to boost attempts to develop new weapons. Owing to attempts to revitalize the defense-related State-Owned Enterprise (SOE) system and the PLA's R&D and procurement system, the Central Military Commission (CMC) has again restructured the entire PLA's weapons acquisition structure. The plan calls for concentrating on only a few key projects but also calls for an increase in spending on overall civilian science R&D from less than 1 percent of the gross domestic product to 3 percent. The defense science and technology establishment will benefit from this added funding because its appropriations come from the civilian science budget rather than the defense budget.[668]

Determining which projects the CMC has decided to focus on provides one of the keys to analyzing which future weapon systems the PLA will receive and China will produce for export. Chinese open-source material often identifies various projects as focal points (*zhong dian zhi yi*), which means that these projects receive the highest political support. This political support, in turn, equates to financial support.

The PLA's Economic Situation

Besides monitoring the five-year plans and defense industry economic indicators, the PLA's economic situation provides valuable clues as to military involvement in WMD proliferation abroad. The military began commercial activities in 1985, following directives issued by the CMC and State Council, mainly as an expression of Deng Xiaoping's economic reform drive. At the movement's peak in the early 1990s, PLA-affiliated businesses were estimated at about 20,000.[669] One of the driving forces was the PLA's need to supplement its budget. As a result, several large companies, the most notable being the General Staff Department's Poly Technologies, emerged as valuable import and export arms of the PLA. Some of these companies became involved in purchasing foreign military equipment and for selling surplus PLA equipment abroad. [670]

Poly Technologies is best known for its 1988 sale of CSS-2 ballistic missiles from the PLA inventory to Saudi Arabia. Several issues coalesced in the CSS-2 sale. First, Saudi Arabia actively sought out China's support. Second, like Iran, Saudi Arabia was able to pay China with much-needed hard currency. Third, China saw the sale as a way of pulling Saudi Arabia away from its diplomatic recognition of the Republic of China (ROC) on Taiwan. This goal was finally achieved when the PRC and Saudi Arabia established diplomatic relations in July 1990. Fourth, the PLA's ongoing modernization program led to the availability of the surplus missiles from its active inventory. Finally, the PLA was actively seeking ways to accrue much-needed additional money to supplement its official budget.

The 1988 situation may be replayed over the next few years, following Jiang Zemin's 1998 ruling that the PLA must divest itself of its non-agriculture and industrial production companies. Although the State Council has reportedly increased the PLA's annual budget, the PLA might seek ways to supplement this budget with further WMD sales abroad--either officially or unofficially.

High-Level Exchanges

Indicators for official government involvement in WMD activity will include exchanges by high-level officials, as well as visits by officials from the nuclear industry, defense industries, and the military. Although the official government media may cover the existence of high-level visits, those by lower-level officials most likely will not be covered. These types of visits, however, may be reported in local newspapers or in factory or ministry newsletters. Cross-referencing multiple sources often gives a good indication of the people and organizations involved.

Another indicator of official activities involves the use of military aircraft to transport Chinese delegations abroad or foreign delegations around China. When transporting Chinese delegations abroad, these aircraft most likely will stop in various locations around China to pick up or drop off passengers. Once negotiations have begun in earnest, these flights may become routine.

Absence/Presence of Key Officials

Although the negotiation process largely will be concluded in secrecy, one possible indicator is the unexplained absence or presence of certain key people for extended periods of time. Key people include ministers, vice ministers, factory managers, military procurement officers, scientists, import/export company representatives, and interpreters.

If negotiations are handled through the Chinese Embassy abroad or the foreign embassy in Beijing, the permanent or temporary assignment of a new embassy official often provides an indication of ongoing, long-term negotiations and contract implementation. If the PLA is involved, the PLA may assign military representatives from the appropriate organization such as the newly established General Armament Department to the defense attache office. These officers will not participate in normal military attache functions, but will be responsible for the military sales or assistance program. This was the case when the United States had four foreign military sales (FMS) programs with China during the 1980s. At that time, the Commission for Science, Technology, and Industry for National Defense (COSTIND) had uniformed military representatives assigned to the PRC Embassy in Washington.

Many Chinese ministries have established branch offices of their import/export companies in foreign countries. These representatives are posted abroad to establish business links, facilitate contract negotiations, and to conduct follow-on support for existing contracts. The addition of new representatives to these offices or an unusual number of visitors from China provide indicators of negotiations or completed contracts.

Equipment Support
When the Chinese provide any type of major equipment abroad, they also provide training and follow-up support either in China or in the host country for that equipment. This training may be conducted for several years in some cases. Thus, the continuing presence of large numbers of Chinese in key cities or weapons-related areas is a valuable indicator of on-going activity. Since the Chinese do not readily publish lists of key personnel or organizational structures, knowing who the key personnel are is often difficult. Therefore, compiling organizational data as it becomes available is important, so that names can be cross-referenced later.

Monitoring Contract Implementation
Information gathered from reconnaissance satellites provides classic indicators of impending, ongoing, or previous sales or acquisition of WMD. These indicators include communications, electronic emissions, and photography of production facilities, deployment areas, and transportation hubs.

Each ministry or corporation has its own import/export company. These companies arrange the transportation for components and full systems, and use their warehouse and loading facilities along the route, whether by road, rail, or sea. Because they generally use the same shipping companies, monitoring these facilities could provide indicators of deliveries.

Monitoring of China's ground and sea transportation systems also can provide potential indicators of delivery activity. Because almost all of China's goods are moved by rail at one time or another within the country, unusual rail movements may provide important clues to the transfer of equipment. As China's economy grows, competition for cargo space is becoming more intense. The PLA must submit requirements through the proper military and railway ministry channels anywhere from three to twelve months in advance. When such hazardous cargoes as munitions are carried on trains, the amount of coordination and limitations increases exponentially. The cargo must be delivered immediately and is not allowed to remain in one spot for more than twenty-four hours. The shipping organization must notify public security organizations en route to ensure that there are no problems.[671] Occasionally, a local newspaper may carry an article describing the role the local police or other organizations played in the train's movement.

Even nonhazardous cargo oftentimes receives local media attention. For example, during 1988, the Ministry of Aviation's weekly newspaper described the transfer by road of a Y-8 transport aircraft from the production facility in northern Sichuan Province to the flight test center at Xian. The planning process took nearly a year and involved the police in every small town en route. Local newspapers may also carry similar articles covering activities at facilities involved in WMD.

The difficulty comes when nonhazardous cargo containing items such as weapons or nuclear components rather than entire systems are shipped by rail or sea on a non-urgent basis. Specific indicators of this activity are unlikely, other than by monitoring the place of origin and destination.

International Exhibitions and Symposiums

A review of industry literature and information provided at international exhibitions and symposiums may render clues to ongoing domestic and foreign programs. Chinese attendance at international symposiums provides a good indication of China's interest in certain technologies. Chinese hosting of international exhibitions and symposia enables them to agenda-set and invite foreign scholars and scientists who have information tailored to China's needs and interests. Furthermore, hosting these exhibitions provides the most cost-effective means of obtaining information, since the Chinese normally charge foreign companies high prices for exhibition space.

Upgrading the PLA's Ballistic Missile Force

There are several indicators for proliferation of WMD systems within the PLA. First, occasional articles in PLA and non-military publications, when added to previous information, unveil organizational changes related to impending or recent missile deployments.

Second, an increase in the number of launch bases would point directly to missile proliferation. A close review of the PLA's organizational structure for the Second Artillery Corps provides valuable clues to the future structure of China's ballistic missile force.[672] If China were to double or triple the number of ballistic missiles, as suggested in the 1997 Department of Defense report to Congress, the Second Artillery, headquarters for six bases, would have to 1) increase the number of bases; 2) increase the number of brigades per base; 3) increase the number of battalions per brigade; and/or 4) increase the number of reserve missiles. The PLA has historically adhered to the "rule of three," which means that each division has three regiments, each regiment has three battalions, and each battalion has three companies. Although this rule is not hard and fast, it has provided the guiding principles for the PLA's organizational structure for fifty years.[673] The Second Artillery appears to have as few as two brigades per base and as many as four battalions per brigade in some cases, but the PLA most likely would be reluctant to increase the number of brigades or battalions beyond four at a time when the rest of the PLA is shrinking. Because the only real way for the PRC to radically increase the total number of missiles, other than increasing the number of reserve missiles, is to build more bases, an increase in bases would be a glaring indicator of missile proliferation.

Summary

For political and economic reasons, the PRC is likely to continue as a WMD proliferator regardless of its acceptance of international regimes. Sales of WMD technology and equipment abroad will be done officially and unofficially, involving the defense industry and the PLA. Key indicators include changes in China's foreign and economic policies, especially as they pertain to relations with the United States.

All of China's WMD proliferation activity has taken place in South Asia, the Middle East, and Africa. Other than the possibility of war between Pakistan and India, the acquisition of WMD by the other countries would not directly affect China's security. Therefore, monitoring of requirements by countries in these regions where China could fulfill some or all of their demands should provide an indicator of at least the potential for China to become involved in WMD proliferation there. China is constantly seeking markets for its WMD technology and equipment. Although China might not be able to provide everything these proliferator countries are seeking, PRC companies, whether legally or illegally, might be willing to sell what they have available for the right price.

Footnotes

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2 This research focuses on China's nuclear arsenal, and does not address other possible Chinese weapons of mass destruction such as chemical and biological weapons (CBW). According to treaties to which China is a party, the country is prohibited from developing, producing, or stockpiling CBW. China states that it "does not produce or possess chemical weapons" and that it "has never developed, produced, stockpiled, or otherwise acquired or retained biological agents, toxins, or weapons equipment or means of delivery for them." See "China: Arms Control And Disarmament," Information Office of the State Council of the Peoples Republic of China, November 1995, *Beijing Review*, 27 November-3 December 1995, pp. 12-13, 18; "Explanation by the Government of the People's Republic of China on its Observance of the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction," BWC/CONF.III/3/Add.1, 1991. Many open-source publications, including documents from the US Government, claim otherwise. Among the open-source reports, see, for example, Office of the Secretary of Defense, *Proliferation: Threat and Response* (on-line version); Arms Control and Disarmament Agency, *Adherence To And Compliance With Arms Control Agreements* (Washington, DC: ACDA, 1997) (on-line version); "Albright warns of Chinese BW," *Iran Brief*, 5 February 1997, p. 9; "US Suspects Chinese Biological Arms," *Asian Defence Journal* (September 1995), p. 106; Bill Gertz, "China has biological arsenal, Congress told," *Washington Times*, 15 July 1995, p. A2; R. Jeffrey Smith, "China May Have Revived Germ Weapons Program, US Officials Say,"*Washington Post*, 24 February 1993, p. A4; *Countering the Chemical and Biological Weapons Threat in the Post-Soviet World*, Report of the Special Inquiry into the Chemical and Biological Threat of the Committee on Armed Services, US House of Representatives, 102nd Congress, second session, 23 February 1993, pp. 12-13.

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8 Johnston, "Prospects for Chinese Nuclear Force Modernization," ***op. cit.,*** p. 552.

9 John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," *International Security*, vol. 17, no. 2 (fall 1992), pp. 6-7.

10 See Barry Posen, *The Sources of Military Doctrine* (Ithaca: Cornell University Press, 1984), especially pp. 59 ***et seq.***

11 Scott D. Sagan, "The Perils of Proliferation: Organization Theory, Deterrence Theory, and the Spread of Nuclear Weapons," ***International Security***, vol. 18, no. 4 (spring 1994).

12 The single-most in-depth elaboration of how China's strategic tradition shapes its nuclear strategy is found in Lin, *China's Nuclear Weapons Strategy: Tradition within Evolution, op.cit.* Lin writes, "China does have a distinctive nuclear strategy of its own which, even while evolving, manifests certain persistent strategic principles found in Chinese traditional culture." *Ibid.*, 1. He focuses particularly on the relevance for contemporary Chinese strategic doctrine of such traditional concepts as "ambiguity," "extramilitary [i.e., political and economic] emphasis," "the art of waiting and yielding," "minimalism," and the use of "negative" strengths.

13 Johnston, "China's New 'Old Thinking'," *op. cit.*

14 Lewis and Xue, *China's Strategic Seapower, op. cit.*, pp. 232-33.

15 Hua Hongxun, "China's Strategic Missile Programs: Limited Aims, Not 'Limited Deterrence'," *Nonproliferation Review* 5, no. 2 (winter 1998), pp. 60-68.

16 A more detailed analysis of how these Maoist concepts affected Chinese nuclear doctrine is in Alice Langley Hsieh, *Communist China's Strategy in the Nuclear Era* (Englewood Cliffs, New Jersey: Prentice-Hall, 1962), especially chaps. 1 and 2. See also Lin, *China's Nuclear Weapons Strategy, op. cit.*, pp. 18-22.

17 Sun Tzu, *The Art of War*, Samuel B. Griffith, trans., (Oxford: Oxford University Press, 1963). Mao's debt to Sun Zi is evident in virtually all of his works on military strategy, and especially in *Strategic Problems of China's Revolutionary War*, *On Protracted War*, and *On Guerrilla Warfare.*

18 One recent analysis takes issue with this historical interpretation that China has traditionally eschewed violence in its external relations. Relying on analysis of the ancient *Seven Military Classics* and Ming Dynasty (1368-1644) memorials on foreign policy which make frequent reference to classic Chinese strategic thinking, Iain Johnston shows that resort to violence, elimination of threats by force, and the imperative of offensive solutions were very much a part of Chinese strategic tradition. As Johnston acknowledges, however, the proclivities evident among Chinese strategists some 500 years ago or more are not necessarily reflected in contemporary China. However, he shows that, contrary to widely held opinion, there is a tradition of violent and offense-oriented strategies in traditional Chinese military

thought. Alastair Iain Johnston, *Cultural Realism: Strategic Culture and Grand Strategy in Chinese History* (Princeton: Princeton University Press, 1995). What is important for our analysis here is that, in spite of this historical record, the more benign model is widely held *in China* to be the defining character of Chinese foreign policy, and probably influenced Mao's thinking on Chinese nuclear weapons doctrine.

19 Statement by Sha Zukang, Chinese Disarmament Ambassador, at the General Debate of the First Committee of the 50th Session of the UN General Assembly, 17 October 1995 (emphasis added); discussions with Chinese nuclear weapons strategists, November 1996, March 1998, and September 1998. For a further discussion of Chinese distinction between offensive and defensive deterrence, see the conference report on the results of the Center for Nonproliferation Studies--organized track 1 dialogue between US and Chinese counterparts on arms control and nonproliferation, <http://cnssun2.miis.edu/cns/projects/eanp/beijing/report.htm>. On the discussion of Chinese terms for deterrence, see also Lin, ***China's Nuclear Weapons Strategy***, ***op. cit.,*** p. 110.

20 Note that "factional networks" and decisions based on "personal relations" have been linked to traditional aspects of Chinese political culture. On this point, and a more in-depth discussion of Chinese Party-Army relations, see Ellis Joffe, "Party-Army Relations in China: Retrospect and Prospect," *China Quarterly*, no. 146 (June 1996), pp. 299-314.

21 David Shambaugh, ***Reforming the Chinese Military*** (Berkeley: University of California Press, forthcoming), in chap. 3; see also the papers delivered by Paul H. B. Godwin and David Finkelstein at the RAND-CAPS Conference on the PLA, Washington, DC, July 1999.

22 *Report of the Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China* [The Cox Committee Report], House of Representatives Report 105-851, vol. 1(Washington, DC: US Government Printing Office, 1999), p. 192.

23 Lewis and Xue, ***Strategic Seapower****, op. cit.*, p. 4: "Nie [Rongzhen, military leader and "father" of the Chinese bomb]'s group did not discuss or appear to consider relevant how these programs, if successful, would fit any new strategic concept. The members of Nie's group did not explicate the underlying strategic rationale for the program, and no one asked them to do so." Also ***ibid.,*** p. 20: "[China's] strategic doctrines are the product, not the cause, of the [weapon] project's political-technical evolution." See also Michael D. Swaine, *The Role of the Chinese Military in National Security Policymaking*, rev. ed., (Santa Monica, California: RAND, 1998), p. 39: "[Chinese] nuclear weapons development was apparently target- and technology-, and not specifically doctrinally driven."

24 Lewis and Xue, *China Builds the Bomb, op. cit.*, p. 214.

25 Lewis and Xue, *China's Strategic Seapower*, ***op. cit.,*** p. 19.

26 In the context of developing the Chinese nuclear arsenal, Lewis and Xue describe the Chinese conundrum of balancing the need for Soviet aid with a traditional "self-reliance" posture in their *China's Strategic Seapower*, pp. 2-4. A more in-depth explication of this conundrum and its impact on Chinese defense industrialization is found in John Frankenstein, "Back to the Future: A Historical Perspective on Chinese Military Modernization," a paper presented at the annual meeting of the International Studies Association, Anaheim, CA, March 1986, and in Bates Gill and Taeho Kim, *China's Arms Acquisitions from Abroad: A Quest for "Superb and Secret Weapons"* (Oxford: Oxford University Press, 1995), especially chap. 2. A discussion of historical and socio-cultural developments, and their impact on

Chinese military-technical modernization (especially in relation to the Revolution in Military Affairs) is found in Bates Gill, ***China and the Revolution in Military Affairs: Assessing Economic and Socio-Cultural Factors*** (Carlisle Barracks, Pennsylvania: US Army War College, May 1996).

27 The database on China compiled by the East Asia Nonproilferation Project, Center for Nonproliferation Studies, Monterey Institute of International Studies, is particularly helpful in covering the Chinese nuclear principles discussed here.

28 See, for example: Lewis and Xue, *China Builds the Bomb, op. cit.*, pp. 11-34.

29 Statement of the Government of the People's Republic of China, 16 October 1964, found in Lewis and Xue, *China Builds the Bomb*, pp. 241, 242.

30 Lt. Gen. Li Jijun, *Traditional Military Thinking and the Defensive Strategy of China*, Letort Paper no. 1 (Carlisle Barracks, PA: US Army War College, 29 August 1997), p. 7.

31 China's no-first-use pledge: "China undertakes not to be the first to use nuclear weapons at any time or under any circumstances." (China's National Statement On Security Assurances, 5 April 1995.)

32 China's negative security assurances: "China undertakes not to use or threaten to use nuclear weapons against non-nuclear-weapon States or nuclear-weapon-free zones at any time or under any circumstances. This commitment naturally applies to non-nuclear-weapon States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons or non-nuclear-weapon States that have undertaken any comparable internationally binding commitments not to manufacture or acquire nuclear explosive devices." China's National Statement On Security Assurances, 5 April 1995.

33 Johnston, "China's New 'Old Thinking'," pp. 21-23.

34 *China's National Statement On Security Assurances*, 5 April 1995; see also China's white paper *China: Arms Control and Disarmament* (Beijing: Information Office of the State Council, November 1995).

35 As presented by Ambassador Steven J. Ledogar, US Ambassador to the Conference on Disarmament, 6 April 1995.

36 China's National Statement, op. cit.

37 ***China: Arms Control and Disarmament*** (Beijing: State Council Information Office, November 1995).

38 Unless otherwise noted, this section draws from Xie Guang, et al., eds., ***Dangdai Zhongguo de Guofang Keji Shiye*** [Contemporary China's Defense Science and Technology Undertakings], vol. 1 (Beijing: Dangdai Zhongguo Chubanshe, 1992), chaps. 8, 9, and 10.

39 Robert Norris, Andrew S. Burrows, and Richard W. Fieldhouse, ***Nuclear Weapons Databook, Volume Five: British, French, and Chinese Nuclear Weapons*** (Boulder, CO: Westview Press, 1994), pp. 377-78.

40 Lewis and Hua, *China Builds the Bomb*, p. 212.

41 General Dynamics, ***The World's Missile Systems***, 8*th* ed., (Pomona, CA: General Dynamics, August 1988), p.52.

42 Joint Chiefs of Staff, ***United States Military Posture FY 1982***, p.109.

43 Lewis and Hua, "China's Ballistic Missile Programs," p. 9.

44 Norris, ***et al.***, ***Nuclear Weapons Databook,*** p. 380. The DF-3 may have drawn in part from research and development conducted on the DF-1 that was originally based in part on the Soviet R-12 (NATO code name SS-4 or "Sandal"), which, like the DF-3, had a cluster of four engines, and which Chinese rocket scientists had learned about during training in Moscow in the 1950s. See Lewis and Hua, "China's Ballistic Missile Programs," ***op. cit.,*** p. 13.

45 ***Jane's Strategic Weapons Systems***.

46 Center for Defense Information, ***Nuclear Weapons Database: Chinese Arsenal***.

47 Lewis and Xue, ***China Builds the Bomb***, p. 213.

48 Norris, ***et al., Nuclear Weapons Databook***, p. 381. Lewis and Hua, "China's Ballistic Missile Programs," ***op. cit.,*** p. 16, also provides the May 1971 date.

49 Lewis and Hua, "China's Ballistic Missile Programs," ***op. cit.,*** p. 17.

50 Ibid.

51 Norris, ***et al.***, ***Nuclear Weapons Databook***, p. 383.

52 Lewis and Hua, "China's Ballistic Missile Programs," p. 24.

53 Norris, et al., ***Nuclear Weapons Databook***, p. 383.

54 ***Ibid.,*** p. 382.

55 This section draws from "China's Solid Propellant ICBM Research," in Xie Guang, et al., eds., ***Dangdai Zhongguo de Guofang Keji Shiye*** [Contemporary China's Defense Science and Technology Undertakings], vol. 1 (Beijing: Dangdai Zhongguo Chubanshe, 1992).

56 Lewis and Hua also note that problems in warhead miniaturization, nuclear submarine development, and bureaucratic turf battles also slowed the program.

57 The nuclear capability of these missiles is cited in US Department of Defense, "Selected Military Capabilities of the People's Republic of China," report to Congress pursuant to Section 1226 of the FY98 National Defense Authorization Act, October 1998.

58 The authors are indebted to Evan Medeiros for this point.

59 US Department of Defense, "Selected Military Capabilities of the People's Republic of China," report to Congress pursuant to Section 1226 of the FY98 National Defense Authorization Act, October 1998.

60 On the 1995 and 1996 Taiwan Strait missile tests, see "China Announces Missile Launch Testing,"

Executive News Service, 19 July 1995; "Taiwan Detects Chinese Missiles," ***Executive News Service***, 8 March 1996.

61 US Department of Defense, "Selected Military Capabilities of the People's Republic of China," report to Congress pursuant to Section 1226 of the FY98 National Defense Authorization Act, October 1998.

62 Reported in Mark Stokes, "PLA Strategic Warfighting in the 21st Century: Space and Theater Missile Development," (paper presented at the Conference on the People's Liberation Army, 10-12 September 1999, US Army War College, Carlisle Barracks, Pennsylvania).

63 ***1999 DoD Report to Congress on the Security Situation in the Taiwan Strait***, (Washington, DC: Government Printing Office, 1999), p. 4.

64 See ***Jane's Defense Weekly*** coverage of the parade.

65 An informal testing moratorium among four of the nuclear weapon states--Soviet Union/Russia, the United States, France and the United Kingdom--had already been in place for several years. The Soviet Union's last test was in October 1990; the newly independent state of Russia has not since tested; the last US test was in September 1992; the last UK test was in November 1991. France had participated in the moratorium for nearly four years, from late 1991 until late 1995, when it resumed its final series of six tests, which ran from September 1995 to January 1996.

66 With 45 tests over a period of 381 months (October 1964 through July 1996), China averaged about 0.118 tests every month, or 2.95 tests on average for a 25-month period. Comparably intensive testing for China occurred over the period October 1975 to December 1978, when China tested nine times over a 38-month period, and four times in 1976 alone.

67 Thirty-two of China's 45 tests--more than 70 percent--took place in either May-June or September-October.

68 This line of argument is most credibly presented by Richard Garwin and Wolfgang Panofsky. See Richard L. Garwin, "Why China Won't Build US Warheads, "***Arms Control Today*** (April/May 1999), pp. 28-31; and Wolfgang K. H. Panofsky, "Assessing the Cost vs. Benefit of US-Chinese Nuclear Cooperation," ***Arms Control Today*** (April/May 1999), pp. 28-31.

69 Paul Godwin, "China's Nuclear Forces: An Assessment," ***Current History*** (September 1999).

70 ***The Intelligence Community Damage Assessment on the Implications of China's Acquisition of US Nuclear Weapons Information on the Development of Future Chinese Weapons***, 21 April 1999.

71 See, for example, Robert S. Norris and William M. Arkin, "British, French, and Chinese Nuclear Forces," ***Bulletin of the Atomic Scientists*** (November/December 1996), p. 66; Robert S. Norris and William M. Arkin, "Global Nuclear Stockpiles, 1945-1997," ***Bulletin of the Atomic Scientists*** (November/December 1997), p. 67.

72 Office of the Secretary of Defense, ***Proliferation: Threat and Response*** (Washington, DC: US Government Printing Office, November 1997) (online version).

73 Norris, ***et al., Nuclear Weapons Databook***, pp. 370-371. Beijing has not acknowledged possession of

tactical weapons. Jonathan D. Pollack, "The Future of China's Nuclear Weapons Policy," in John C. Hopkins and Weixing Hu, eds., ***Strategic Views from the Second Tier: The Nuclear Weapons Policies of France, Britain, and China*** (New Brunswick: Transaction Publishers, 1995), p. 160.

74 David Albright, Frans Berkhout, and William Walker, ***Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities, and Policies***, (New York: Oxford University Press, 1997), pp.77, 129.

75 Johnston, "China's New 'Old Thinking'," p. 36.

76 Office of the Secretary of Defense, ***Proliferation: Threat and Response*** (on-line version).

77 Office of the Secretary of Defense, ***Proliferation: Threat and Response*** (on-line version).

78 ***Xinhua***, 23 May 1996, in Foreign Broadcast Information Service, ***Daily Report: China***, FBIS-CHI-96-105, 23 May 1996.

79 We suspect that the CEP of the DF-15 is now much lower than 600 meters. Lower estimates of the DF-15's CEP have been discussed in the Hong Kong and Taiwan media, but 600 meters is the only verifiable number in open sources.

80 Stokes, "PLA Strategic Warfighting," pp. 10-11.

81 Lockwood, "The Status of US, Russian, and Chinese Nuclear Forces," p. 24.

82 Ibid.

83 Ibid.

84 National Intelligence Council, "Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015," September 1999, p. 11.

85 Lockwood, "The Status of US, Russian, and Chinese Nuclear Forces," p. 24.

86 There is a discrepancy among analysts as to how many Xia-class submarines China has. Some analysts state that China has two such vessels. The Jane's Information Group, however, notes that "To maintain one submarine on continuous patrol takes a minimum of three, and, to be absolutely safe, and optimum number of five hulls. Because of this known requirement, there has been a tendency in the West to exaggerate the Chinese [nuclear-powered ballistic missile submarine] programme, both in terms of numbers and timescales." Richard Sharpe, ed., ***Jane's Fighting Ships 1994-95*** (Coulsdon, Surrey: Jane's Information Group, 1994), p. 114.

87 Godwin, "China's Nuclear Forces."

88 ***The Military Balance 1997/98*** (London: Oxford University Press, October 1997), p. 178; Robert S. Norris and William M. Arkin, "Appendix 11A. Tables of nuclear forces," in ***SIPRI Yearbook 1997*** (Oxford: Oxford University Press, 1997), Table 11A.5, p. 401. According to the ***Military Balance***, China still deploys over 200 of the older H-5 bombers in a conventional role. For information on Chinese military aircraft production, see Randall Forsberg, ed., ***International Fighter Study*** (Cambridge, MA: Institute for Defense and Disarmament Studies, January 1994), Table 3.5; Kenneth W. Allen, Glenn

Krumel, and Jonathan D. Pollack, ***China's Air Force Enters the 21st Century*** (Santa Monica, CA: RAND, 1995).

89 Lewis and Hua, "China's Ballistic Missile Programs," pp. 6-7.

90 ***Ibid***., p. 6.

91 ***Ibid.,*** p. 17.

92 Of course, it must be recognized that the Chinese may not believe the 1991 withdrawal took place.

93 Claire Hollingsworth, "China's Growing Missile Might," ***Defense and Foreign Affairs***, March 1985, p. 28.

94 See, for example, Institute for National Strategic Studies, ***Strategic Assessment 1997*** (Washington, DC: National Defense University, 1997), p. 50; Godwin and Schulz, "Arming The Dragon," p. 6; Xue, "Evolution of China's Nuclear Strategy," pp. 173-76.

95 Robert Walpole, National Intelligence Officer for Strategic and Nuclear Programs, briefing to Carnegie Endowment for International Peace, 17 September 1998.

96 Godwin, "China's Nuclear Forces."

97 On 23 October 1978, the DF-3 was able to achieve a response time of 2 hours, 32 minutes. See Lewis and Hua, "China's Ballistic Missile Programs," ***op. cit.,*** pp. 22-24.

98 The Cox Committee Report, vol. 1, ***op. cit.,*** p. 192, citing testimony by Robert Walpole, states that "the intercontinental CSS-4s [DF-5s] are deployed in their silos without warheads and without propellants during day-to-day operations."

99 Lewis and Xue, ***China's Strategic Seapower.***

100 Estimates vary as to the minimum number of submarines necessary for sustained patrolling, ranging from four to six hulls.

101 Harlan Jencks, "PRC Nuclear and Space Programs," in Richard H. Yang, ed., ***SCPS Yearbook on PLA Affairs 1987*** (Kaohsiung, Taiwan: Sun Yat-sen Center for Policy Studies, National Sun Yat-sen University, 1987), p. 110.

102 Robert G. Sutter, ***Chinese Nuclear Weapons and Arms Control Policies: Implications and Options for the United States***, CRS Report 94-422S (Washington, DC: Congressional Research Service, 25 March 1994), p. 7.

103 This section relies in part on Mark A. Stokes, ***China's Strategic Modernization,*** especially the section on the Second Artillery.

104 Xue, "Evolution of China's Nuclear Strategy," p. 180; see also Lewis and Xue, ***China's Strategic Seapower***, p. 325, fn. 31.

105 For an excellent analysis of Chinese command and control of its military forces, see Michael Swaine,

The Military and Political Succession in China: Leadership, Institutions, Beliefs, (Santa Monica, CA: RAND, R-4254-AF, 1992).

106 "Daodan shixian 'quantianhou' tongxin baozhang" ["Missile launch 'all-weather' communications secured"], ***Jiefangjun Bao*** [***People's Liberation Army Daily***], 5 January 1998, p. 2.

107 US Department of Defense, "Selected Military Capabilities of the People's Republic of China," report to Congress pursuant to Section 1305 of the FY97 National Defense Authorization Act, April 1997.

108 Ge Xinqing, Mao Guanghong, and Yu Bo, "Xinxizhanzhong daodan budui mianlin de wenti yu duice" [Questions and Countermeasures Facing Missile Units in Information Warfare], in ***Junshi xueshu***, ed., ***Wojun xinxizhan wenti yanjiu*** [Studies into Information Warfare Issues for Our Military], (Beijing: National Defense University, 1999), pp.189-192.

109 Han Tiejun and Li Qinsuo, "Didi changdui daodan budui zuozhan de jiben yuance" [Fundamental Principles of Conventional Surface-to-Surface Missile Unit Operations], in ***Lianhe zhanyi yu junbingzhong zuozhan*** [Joint Theater and Service Operations], (Beijing: National Defense University, 1998), pp. 232-235.

110 For a Chinese perspective on this issue, see Yang Huan, "China's Strategic Nuclear Weapons," in Michael Pillsbury, ed., ***Chinese Views of Future Warfare***, (Washington, DC: National Defense University Press, 1997), pp. 131-135.

111 Godwin, "China's Nuclear Forces."

112 Johnston, "China's New 'Old Thinking'."

113 Mark A. Stokes, ***China's Strategic Modernization: Implications for the United States*** (Carlisle Barracks: Strategic Studies Institute, US Army War College, September 1999), p. 96.

114 Godwin, "China's Nuclear Forces."

115 Secretary of Defense William Perry, ***Annual Report to the President and the Congress***, (Washington, DC: Government Printing Office, 1995), p. 83.

116 US Department of Defense, "Selected Military Capabilities of the People's Republic of China," report to Congress pursuant to Section 1305 of the FY97 National Defense Authorization Act, April 1997.

117 Gen. Patrick M. Hughes, Director of the Defense Intelligence Agency, Senate Armed Services Committee hearings on "Current and Projected National Security Threats," 2 February 1999.

118 National Intelligence Council, "Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015," September 1999, p. 11.

119 ***Report of the Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China***, (Washington, DC: US Government Printing Office, 1999), pp.185-86.

120 Ibid.

121 General Patrick M. Hughes, Director of the Defense Intelligence Agency, Senate Armed Services

Committee hearings on "Current and Projected National Security Threats," 2 February 1999.

122 Department of Defense, "Selected Military Capabilities of the People's Republic of China."

123 Lewis and Xue, ***Strategic Seapower***, p. 181.

124 Lewis and Hua, "China's Ballistic Missiles," p. 27.

125 National Intelligence Council, "Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015," September 1999, p. 11.

126 Lewis and Hua, "China's Ballistic Missile Programs," p. 29.

127 Office of Naval Intelligence, ***Worldwide Submarine Challenges 1997*** (February 1997), p. 22.

128 Lewis and Xue, ***China's Strategic Seapower,*** pp. 236-37.

129 Lewis and Hua, "China's Ballistic Missile Programs," p. 25.

130 ***Ibid.***, the struggles over the transition from liquid to solid-fuel are well documented.

131 Godwin, "China's Nuclear Forces."

132 Gen. Patrick M. Hughes, Director of the Defense Intelligence Agency, Senate Armed Services Committee hearings on "Current and Projected National Security Threats," 2 February 1999.

133 Stokes, ***China's Strategic Modernization***, p. 91.

134 US Department of Defense, "Selected Military Capabilities of the People's Republic of China," report to Congress pursuant to Section 1305 of the FY97 National Defense Authorization Act, April 1997.

135 Scott Pace, ***et al.***, ***The Global Positioning System: Assessing National Policies*** (Santa Monica, CA: RAND, Critical Technologies Institute, MR-614-OSTP, 1995), p. 68.

136 ***Report of the Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China***, (Washington, DC: US Government Printing Office, 1999), pp. 185-86.

137 Godwin, "China's Nuclear Forces."

138 Banning N. Garrett and Bonnie S. Glaser, "Chinese Perspectives on Nuclear Arms Control," ***International Security*** 20, no. 3 (winter 1995/96), pp. 55-56; Godwin and Schulz, "China and Arms Control," p. 9; Robert S. Norris, "Nuclear Arsenals of the United States, Russia, Great Britain, France and China: A Status Report," presented at the 5th ISODARCO Beijing Seminar on Arms Control, Chengdu, China, 12-15 November 1996, p. 5; Norris and Arkin, "British, French, and Chinese Nuclear Forces," pp. 66-67.

139 Lewis and Hua, "China's Ballistic Missiles," p. 21.

140 Dingli Shen, "The Prospects For A Comprehensive Test Ban Treaty: Implications Of Chinese Nuclear Testing," in W. Thomas Wander, Eric Arnett, and Paul Bracken, eds., ***The Diffusion of Advanced Weaponry: Technologies, Regional Implications, and Responses*** (Washington, DC:

American Association for the Advancement of Science, 1994), pp. 272-273.

141 ***Report of the Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China*** [The Cox Committee Report], House of Representatives Report 105-851, vol. 1(Washington, DC: US Government Printing Office, 1999).

142 Ibid.

143 ***The Intelligence Community Damage Assessment on the Implications of China's Acquisition of US Nuclear Weapons Information on the Development of Future Chinese Weapons***, 21 April 1999.

144 Lewis and Hua, "China's Ballistic Missiles," p. 21.

145 ***Ibid.,*** pp. 21-22.

146 Lin, ***China's Nuclear Weapons Strategy,*** p. 51; Stockholm International Peace Research Institute, ***SIPRI Yearbook 1987: World Armaments and Disarmament*** (Oxford: Oxford University Press, 1987), p. 34.

147 ***The Intelligence Community Damage Assessment on the Implications of China's Acquisition of US Nuclear Weapons Information on the Development of Future Chinese Weapons***, 21 April 1999.

148 Johnston, "China's New 'Old Thinking'," p. 5.

149 ***Ibid.,*** p. 19.

150 ***Ibid.,*** p. 20.

151 Godwin, "China's Nuclear Forces."

152 Ibid.

153 Ibid.

154 Johnston, "China's New 'Old Thinking'," pp. 35-36.

155 Yu Xinhua, Yang Qingzhen, eds., ***Shengwu Wuqi yu Zhanzheng***, 1997, ***op. cit***., p. viii.

156 Karlheinz Lohs, ***Synthetic Poisons*** (***Chemistry, Effects and Military Significance***), Second Edition (East Berlin: German Military Publishing House, 1963) translated in JPRS 23,681, p. 34.

157 Wang Qiang, Yang Qingzhen, eds. ***Wuqi yu zhanzheng jishi congshu*** (#14): ***Huaxue wuqi yu zhanzheng*** (***Beijing:*** Guofang Gongye Chubanshe, 1997), p. 2. I rely upon this source out of necessity, for it is one of the few extant PRC writings on the subject, and it is reasonably competent. While it distorts the historical record with regard to allegations of US having used chemical and biological weapons, especially during the Korean and Vietnamese conflicts, it probably reflects the current wisdom among the CBW cognoscenti in the PLA.

158 Other names are beta-Mehylacrolein, Propylene aldehyde, Crotonic aldehyde, 2-Butenal. It is reasonably toxic and rather noxious.

159 Wang Qiang, Yang Qingzhen, eds. ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 3.

160 A.k.a. Guan Yu, Guang Fu Zi, etc.

161 Wang Qiang, Yang Qingzhen, eds. ***Huaxue wuqi yu zhanzheng***, 1997, o***p. cit***., p. 5.

162 Much of the information seems to have been lifted from the SIPRI series on CB weaponry by Robinson, Leitenberg, et al.

163 Zhang Bucai, ***Dizhan Qishilu*** (Beijing: Junshi Kexue Chubanshe, 1990) pp. 239-240.

164 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 52.

165 Benjamin Garrett, "The Chinese Warlords' Chemical Arms Race," ***The ASA Newsletter***, No. 98-4, August 14, 1998, p. 16.

166 ***Ibid.***, p. 17.

167 Wang Qiang, Yang Qingzhen, eds. ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 101.

168 ***Ibid***., p. 97.

169 ***Ibid***., p. 102.

170 SIPRI, ***The Problem of Chemical and Biological Warfare***, Volume I, 1971, ***op cit***., p. 309; Brown, p. 315.

171 Wang Qiang, Yang Qingzhen, eds. ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 73.

172 According to one member of the Chinese Ministry of Foreign Affairs.

173 Wang Dejian, ***Xinzhongguo Zhanshi***, Volume 1 (Huhehaote, Mongolia: Yuanfang Chubanshe, 1998), p. 222. I have not read the complete work; however, only passing mention of CBW in Korea is made in pages 183-237.

174 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., pp. 123-124.

175 ***Ibid***., p. 124.

176 ***Ibid***., p. 144. There are rumors in the American Vietnam veteran community that Czech chemical shells were found by US soldiers in Vietnam. I cannot verify these claims, although it is possible that Czech equipment did find its way to Southeast Asia.

177 Harlan Jencks, "Ground Forces," in Gerald Segal and William T. Tow, eds, ***Chinese Defense Policy*** (Hong Kong: MacMillan, 1984), p. 65.

178 Joachim Krause and Charles K. Mallory, ***Chemical Weapons in Soviet Military Doctrine*** (San Francisco: Westview Press, 1992), p. 131.

179 Jappie, "Dutch Claim lead in CW Antidotes," ***Jane's Defence Weekly***, Vol. 11, No. 23, June 10, 1989, p. 1203.

180 This person shall go nameless to avoid possible embarrassment.

181 "Government Denies Selling Sarin Nerve Gas to China," ***Unian*** (Kiev), March 13, 1997, transcribed in FBIS FTS19970313000256.

182 "Special Dispatch: China Reportedly purchases 500 tonnes of Sarin Toxin from Ukraine for Secret Manufacture of Chemical Weapons in Preparations Against Taiwan," ***Ping Huo Jih Bao*** (Hong Kong), March 3, 1997, translated in FBIS-CHI-97-062.

183 Supposedly 5-10 times more potent than VX, ***novichok,*** or newcomer, may not even exist, at least not in the way it is conceived in the open literature.

184 " [A]rtillery cannot match the surprise dosage, area-coverage performance of multiple rocket launchers." Stockholm International Peace Research Institute (SIPRI), ***The Problem of Chemical and Biological Warfare***, ***Volume I: The Rise of CB Weapons*** (New York: Humanities Press, 1971), p. 105.

185 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, ***op. cit***., p. 245.

186 ***Ibid***., p. 232.

187 Zhou Jinhuang, et al. Chinese Medical Encyclopedia: Protective Medicine against Chemical Weapons (***Zhongguo Yixue Baike Quanshu: Huaxue Wuqi Fanghu Yixue***, 1985. Translated by Canadian Ministry of National Defense, DSIS/CRAD, Ottawa, p. 33.

188 ***Ibid***., p. 34.

189 Tributyl phosphate (TBP) was actually one of the first substances recorded in A. E. Arbusov's early work in organophosphorus compounds. It is not only a useful, nonflammable additive for hydraulics and synthetic oils, but is employed as a chelating agent for uranium and plutonium extraction.

190 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., ***passim***.

191 Joachim Krause and Charles K. Mallory, ***Chemical Weapons in Soviet Military Doctrine***, 1992, op.cit., p63. Soviet chemical doctrine was, at least in the early days, developed by none other than Marshal M. N. Tukhachevskij.

192 ***Ibid***., p. 197.

193 Joachim Krause and Charles K. Mallory, ***Chemical Weapons in Soviet Military Doctrine***, 1992, ***op. cit***., p. 100. Hirsch also reports the use of metallic substances and sawdust, a traditional carrier for HCN, as delivery aids from aircraft.

194 Wang Qiang, Yang Qingzhen, eds. ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 196.

195 ***Ibid***., p. 68.

196 Rosita Dellios, ***Modern Chinese Defense Policy*** (New York: St. Martin's Press, 1990), p. 69.

197 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 167.

198 ***Ibid***., p. 174.

199 See diagram in Brian Beckett, Weapons of Tomorrow (New York: Plenum Press, 1983), p. 133.

200 Leader of the Chinese delegation at the Fourth Conference of States Parties to the CWC, Gong Chunsen, at The Hague, June-July 1999.

201 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 232.

202 ***Ibid***., p. 231.

203 This is consistent with contemporaneous press accounts, e.g., William Flannery, "Tactics: US Unlikely to Use Nuclear Arms in Gulf Conflict--No Matter What," ***St. Louis Post-Dispatch***, February 6, 1991, p. C1.

204 Albert J. Mauroni, ***Chemical-Biological Defense: US Military Policies and Decisions in the Gulf War*** (Westport, CT: Praeger, 1998): "First, the Army was preparing to remove the US chemical weapons from Germany to Johnston Island (Operation "Steel Box") in November 1990. Instead of shipping them to Johnston Island as planned, they could reroute the chemical munitions to Saudi Arabia. . . . [B]inary projectile shells themselves (minus the second component) could be shipped to the Gulf to fool the Iraqis into thinking there were US chemical munitions available for retaliation. Both of these options were ultimately rejected as politically too controversial. . . . [Later] in the month . . . ODCSOPS officially confirmed to CENTCOM that there would be no chemical munitions deployment to Saudi Arabia. No plans were developed for US retaliation using chemical munitions." p. 48.

205 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 146.

206 ***Ibid***., p. 234.

207 ***Ibid***., p. 242.

208 Maj. Gen. Jiang Zhizeng, Chief of the Chemical Defense Department, "***Jiang moshen bing zhan xiong zi***," (Heroic stance of the demon corps), ***PLA Pictorial***, No. 11, 1989, p. 30.

209 He is listed as "primary editor" for the NBC portion of ***Zhongguo Junshi Baike Chuanshu*** (Beijing: Junshi Kexue Chubanshe, 1990).

210 Zhang Dongwen, Xia Wei, and Zhang Yanzhong, "Cradle of the Chemical Defense Troops: The Anti-Chemical Warfare Command and Engineering Academy," ***Xiandai Bingqi***, No. 4, April 8, 1998, pp. 37-38, translated in FBIS FTS19980721001507.

211 ***Ibid***.

212 ***Ibid***.

213 Li Junting and Yang Jinhe, eds., ***Zhongguo Wuzhuang Liliang Tonglan, 1949-1989*** (Beijing?: Renmin Chubanshe, no imprint date) p. 214.

214 Wang Dejian, ***Xinzhongguo Zhanshi***, Volume 2 (Huhehaote, Mongolia: Yuanfang Chubanshe, 1998), p. 427.

215 ***Ibid***., p. 436.

216 Maj. Gen. Jiang Zhizeng, ***PLA Pictorial***, No. 11, 1989, ***op. cit***., p. 31.

217 ***Chuanjian Jiangzeijun Yiqianduoming***," ***Ren Min Ri Bao***, January 20, 1955, p. 1.

218 Maj. Gen. Jiang Zhizeng, ***PLA Pictorial***, No. 11, 1989, ***op. cit***., p. 30.

219 ***Ibid***.

220 Chen Peifu, Wang Zhaogu, eds., ***Fanghua Xuebing*** (Beijing: Zhongguo Qingnian Chubanshe, 1957), p. 9.

221 Li Junting and Yang Jinhe, eds., ***Zhongguo Wuzhuang Liliang Tonglan, 1949-1989***, ***op. cit***., p. 214.

222 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng,*** 1997, ***op. cit***., p. 22.

223 ***Ibid***., p. 202.

224 ***Ibid***., p. 203.

225 Li Junting and Yang Jinhe, eds., ***Zhongguo Wuzhuang Liliang Tonglan, 1949-1989***, ***op. cit***., p. 215.

226 Zhu Kewen, Gao Zixian, Gong Chun, eds., ***Zhongguo Junshi Yixueshi*** (Beijing: Renmin Junyi Chubanshe, 1996), p. 515.

227 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 209.

228 ***Ibid***., p. 210.

229 ***Zhongguo Junshi Baike Chuanshu***, 1990, ***op. cit***., p. 124.

230 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 214.

231 ***Ibid***., p. 217.

232 ***Zhongguo Junshi Baike Chuanshu***, 1990, ***op. cit***., p. 143.

233 Wang Qiang, Yang Qingzhen, eds., ***Huaxue wuqi yu zhanzheng***, 1997, ***op. cit***., p. 217.

234 ***Zhongguo Junshi Baike Chuanshu***, 1990, ***op. cit***., p. 139.

235 Zhu Kewen, Gao Zixian, Gong Chun, eds., ***Zhongguo Junshi Yixueshi***, 1996, ***op. cit***., p. 515.

236 ***Zhongguo Junshi Baike Chuanshu***, 1990, ***op. cit***., p. 130.

237 Zhu Kewen, Gao Zixian, Gong Chun, eds., ***Zhongguo Junshi Yixueshi***, 1996, ***op. cit***., p. 510.

238 ***Ibid***., p. 511.

239 Ranajit Ghosh, to Imperial Chemical Industries, British patent #797,603, July 2, 1958, covering "pesiticidal compds. of the type RP-(O)(OR)SR' in which R are like or unlike alkyl groups and R' is an

amino group containing aliphatic or heterocyclic group." Chemical Abstracts, 2157I, 1959.

240 Nicholas Wade, "Going Public with VX Formula--A Recipe for Trouble?" ***Science***, Vol. 187, No. 4175, February 7, 1975, p. 414.

241 James. A. F. Compton, ***Military Chemical and Biological Agents*** (Caldwell, NJ: The Telford Press, 1987), p166.

242 Lev A. Fedorov and Mary S. Svetlakova, "Russian V-Gas Production and Its Legacy," ***The ASA Newsletter,*** No. 95-6, December 8, 1995, p. 1.

243 Zhu Kewen, Gao Zixian, Gong Chun, eds., ***Zhongguo Junshi Yixueshi***, 1996, ***op. cit***., p. 512.

244 ***Junshi Yixue Cidian*** (Shanghai: Shanghai Cishu Chubanshe, 1997), p. 331.

245 Zhou Jinhuang, et al., ***Chinese Medical Encyclopedia: Protective Medicine against Chemical Weapons***, 1985, ***op. cit***., p. 248.

246 ***Ibid***., p. 248.

247 Zhu Kewen, Gao Zixian, Gong Chun, eds., ***Zhongguo Junshi Yixueshi***, 1996, ***op. cit***., p. 512.

248 ***Ibid***., p. 513.

249 ***Ibid***.

250 ***Ibid***., p. 514.

251 ***Ibid***., p. 516.

252 ***Ibid***., p. 515.

253 ***Ibid***., p. 516.

254 SIPRI, ***The Problem of Chemical and Biological Warfare***, Volume I, 1971, ***op. cit***., p. 134.

255 Restriction of pinacolyl alcohol exports from the West in the late 1980s, and its subsequent control in export legislation (Australia Group and CWC) may have prevented Iraq from pursuing GD further.

256 Yu Yan Wu, "***Zaonian junshi jishu duling fengsao, kaifang how gexiang keji xianzhe jinbu***," ***Touzi Zhongguo*** (Fortune China Monthly), October 1999, p. 32.

257 Patricia L. Layman, "BASF Still Tops Global Top 50," ***Chemical & Engineering News***, Vol. 77, No. 30, July 26, 1999, p. 24.

258 John D. Baldeschwieler, ed., ***Chemistry and Chemical Engineering in the People's Republic of China: A Trip Report of the US Delegation in Pure and Applied Chemistry*** (Washington, DC: American Chemical Society, 1979), p. 1.

259 ***Ibid***., p. 2.

260 Brian Harvey, ***The Chinese Space Programme: From Conception to Future Capabilities*** (West

Sussex, UK: John Wiley & Sons, 1998), pp. xi, 6.

261 ***Ibid***., pp. 9-10.

262 Siwei Cheng, "Focusing on R&D in China," ***Chemical Engineering***, Vol. 97, No. 2, February 1990, p. 35.

263 Roderick MacFarquhar, ***Origins of the Cultural Revolution***, Vol. 3, (New York: Columbia University Press, 1997), p. 192.

264 "China's Chemical Industry Growth," ***Chemical Week***, August 25-September 1, 1993, p. S6.

265 John D. Baldeschwieler, ed., ***Chemistry and Chemical Engineering in the People's Republic of China***, ***op. cit***., p. 2. In fact, some of the older generation mainland Chinese still remember Lysenko's harebrained genetics being taught in textbooks adapted from the Soviet Union.

266 Michael Freemantle, "A Makeover for Science in China," ***Chemical & Engineering News***, Vol. 76, No. 34, August 24, 1998, p. 23.

267 John Wilson Lewis and Xue Litai, ***China Builds the Bomb*** (Stanford, CA: Stanford University Press, 1988), p. 88.

268 Robert S. Desowitz, ***New Guinea Tapeworms and Jewish Grandmothers: Tales of Parasites and People*** (New York: W. W. Norton, 1981), p. 126.

269 Brian Harvey, ***The Chinese Space Programme: From Conception to Future Capabilities***, ***op. cit***., pp. 7-8. As far as one can tell, only Liu Shaoqi personally reduced his own rations in sympathy with the plight of the Chinese ***laobaixing***.

270 John D. Baldeschwieler, ed., ***Chemistry and Chemical Engineering in the People's Republic of China***, ***op. cit***., p. 3.

271 Michael Freemantle, "A Makeover for Science in China," ***Chemical & Engineering News***, ***op. cit***., p. 21.

272 Michael Roberts, "China: Cultivating Home-Grown Technology," ***Chemical Week***, May 15, 1996, p. 39.

273 John D. Baldeschwieler, ed., ***Chemistry and Chemical Engineering in the People's Republic of China***, ***op. cit***., pp. 4-5.

274 ***Ibid.***, p. 36.

275 Michael Freemantle, "A Makeover for Science in China," ***Chemical & Engineering News***, ***op. cit***., p. 21.

276 Dr. Walter Hirsch, chemical warfare specialist and former Chief of the Chemical Warfare Section, Germany Army Ordnance Development Department (OKW--WA Pruef A), ***Soviet BW and CW Preparations and Capabilities***, "Section I, Soviet CW Agents, Installations, Production, Research," (Washington, DC: Intelligence Branch, Plans, Training & Intelligence Division, Office of the Chief,

Chemical Corps,1947), p. 25.

277 ***Ibid***., p. 28: "Owing to the action of impurities hydrogen accumulated within the container building up a considerable pressure (8-12 atmospheres)."

278 By way of Hirsch, found in Joachim Krause and Charles K. Mallory, ***Chemical Weapons in Soviet Military Doctrine***, 1992, ***op. cit***., p. 47.

279 US Congress, Office of Technology Assessment, ***Technologies Underlying Weapons of Mass Destruction***, OTA-BP-ISC-115 (Washington, DC: US Government Printing Office, December 1993), p. 22.

280 Hirsch, ***Soviet BW and CW Preparations and Capabilities***, Section I, Soviet CW Agents, ***op. cit***., p. 32.

281 ***Ibid***., p. 44.

282 News of VX in the open press appeared in the late 1950s, but probably too late for China to do very much about it until much later.

283 ***Ibid***., p. 7.

284 Li Junting and Yang Jinhe, eds., ***Zhongguo Wuzhuang Liliang Tonglan,*** 1949-1989, ***op. cit***., p. 214.

285 Zhu Kewen, Gao Zixian, Gong Chun, eds., ***Zhongguo Junshi Yixueshi***, 1996, ***op. cit***., p. 514.

286 Arthur Dock Fon Toy, ***Phosphorus Chemistry in Everyday Living*** (Washington, DC: American Chemical Society, 1976), p. 220. It may be noted here that the author of this book (d.1996), was one of the foremost experts on phosphorus chemistry, especially in the field of contact insecticides utilizing organophosphorus compounds, and has over 80 patents to his name. A native of Guangzhou, Dr. Toy received his Ph.D. from the University of Illinois, and worked at the Victor Chemical Works in Illinois and then the Stauffer Chemical Company in Westport, CT. He retired as director of research from Stauffer in 1981. Being from a generation that would have been at the right age (35) during the Chinese Communist takeover, his expertise would, of course, been invaluable to the PRC, but he lived out his life and career in the United States.

287 "Country Focus: Clear Path Into China," ***Chemical Week***, August 25/September 1, 1993, p. S27.

288 Michael Freemantle, "A Makeover for Science in China," ***Chemical & Engineering News***, ***op. cit***., p. 21.

289 Siwei Cheng, "Focusing on R&D in China," ***Chemical Engineering***, February 1990, ***op. cit***., p. 35.

290 Michael Freemantle, "A Makeover for Science in China," ***Chemical & Engineering News***, ***op. cit***., p. 26.

291 "Japan-China Deal to Include Chemical Plants," ***Chemical Week***, February 22, 1978, p. 25.

292 Gene Linn, "China's Chemical Boom Prompts Fears of Glut," ***Journal of Commerce***, October 1, 1992, p. A1.

293 P.T. Bangsberg, "China Predicts 9 Percent Annual Growth in Chemical Sector over 5 Years," ***Journal of Commerce***, December 26, 1995, p. B5.

294 "China Adjusts Development Goals for Chemical Industry," Beijing Xinhua news service, in English, August 23, 1997, transcribed in FBIS, FTS19970823000347.

295 Wang Luxian, "Chemical Pesticides," ***China Chemical Industry Yearbook*** (English Edition) (Beijing: China National Chemical Information Centre), 1997, p. 41.

296 Shen Liao, "Agrochemicals Draw Attention," ***China Daily***, May 24, 1999, transcribed in FBIS FTS19990524000029.

297 Siwei Cheng, "Focusing on R&D in China," ***Chemical Engineering***, February 1990, ***op. cit***., p. 35.

298 ***Ibid***., p. 35.

299 Howard Qiu, "Booming Domestic Demand Pushes China," ***Chemical Market Reporter***, Vol. 251, No. 22, June 2, 1997, pp. SR19-22.

300 Con Coughlin, "China Helps Iran to Make Nerve Gas," ***The Sunday Telegraph*** (Internet Version), May 24, 1998, transcribed by FBIS, FTS 19980525000796.

301 ***Ren Min Ri Bao***, June 15, 1998, mainland edition.

302 Chemical Business Newsbase, May 20, 1999.

303 China Chemical Week, Electronic edition, May 13, 1999.

304 Wang Luxian, "Chemical Pesticides," ***China Chemical Industry Yearbook***, 1997, ***op. cit***., pp. 35-36.

305 "China: General Aspects of Domestic Pesticide Production," ***China Chemical Week***, May 13, 1999, p. 3.

306 Shen Liao, "Agrochemicals Draw Attention," ***China Daily***, May 24, 1999, ***op. cit***.

307 Wang Luxian, "Chemical Pesticides," ***China Chemical Industry Yearbook***, 1997, ***op. cit***., p. 33. Wang Luxian, incidentally, is secretary general of the China Association of Pesticide Industry. Shen Liao, "Agrochemicals Draw Attention," ***China Daily***, May 24, 1999, ***op. cit***.

308 ***Chemical Market Reporter***, June 2, 1999.

309 ***Huaxuepin Duxing, Fagui, Huanjing Shuju Shouce*** (Beijing: Zhongguo Huanjing Kexue Chubanshe, 1992), p. 696.

310 ***Ibid***. Pentasulfide route also indicated in Thomas A. Unger, ***Pesticide Synthesis Handbook*** (Park Ridge, New Jersey: Noyes Publications, 1996), p. 1032.

311 Joachim Krause and Charles K. Mallory, ***Chemical Weapons in Soviet Military***, 1992, ***op. cit***., p. 131.

312 Yu Xinhua, Yang Qingzhen, eds., ***Wuqi yu zhanzheng jishi congshu*** #13: ***Shengwu Wuqi yu***

Zhanzheng (Guofang Gongye Chubanshe, 1997), p. 87.

313 Stephen Endicott and Edward Hagerman, ***The United States and Biological Warfare*** (Indianapolis: Indiana University Press, 1998). The reader is encouraged to look at this book, if only to see how sycophantic admirers of ***c***ommunist movements can maintain their faith. But do not waste more time than necessary.

314 ***Ibid***., p. 150.

315 Yu Xinhua, Yang Qingzhen, eds., ***Shengwu Wuqi yu Zhanzheng***, 1997, ***op. cit***., pp. 77-85. "***Jinian yihou, Meiguo zhengfu chengren, zai Chaoxian Zhanzheng zhong tamen shiyong guo shengwu wuqi***."

316 Considering that there were experts from the United States Army Medical Research Institute of Infectious Disease (USAMRIID) who visited northern China in the late 1980s to assist in characterizing and treating Korean hemorrhagic fever, one wonders if such "good will" gestures are appreciated or even widely known in the PLA**.**

317 Yu Xinhua, Yang Qingzhen, eds., ***Shengwu Wuqi yu Zhanzheng***, 1997, ***op. cit***., p. vii. The contributors to this volume, and who are listed as the primary editors, are not your ordinary authors of jeremiads and calumny, but a research instructor of colonel rank (Yu Xinhua), and Yang Qingzhen, an associate professor at the National Defense University with the rank of senior colonel.

318 Fu Zhigang, Monterey, spring 1999.

319 Yu Xinhua, Yang Qingzhen, eds., ***Shengwu Wuqi yu Zhanzheng***, 1997, ***op. cit***., p. viii.

320 My appreciation goes to Dr. Bates Gill for obtaining the documents.

321 Chinese BWC declarations for 1996.

322 Ken Alibek, ***Biohazard*** (New York: Random House, 1999), p. 273.

323 Conversation following roundtable with academics in Taipei, fall 1999. Due to the nature of the sponsoring organization, this person shall go nameless. He is well versed in PRC military affairs.

324 Yen Yu-Chen, et al., "Characteristics of Crimean-Congo Hemorrhagic [sic] Fever Virus (Xinjiang Strain) in China," ***American Journal of Tropical Medicine and Hygiene***, Vol. 34, No. 6, p. 1169. Dr. Robert Shope assisted with the publication of this article, and seems to concur with the possibility of a natural outbreak. CCHF is very unique, he reports, and requires BL-4 (at least in the West). Conversation with Dr. Shope.

325 Steve Goldstein, "US Could Face New Terror Tactic: Agricultural Warfare," ***Philadelphia Inquirer***, June 22, 1999, p. 1.

326 Sofia Wu, "Taiwan Rules out Imports of mainland China-Made FMD Vaccine," CNA, June 23, 1999.

327 Terrance M. Wilson, D.V.M., Ph.D., Defense Intelligence Agency, Armed Forces Medical Intelligence Center, "Foot-and-Mouth Disease Control in Taiwan," lecture and unpublished paper, 1999.

328 Fang Qingquan, "***Cong Kodiyi Tan Yangzhu Zhengce***," (***Nongmu Xunkan***), No. 1265, September

25, 1999, p. 43.

329 ***Ibid***., p. 280.

330 Zhu Kewen, Gao Zixian, Gong Chun, eds., ***Zhongguo Junshi Yixueshi***, 1996, ***op. cit***., p. 521.

331 ***Zhongguo Junshi Baike Chuanshu***, 1990, ***op. cit***., pp. 115-116.

332 Zhu Kewen, Gao Zixian, Gong Chun, eds., ***Zhongguo Junshi Yixueshi***, 1996, ***op. cit***., p. 519.

333 Christopher S. Cox and Christopher M. Wathes, eds., ***Bioaerosols Handbook*** (Boca Raton, FL: CRC Press, 1995), p. 247.

334 Yu Xinhua, Yang Qingzhen, eds., ***Shengwu Wuqi yu Zhanzheng***, 1997, ***op. cit***., p. 260.

335 Christopher S. Cox and Christopher M. Wathes, eds., ***Bioaerosols Handbook***, 1995, ***op. cit***., p. 278

336 Yu Xinhua, Yang Qingzhen, eds., ***Shengwu Wuqi yu Zhanzheng***, 1997, ***op. cit***., p. 260.

337 Christopher S. Cox and Christopher M. Wathes, eds., ***Bioaerosols Handbook***, 1995, ***op. cit***., p. 250.

338 Zhu Kewen, Gao Zixian, Gong Chun, eds., ***Zhongguo Junshi Yixueshi***, 1996, ***op. cit***., p. 520.

339 ***Ibid***., p. 516.

340 ***Ibid***.

341 ***Ibid***., p. 517.

342 For the purposes of this paper, WMD is broadly defined to include nuclear weapons, chemical weapons, biological weapons, and delivery systems such as ballistic and cruise missiles. However, this paper does not address biological weapon (BW) because there are few consistent and reliable reports in the open-source literature about Chinese exports of BW-related items.

343 See Appendix I.

344 The most comprehensive account of China's nuclear exports in 1980s can be found in the series of books on global proliferation developments written by Leonard S. Spector. These include: ***Nuclear Proliferation Today***, (NY, NY: Vintage Books, 1984); ***New Nuclear Nations,*** (NY, NY: Vintage Books, 1985); ***Going Nuclear*** (Cambridge, MA: Ballinger Publishing Co., 1986); ***The Undeclared Bomb*** (Cambridge, MA: Ballinger Publishing Co., 1988), and ***Nuclear Ambitions*** (Boulder, CO: Westview Press, 1990.) For additional information, see Yan Kong, ***China and Nuclear Proliferation, 1980-1990: A Select Annotated Bibliography of English-Language Publications***, (Cambridge, MA: Center for Science and International Affairs, Harvard University, 1990.)

345 Yitzak Shichor, ***Peaceful Fallout: The Conversion of China's Military-Nuclear Complex to Civilian Use***, Bonn International Center for Conversion, Brief 10, November 1997.

346 China has also signed nuclear cooperation agreements with: Belgium, Canada, Chile, Finland, France, Germany, Indonesia, Italy, Japan, Romania, Russia, South Korea, Spain, Sweden, and the UK. The United States and China signed a peaceful nuclear cooperation agreement in 1984, and it was

approved in 1985 by Congress but conditions were attached that delayed the accord's activation until 1997 when the President certified that China's nonproliferation record had improved.

347 For the official Chinese statement on the Sino-Algerian reactor deal, see "Chinese Nuclear Cooperation with Algeria is Entirely Peaceful," ***Xinhua***, 30 April, 1991.

348 These factors include the secretive nature of the reactor project; the absence of electrical power lines leading away from the plant; the facility's location in the desert far away from population centers; the large cooling towers which suggested a reactor core as large as 60MW; and the fact that the reactor site was surrounded by several SA-5 surface-to-air missile batteries. Some reports say that there were signals that a reprocessing facility might be built next to the Chinese reactor. For more details, see Barbara Gregory, ***Algeria: Contemplating a Nuclear Weapon Option?***, (Mc***l***ean, VA: Science Applications International Corporation,), 25 March 1995.

349 Elaine Sciolino and Eric Schmitt, "Algerian Reactor Came from China," ***The New York Times***, 14 November 1991, p. A1.

350 Mark Hibbs, "Bonn Will Decline Teheran Bid To Resuscitate Bushehr Project" *Nucleonics Week*, 2 May 1991, pp. 17-18.

351 In the early stages of Iraq's nuclear weapons program, calutrons were used to enrich uranium but this method was abandoned because it was highly inefficient; Iraq then turned its energies toward the gas centrifuge program.

352 Gary Milhollin and Gerard White, ***Bombs From Beijing: A Report On China's Nuclear And Missile Exports***, (Washington, DC: The Wisconsin Project on Nuclear Arms Control, May 1991), p. 17.

353 For details on Chinese nuclear exports to Pakistan in the 1980s, see the biannual series of books by Leonard Spector listed in note 2. Also see R. Jeffrey Smith, "US Aides See Troubling Trend in China-Pakistan Nuclear Ties," The ***Washington Post***, 1 April 1996. Smith's article importantly points out that Sino-Pakistani nuclear cooperation was a two-way street. Chinese scientists benefited from Pakistan's advanced gas-centrifuge designs because up to that point China was not able to master gas centrifuge enrichment technology and mainly relied on gaseous diffusion to produce HEU. For reports on tritium exports to Pakistan, see Mark Hibbs, "Pakistan Rebuts Proliferation Charge, But Germans Step Up Investigation," ***Nuclear Fuel***, 3 April 1989.

354 Zhu Mingquan, "The Evolution of China's Nuclear Nonproliferation Policies," ***The Nonproliferation Review***, Winter 1997; Hu Weixing. "China's Nuclear Export Controls: Policy and Regulations," ***The Nonproliferation Review***, December 1994, pp. 3-9.

355 This discussion of the early years of China's arms control community is based on extensive discussions with Chinese Foreign Ministry officials, both active and retired. For a discussion of the growth of China's arms control community, see Alastair Iain Johnston, "Learning Versus Adaptation: Explaining Change in Chinese Arms Control Policy in the 1980s and 1990s," ***The China Journal***, January 1996; ***Individuals, Institutions, and Policies in the Chinese Nonproliferation and Arms Control Community,*** Conference Report**,** East Asia Nonproliferation Project, (Monterey, CA: Center for Nonproliferation Studies, 1997).

356 Mark Hibbs, "Sensitive Iran Reactor Deal May Hinge On MFN For China," *Nucleonics Week*, 1 October 1992, pp. 5-6; Steve Coll, "US Halted Nuclear Bid By Iran," ***The Washington Post***, 17 November 1992, p. A1.

357 R. Jeffrey Smith, "China in Rebuff to US, Defends Its Nuclear Dealings with Iran," ***The Washington Post***, 18 April 1995, p. 13; Steven Mufson, "China Says It Sees No Reason to Halt Plan to Sell Nuclear Rector to Iran," ***The Washington Post***, 18 May 1996, p. 22. For information on the UF6 facility, see R Jeffrey Smith, "China Nuclear Deal with Iran is Feared," ***The Washington Post***, April 17, 1995, p. A1; Bill Gertz, "Iran Gets China's Help on Nuclear Arms," *The Washington Times*, 17 April 1996, p. A1.

358 The White House, Office of the Press Secretary, "Press Briefing by Secretary of State Madeleine Albright and National Security Advisor Sandy Berger," 29 October 1997; R. Jeffrey Smith, "China's Pledge to End Iran Nuclear Aid Yields US Help," ***Washington Post***, 30 October 1997, p. 1; Mark Hibbs and Michael Knapik, "China Agrees to End Nuclear Trade with Iran When Two Projects Completed," ***Nuclear Fuel***, 3 November 1997, pp. 3, 4.

359 The most recent report was submitted to Congress in February 1999 and surveyed proliferation developments in the first half of 1998. ***Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions: 1 January Through 30 June 1998***, The Nonproliferation Center, Directorate of Central Intelligence, Central Intelligence Agency, 9 February 1999.

360 For Chinese assistance to the Khushab facility, see Leonard S. Spector, et al***., Tracking Nuclear Proliferation, 1995: A Guide in Maps and Charts***, (Washington, DC: The Carnegie Endowment for International Peace, 1995), p. 49; Bill Gertz, "Beijing Flouts Nuke-Sales Ban," ***The*** *Washington Times*, 9 October 1996, pp. A1, A9; R. Jeffrey Smith, "China Sold Nuclear Items Before Vow," ***The Washington Post***, 10 October 1996, p. A38

361 Rodney W. Jones, et al., ***Tracking Nuclear Proliferation: A Guide in Maps and Charts, 1998***, (Washignton, DC: Carnegie Endowment for International Peace, 1998), pp. 52-53.

362 "China and Pakistan Discuss US Demarche on Nuclear Assistance," classified CIA memorandum, 14 September 1996, released as an addendum in Bill Gertz, ***Betrayal***, (Washington, DC: Regnery Publishers, 1999), pp. 266-267.

363 The official Chinese statements about the magnet deal were somewhat contradictory. Officials from China's National Nuclear Corporation admitted in an early April statement that the magnets were exported but that the deal did not constitute a proliferation risk. By contrast, the Foreign Ministry vehemently denied that the sale had ever occurred. See Vivian Pik-Kwan Chan, "Nuclear Sales Talks Bid to Stop Sanctions," ***The South China Morning Post***, 3 April 1996.

364 China is still not a member of the NSG because joining the regime would require China to end all of its nuclear cooperation with Pakistan such as the 300 MWe reactor project. The NSG requires all members to pledge not to export any controlled nuclear items to nonnuclear weapon states that have not placed full-scope safeguards on at its nuclear facilities. Chinese officials have unofficially stated that China will join the NSG when the Chasma power reactor project in Pakistan is complete but they maintain that China's membership in the NSG is a nominal step because China has already incorporated the NSG control lists into its domestic export control laws.

365 Conversations with US officials, Washington, DC, July and September 1999.

366 See Appendix II.

367 In one incident, an Iranian patrol craft hit two ships operating under US flag using Chinese-supplied Silkworm missiles. For details, seeR. Bates Gill, ***Chinese Arms Transfers: Purposes, Patterns and Prospects in the New World Order*** (Westport, CT: Praeger Publishers, 1992); Richard Bitzinger, "Arms To Go: Chinese Arms Sales to the Third World," ***International Security***, Fall 1992.

368 For the origins of the DF-3 sale, see Lu Ning, ***The Dynamics of Foreign-Policy Decision-making in China***, (Boulder, CO: Westview Press, 1997,) p. 113-117; John W. Lewis, Hua Di, and Xue Litai, "Beijing's Defense Establishment: Solving the Arms-Export Enigma," ***International Security***, Spring 1991. These two sources differ about the internal debates leading up to the DF-3 sale. Lu Ning argues that the Foreign Ministry supported the deal, whereas Lewis argues the Foreign Ministry opposed it and that Deng Xiaoping made the final decision. For an assessment of the implications of the deal, see Yitzhack Shichor, ***East Wind Over Arabia: Origins and Implications of the Sino-Saudi Missile Deal***, China Research Monograph No. 35, Institute of East Asian Studies, (Berkley, CA: University of California, Berkley, 1989).

369 Gordon Jacobs and Tim McCarthy, "China's Missile Sales--Few Changes For The Future," ***Jane's Intelligence Review***, December 1992, p. 562; for an analysis of the motivations for China's M-9 and M-11 exports, see Hua Di, "China's Case: Ballistic Missile Proliferation," in William C. Potter and Harlan W. Jencks (eds.), ***The International Missile Bazaar***, (Boulder, CO: Westview Press, 1995.)

370 Statement by Tom Lantos, Chairman, Subcommittee on International Security, International Organizations and Human Rights, 20 May 1993.

371 "Syria, Iran Want to Buy China's M-9," ***Flight International***, 22 January 1992, p. 18.

372 Gordon Jacobs and Tim McCarthy, "China's Missile Sales--Few Changes For The Future," ***Jane's Intelligence Review***, December 1992, p. 561; "Iran Now Top Threat In Region," *The Washington Times*, 30 May 1991, pp. A1, A11.

373 testimony of Dr. Gordon Oehler, Hearing on The Proliferation of Chinese Missiles, Senate Foreign Relations Committee, US Senate, 11 June 1998. Some sources suggest that the November 1992 M-11 shipment was in retaliation for Bush's fall 1992 decision to sell F-16s to Taiwan; yet there is still not sufficient information to make such a determination.

374 Private discussion with James Baker III, London, October 1998. For a public acknowledgment by Baker that the M-11 was not covered in China's 1991 MTCR pledge, see James Mann***, About Face: A History of America's Curious Relationship with China from Nixon to Clinton***, (New York, NY: Alfred A. Knopf, Inc.), p. 271.

375 Barbara Opall, "US Queries China on Iran," ***Defense News***, 14-25 June 1995; Elaine Sciolino, "CIA Report Says Chinese Sent Iran Arms Components," ***New York Times***, 21 June 1995.

376 testimony of Dr. Gordon Oehler , Hearing on Proliferation of Chinese Missiles, Senate Foreign Relations Committee, US Senate, 11 June 1998; Bill Gertz, "China Assists Iran, Libya on Missile**,**" *The*

Washington Times , 16 June 1998, pp.1-3.

377 Fred Wehling, "Russian Nuclear and Missile Exports to Iran," ***The Nonproliferation Review***, Winter 1999, p. 134-143; Aaron Karp, "Lessons of the Iranian Missile Programs for US Nonproliferation Policy," ***The Nonproliferation Review***, Spring-Summer 1998, pp. 17-26.

378 China's cruise missile exports to Iran are exempt from MTCR prohibitions, given their short ranges, and this allowed China to broaden and expand its cruise missile exports to Iran. These cruise missile shipments could be banned under the MTCR if China adhered to the 1993 revision of the MTCR guidelines and if these cruise missiles were "intended for the delivery of weapons of mass destruction." In 1993, MTCR members expanded the scope of the guidelines to ban exports of any and all delivery systems that are intended for the delivery of WMD.

379 Bates Gill argues that China sold Iran more than 110 HY-2 missiles in the 1980s, and by the mid-1990s Iran deployed close to 200 C-801 missiles. See R. Bates Gill, ***Chinese Arms Transfers***, ***op. cit***.

380 For details on China's C-802 shipments to Iran, see John Mintz, "Tracking Arms: A Study in Smoke," ***The Washington Post***, 3 April, 1999, p. 3. This press report is based on a set of highly detailed, classified intelligence documents that outline the scope of Sino-Iranian cruise missile cooperation, especially regarding China's production assistance to Iran for the C-802 missile. These documents were made available by the National Security News Service in Washington, DC; the author surveyed these intelligence documents in preparing this article.

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389 ***Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions**, **op. cit***.

390 Evan S. Medeiros and Bates Gill, ***Chinese Arms Exports: Policy, Players and Process***, East Asia Nonproliferation Project, Occasional Paper, (Monterey, CA: Center for Nonproliferation Studies, July 1999.)

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392 testimony of Robert Gates to Hearing on The International Security Environment Over the Next Decade, Committee on Armed Services, US Senate, 22 January 1992.

393 Shirley A. Kan, ***Chinese Proliferation of Weapons of Mass Destruction: Background and Analysis***, Congressional Research Service, Library of Congress, 13 September 1996, p. 37.

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Denies Report of Chemical Arms Shipment from China," ***Agence France-Presse***, 27 May 1998.

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406 Director of Central Intelligence, "The Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, July-December 1996," June 1997.

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418 John Wilson Lewis and Xue Litai, ***China Builds the Bomb*** (Stanford, CA: Stanford University Press, 1988), pp. 215-216, Lewis (1980), p. 149.

419 This charge has been rejected by most outside observers, however. For Chinese views on the alleged use of chemical weapons against Chinese forces during the Korean war, see Wang Qiang and Yang Qingzhen, eds., ***Wuqi yu Zhanzheng Jishi Congshu: Huaxue Wuqi Zhanzheng*** (Action Report Book Series on Weapons and War: Chemical Weapons and Warfare), Number 14, Guofang Gongye Chubanshe, Beijing, 1997, pp. 128-135. I am indebted to Eric Cotter for drawing my attention to this source.

420 The nearby deployment of tactical WMD capabilities by the superpowers became increasingly important from the late sixties onward, as discussed below.

421 See, for example, ***China: Arms Control and Disarmament***, Information Office of the State Council of the People's Republic of China, Beijing, November 1995; and ***China's National Defense***, Information Office of the State Council of the People's Republic of China, Beijing, July 1998. We should also point out that, for some Chinese, the complete prohibition of weapons of mass destruction would serve to increase the relative leverage exerted by China's large conventional forces in a political or military crisis near China's borders.

422 "China's Nuclear Exports" and "Nuclear Nonproliferation Treaty (NPT)," from the database of the Center for Nonproliferation Studies, Monterey Institute of International Studies, at http://cns.miis.edu/. These sources also point out that China continues to state that it does not view nonproliferation as an end in itself, but rather as a means to the ultimate objective of the complete prohibition and destruction of nuclear weapons.

423 ***China: Arms Control and Disarmament***, Information Office of the State Council of the People's Republic of China, Beijing, November 1995; Statement by the Chinese Ministry of Foreign Affairs on the Yinhe Incident, September 4, 1993; Statement by the Chinese Government upon signature of the Chemical Weapons Convention (CWC), January 13, 1993; Letter from Chinese Foreign Minister Wu Xueqian to US Secretary of State George Shultz on China's accession to the Biological Weapons Convention (BWC), November 16, 1984; Explanation by the Government of the People's Republic of China on its Observance of the Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, BWC/CONF.III/3/Add., January 1991.

424 For a summary of China's participation in arms control regimes, see Michael D. Swaine and Alaistair

I. Johnston, "China and Arms Control Institutions," in Elizabeth Economy and Michel Oksenberg, eds., ***China Joins the World: Progress and Prospects***, Council on Foreign Relations, New York City, 1999, pp. 90-135.

425 Lewis and Xue (1988), p. 36. Also see "Traditional Military Thinking and the Defensive Strategy of China," An address at the US Army War College by Lt. Gen. Li Jijun, Vice President of the Academy of Military Science, The Chinese People's Liberation Army, Letort Paper No.1, August 29, 1997.

426 Indeed, some Chinese strategists apparently believe that nuclear weapons will become increasingly important for medium-sized nuclear states like China, given supposedly inherent contradictions between the interests of such states on the one hand and US hegemony and its vision of a new world order on the other. See Alaistair Iain Johnston, "China's New 'Old Thinking': The Concept of Limited Deterrence," ***International Security***, Vol. 20, No.3 (Winter 1995-96), p. 10.

427 Lewis and Xue (1988), p. 70.

428 Johnston (Winter 1995-96), p. 8.

429 "China's Nuclear Doctrine," from the database of the Center for Nonproliferation Studies, Monterey Institute of International Studies, at http://cns.miis.edu/. Also see Bates Gill and James Mulvenon, "The Chinese Strategic Rocket Forces: Transition to Credible Deterrence," paper prepared for a seminar on China and Weapons of Mass Destruction sponsored by the National Intelligence Council and the Federal Research Division of the Library of Congress, Washington, DC, November 5, 1999, especially pp. 5-6.

430 Lewis and Xue (1988), p.216.

431 See "China's Nuclear Doctrine," from the database of the Center for Nonproliferation Studies, Monterey Institute of International Studies, at http://cns.miis.edu/.

432 See China's National Statement on Security Assurances, April 5, 1995. China has also called on all nuclear powers to issue unconditional NFU pledges, and to issue negative and positive security assurances to the non-nuclear weapons states, to support the development of nuclear-free zones, to withdraw all nuclear weapons deployed outside national territories, and to halt the arms race in outer space. See China's Instrument of Accession to the Nonproliferation Treaty (NPT), March 11, 1992.

433 Jonathan D. Pollack, "The Future of China's Nuclear Weapons Policy," in John C. Hopkins and Weixing Hu, eds., ***Strategic Views From the Second Tier: The Nuclear Weapons of France, Britain, and China*** (New Brunswick: Transactions Publishers, 1995), pp.157-165; Shen Guofang, PRC Policy: No First Use of Nuclear Weapons, Xinhua, October 13, 1999; China's National Statement on Security Assurances, April 5, 1995; "On Effective International Agreements to Assure Non-Nuclear-Weapons States against the use or Threat of Use of Nuclear Weapons," Chnese working paper to the Conference on Disarmament, April 16, 1982.

434 In particular, the Chinese oppose the doctrine of "Mutual Assured Destruction" (known as MAD) employed by the United States and the former Soviet Union. The MAD doctrine relied on the offensive deployment of huge numbers of nuclear weapons by both sides as part of a supposed "warfighting" approach to nuclear deterrence. See Malik J. Mohan, "Chinese Debate on Military Strategy: Trends and Portents," ***Journal of Northeast Asian Studies***, Volume 9, Summer 1990, p. 21.

435 For a Chinese military assessment that other states are continuing to develop chemical weapons, see Johnston, (Winter 1995-96), p. 9.

436 "China and Chemical and Biological Weapons (CBW) Nonproliferation," from the database of the Center for Nonproliferation Studies, Monterey Institute of International Studies, at http://cns.miis.edu/.

437 Office of the Secretary of Defense, ***Proliferation: Threat and Response***, Washington, DC, April 1996, p. 9, and November 1997 (online version).

438 See "Chemical Weapons Convention (CWC)," and "China and Chemical and Biological Weapons (CBW) Nonproliferation, from the database of the Center for Nonproliferation Studies, Monterey Institute of International Studies, at http://cns.miis.edu/.

439 "Adherence to and Compliance With Arms Control Agreements," U.S. Arms Control and Disarmament Agency, Washington, DC, 1997.

440 US officials have stated their concern that a suspected Taiwan biological weapons program (dating from the 1970s) may have acted to encourage a Chinese program. See "China and Chemical and Biological Weapons (CBW) Nonproliferation," from the database of the Center for Nonproliferation Studies, Monterey Institute of International Studies, at http://cns.miis.edu/.

441 For many Chinese, such action would not constitute a violation of the NFU principle, given the assumption of an imminent attack.

442 Lewis (1980), p. 164. Also see Johnston, (Winter 1995-96), p. 16.

443 Lewis (1980), p. 150.

444 For an excellent overview of China's nuclear weapons assistance to Pakistan see Evan S. Medeiros, "The Changing Character of China's WMD Proliferation Activities," a paper prepared for a seminar on China and Weapons of Mass Destruction sponsored by the National Intelligence Council and the Federal Research Division of the Library of Congress, Washington, DC, November 5, 1999, especially pp. 3-5.

445 See "China's Nuclear Exports," from the database of the Center for Nonproliferation Studies, Monterey Institute of International Studies, at http://cns.miis.edu/.

446 Lewis and Xue (1988), pp. 12, 14-15, 34, 195.

447 ***Ibid***., (1988), pp. 66, 215-216; Lewis (1980), p. 153.

448 Lewis and Xue (1988), p.210. Also see Alice Langley Hsieh, ***Communist China's Strategy in the Nuclear Era*** (Englewood Cliffs, NJ: Prentice-Hall, 1962); and Chong-pin Lin, ***China's Nuclear Weapons Strategy: Tradition within Evolution*** (Lexington, MA: Lexington Books, 1988).

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450 Lewis (1980), pp. 150-152, 156.

451 Lewis and Xue (1988), pp. 191-192.

452 ***Ibid***., (1988), p. 211.

453 Lewis (1980), p. 151.

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456 Michael D. Swaine and Alistair I. Johnston, "China and Arms Control Institutions," in Elizabeth Economy and Michel Oksenberg, eds., ***China Joins the World: Progress and Prospects***, Council on Foreign Relations, New York City, 1999, pp. 118-120.

457 Evan S. Medeiros, November 5, 1999.

458 Lewis and Xue (1988), p. 217.

459 Litai Xue, (1995). Also see Robert S. Wang, "China's Evolving Strategic Doctrine," ***Asian Survey***, Volume 24, 1984, University of California, Berkeley, CA, pp. 1044-1051.

460 David Shambaugh, "The Insecurity of Security: The PLA's Doctrine of Threat Perception Toward 2000," ***Journal of Northeast Asian Studies***, Vol.XIII, No.1, Spring 1994, pp. 3-15.

461 For a representative example of the Chinese response to the Kosovo War, see Chi Shulong and Wang Zaibang, "Thoughts on International Situation and China's Response," ***Contemporary International Relations***, China Institute of Contemporary International Relations, Beijing, China, Vol. 9, No. 9, September 1999, pp. 1-24.

462 For a presentation of several Chinese strategists' views on the need for a variety of theater and tactical nuclear weapons, see Johnston, (Winter 1995-96), pp. 26-29.

463 Godwin, Paul H. B., "Changing Concepts of Doctrine, Strategy, and Operations in the People's Liberation Army 1978-87," ***The China Quarterly,*** No. 112, December 1987, pp. 573-590.

464 The deficiencies of the Chinese Air Force are discussed in detail in Kenneth W. Allen, Glenn Krumel, and Jonathan Pollack, ***China's Air Force Enters the 21st Century***, RAND Project Air Force, 1995.

465 For a general discussion of Chinese views toward ballistic missiles, see John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," ***International Security***, Vol. 17, No. 2 (Fall 1992).

466 See "China's Missile Exports," from the database of the Center for Nonproliferation Studies, Monterey Institute of International Studies, at http://cns.miis.edu/. As this source points out, China has argued that if one type of delivery system, such as ballistic missiles, is to be restricted, then other delivery systems, such as combat aircraft, should also be restricted.

467 Robert Norris, Andrew Burrows, Richard Fieldhouse, ***Nuclear Weapons Databook, Volume Five: British, French, and Chinese Nuclear Weapons*** (Boulder, CO: Westview Press, 1994).

468 Johnston, (Winter 1995-96), pp. 5-6, 17-23. As Johnston points out (p. 19), some Chinese strategists argue that "a limited deterrent should be able to respond to any level or type of attack from tactical to strategic, and the initial response should be calibrated to the scope of the initial attack. Limited deterrence thinking appears to entertain war-winning possibilities."

469 Alaistair Iain Johnston, "Prospects for Chinese Nuclear Force Modernization: Limited Deterrence Versus Multilateral Arms Control," ***The China Quarterly***, June 1996, pp. 552-558. Also see Johnston, (Winter 1995-96), p. 6.

470 See "China's Nuclear Doctrine," from the database of the Center for Nonproliferation Studies, Monterey Institute of International Studies, at http://cns.miis.edu/.; Johnston, (Winter 1995-96), pp. 5-42.

471 An additional impetus toward such an expansion in China's WMD capabilities could also result from a significant enlargement of India's nuclear capabilities.

472 As Iain Johnston points out, some Chinese military strategists consider space one of China's "strategic frontiers" and are "seriously concerned about the need to incorporate space satellites and weapons into China's nuclear and conventional operational doctrines." Alaistair Iain Johnston, (Winter 1995-96), p.24.

473 According to Department of Defense ***Joint Publication 3-01.5***, "***theater missile*** applies to ballistic missiles, cruise missiles, and air-to-surface missiles whose targets are within a given theater of operation." This term generally does not apply to shorter-range systems such as Maverick and Harpoon.

474 Wang Xuejin and Zhang Huaibi, "Didi Changgui Daodan Budui Zuozhan Zhidao Sixiang Fenxi," (Analysis of Conventional Surface-to-Surface Missile Operations Guiding Thought) in ***Lianhe Zhanyi Yu Junbingzhong Zuozhan***, (Joint Theater and Service Operations) Beijing: National Defense University Press, 1998, pp. 223-227.

475 Nan Shih-yin, "Inside Story of Enlarged Central Committee Meeting," Hong Kong ***Kuang Chiao Ching***, 16 Jan 96, in FBIS-CHI-96-027; also see Jen Hui-wen, "Latest Trends in China's Military Revolution," in Hong Kong ***Hsin Pao*** (Hong Kong Economic Journal), 9 Feb 96, in FBIS-CHI-96-047; for other comments on lessons from the Gulf War, see Ho Po-shih, "The Chinese Military Is Worried About Lagging Behind in Armament," Tangdai, 9 Mar 91, pp. 17-18.

476 Liang Zhenxing, "New Military Revolution and Information Warfare," ***Zhongguo Dianzi Bao*** (China Electronic News), 24 Oct 97, p. 8, in FBIS-CHI-98-012.

477 According to ***Joint Pub 1-02***, air superiority is "that degree of dominance in the air battle of one force over another which permits the conduct of operations by the former and its related land, sea, and air forces at a given time and place without prohibitive interference by the opposing force."

478 For one of the best overviews of these doctrinal shifts, see Nan Li, "The PLA's Evolving Warfighting Doctrine, Strategy and Tactics, 1985-95: A Chinese Perspective," in ***China Quarterly***, July 1995, pp. 443-463; and Nan Li, "The PLA's Evolving Campaign Doctrine and Strategies," in James C. Mulvenon and Richard H. Yang, ***The People's Liberation Army in the Information Age***, RAND: Washington, DC, 1999, pp. 146-172. For more detail, see Liu Mingtao and Yang Chengjun, ***Gaojishu Zhanzhengzhong de***

Daodanzhan, (Missile War Under High-Tech Conditions), Beijing: NDU Press, 1993, pp. 5-26; Also see Li Qingshan, ***Xin Junshi Geming Yu Gaojishu Zhanzheng*** (New Military Revolution and High-Tech Warfare), Beijing: AMS Press, 1995; Liu Senshan and Jiang Fangran, ***Gaojishu Jubu Zhanzheng Tiaojianxia de Zuozhan (Operations Under High-Tech Local War Conditions)***, Beijing: AMS Press, 1994, pp. 13-33.; and Senior Colonels Huang Xing and Zuo Quandian, "Operational Doctrine for High Tech Conditions," ***Zhongguo Junshi Kexue*** (China Military Science), 20 Nov 96, pp. 49-56, in FBIS-CHI-97-114.

479 Senior Col. Jiang Lei, ***Xiandai Yilie Shengyou Zhanlue*** (***Modern Strategy of Pitting the Inferior Against the Superiority***), Beijing: NDU Press, 6-49. Senior Col. Jiang is one of the few PLA officers awarded a Ph.D. in Operations Research from AMS. He is currently assigned to AMS Strategic Studies Department; on the pre-emptive strike concept, see Lu Linzhi, "Pre-emptive Strikes Endorsed for Limited High-Tech War," ***Jiefangjun Bao***, 14 Feb 96, in FBIS-CHI-96-025. Among numerous references, see, for example, Wang Pufeng, ***Xinxi Zhanzheng yu Junshi Geming*** (Information Warfare and the Military Revolution), Beijing: AMS Press, 1995.

480 With air and sea superiority, some of more seemingly outlandish scenarios for an amphibious invasion, such as the large-scale use of PLA commercial fishing vessels, become more feasible.

481 For a summary of Chinese writings on perceived US weaknesses, see Dr. Michael Pillsbury, ***Dangerous Chinese Misperceptions: The Implications for DoD***, Prepared for Office of Net Assessment, 1998.

482 See Desmond Ball, "Signals Intelligence in China," ***Jane's Intelligence Review***, 1 Aug 95, pp. 365-375; and Robert Karniol, "China Sets Up Border SIGINT Bases in Laos," Jane's ***Defense Weekly***, 19 Nov 94, p. 5.

483 China Aerospace S&T Corporation (CASC), directed by Wang Liheng, is an offshoot of the former China Aerospace Corporation. The new organization adopted the former's CALT (1st Academy); the 4th Academy; CAST (5th Academy); SAST (8th Academy); 062 Base; and the 067 Base. The China Aerospace Electromechanical Group (***Hangtian Jidian Jituan***) includes the Second and Third Academies and the 61 and 66 Bases.

484 There seems to be a debate within the PLA on control of China's future space architecture, pitting GAD against the Second Artillery. See Sen. Col. Ping Fan and Capt. Li Qi, "A Theoretical Discussion of Several Matters Involved in the Development of Military Space Forces," ***Zhongguo Junshi Kexue***, 20 May 97, pp. 127-131, in FBIS-CHI-97-0302.

485 This conclusion is drawn from ONI's 1994 study, "Chinese Space-Based Remote Sensing Programs and Ground-Based Processing Capabilities," discussed in Jefferey Richelson, "Navy Says China Poised To Close Space-Intel Gap," ***Defense Week***, 24 Feb 97, p. 9.

486 ***Ibid***. Weather satellites are also an important sensor but are beyond the scope of this study.

487 Data collected by China's airborne SAR remote sensing platform can be transmitted real time to a ground station that is within 120 km of the aircraft. A tactical ground-processing system equipped with a VSAT terminal can then transmit the data to a command center. See "Remote Sensing Technical Systems for Reducing Flood Disasters," ***Yaogan Kexue Xin Jinzhan***, Apr 95, in FBIS-CST-96-002; and Xu

Guanhua and Guo Huadong, "Progress, Mission of Remote Sensing Research," ***Yaogan Kexue Xin Jinzhan*** (New Progress of Remote Sensing Science), Apr 95, in FBIS-CST-96-002.

488 The HY-1 is a small satellite that will based upon the CAST986 bus. The CAST986 is an inexpensive common-use bus will be used for a range of other satellites to include the SJ-5 experimental satellite, a constellation of electro-optical satellites, a generation-after-next navigation satellite constellation, and a tactical SATCOM system. The 863 Program includes a special budgeting mechanism for R&D in seven key technology areas. The PLA is responsible for oversight of space and laser components of the 863 Program. The specific designation of the national SAR effort is the 863-308 program that also includes a near-real-time electro-optical satellite system. The airborne system was tested on board a US space shuttle mission (SIR-C). See Wang Wei, "State S&T Organs Approve Design of Spaceborne Synthetic Aperture Radar," ***Zhongguo Kexue Bao*** (***China Science News***), 3 May 95, in FBIS-CST-95-010; "Woguo Xingzai Hecheng Kongjing Leida Yingyong Yanjiu Qude Zhongda Jinzhan, (China's Satellite SAR Applied Research Achieves Tremendous Advances), ***Zhongguo Hangtian***, Feb 96, p. 16; "Spaceborne-SAR Modern Information Technology Highlighted," ***Zhongguo Kexue Bao***, 20 Sep 96, p. 4, in FBIS-CST-96-020; Yuan Xiaokang, "High Speed Data Transmission of Satellite-borne SAR," ***Zhidao Yu Yinxin*** (Guidance and Detonators), 1995(4), pp. 8-14. (509th RI), summarized in China Astronautics and Missilery Abstracts (CAMA), Vol. 4, No.4. Also see Yuan Xiaokang, "Performance Parameters and Design Requirements of Satellite SAR," in ***Shanghai Hangtian***, 1996 (3), pp. 12-18; and Long Zhihao,. "Application of Radar Satellites," ***Aerospace China***, Nov 91, p. 29. Li Yudong, "Satellite-borne Radar Reconnaissance," ***New Electronic Warfare Technology and Intelligence Reform Studies Abstracts,*** 1995.10, pp. 126-133. Li is from the Southwest Institute of Electronic Equipment (SWIEE). For comments on preliminary research on the second-generation SAR satellite, see "China's Microwave-Imaging Radar Systems Engineering Highlighted," ***Zhongguo Kexue Bao***, 20 Sep 96, p. 4, in FBIS-CST-96-020.

489 Long Zhihao, "Leida Weixing de Yingyong" (Applications of Radar Satellites), ***Zhongguo Hangtian***, Nov 91, pp. 29-31; Zhang Wanzeng, "Weixing Hecheng Kongjing Chengxiang Leida de Tedian Jiqi Zai Junshi Zhenchazhong de Yingyong" (Applications and Characteristics of Satellite SAR for Military Reconnaissance), ***Zhongguo Hangtian***, Nov 93, pp. 20-22. Zhang Wanzeng is assigned to the PLA GSD Second Department's Technology Bureau. Huang Weigen, Zhou Changbao, and Wan Zhongling, "Woguo Xingzai SAR Haiyang Yingyong de Xianzhuang yu Xuqiu," (Current State and Requirements of China's Satellite-borne SAR for Maritime Applications), in ***Zhongguo Hangtian***, Dec 97, pp. 5-9. China began exploration of space-based SAR systems for antisubmarine warfare purposes in the 8th Five-Year Program (1991-1996). As a side note, a US Los Alamos employee under contract for TRW was arrested in May 1999 for providing the Chinese information on a classified project he was working on with regards to SAR satellite imaging of submarines.

490 See Stokes, ***China Strategic Modernization,*** p. 26.

491 ***Ibid***, p 22.

492 The US and the Soviet Union attained a near-real-time capability in 1976 and 1982, respectively.

493 Jean Etienne, "Les Nouveaux Projets de L'Asie Spatiale," in ***Space News***, No. 110, 4 Nov 96, at http://www.sat-net.com/space-news. Also see Chou Kuan-wu, "China's Reconnaissance Satellites," ***Kuang Chiao Ching***, 16 Mar 98, pp. 36-40, in FBIS-CHI-98-098.

494 China's remote-sensing program is funded at least in part by the 863 Program, specifically the 863-308 project. Hong Mei, "Tactical Application Satellite Imagery System," ***Hangtian Fanhui Yu Yaogan*** (Spacecraft Recovery and Remote Sensing), 1995, Vol. 16, No.1, pp. 30-33, in CAMA, Vol. 2, No. 5. A 700-km orbit optimizes coverage at the expense of resolution--a lower orbit naturally will increase the resolution. See "China To Launch Ten More Satellites by 2000," ***Xinhua***, 22 Feb 98, in FBIS-CHI-98-053.

495 These concepts has been closely examined and strongly advocated by the space and missile industry. See Zhang Dexiong, "Guowai Xiaoxing Weixing de Guti Huojian Tuijin Xitong" (Solid Rocket Propulsion Systems for Foreign Small Satellites), in ***Hangtian Qingbao Yanjiu***, HQ-93011, pp. 139-155; Wang Zheng, "Screening Studies and Technology for All-Solid Space Launch Vehicles," ***Guti Huojian Fadongji Sheji Yu Yanjiu*** (Solid Rocket Engine Design and Research), Apr 1996, pp. 63-73, in ***CAMA***, 1996, Vol. 3, No. 6; and Zhang Song, "Design and Optimization of Solid Launch Vehicle Trajectory," ***Guti Huojian Jishu***, 1997, 20 (1), pp. 1-5; and Zhang Dexiong, "China's Development Concept for Small Solid Launch Vehicles," CASC Fourth Academy Information Research Reports, the Fourth Edition, October 1995, pp. 1-11, in ***CAMA***, Vol. 5, No. 2.

496 Mao Genwang and Wang Liang, "Weixing de Junshi Yingyong Tedian, Fazhan Xianshi yu Yingyong Qianjing" (Military Satellites and their Prospects for Development), ***Zhongguo Hangtian***, May 92, pp. 33-53.

497 Mao Genwang and Wang Liang, "Weixing de Junshi Yingyong Tedian, Fazhan Xianshi yu Yingyong Qianjing" (Military Satellites and their Prospects for Development), ***Zhongguo Hangtian***, May 92, pp. 33-53.

498 Jefferey Richelson, "Navy Says China Poised To Close Space-Intel Gap," ***Defense Week,*** 24 Feb 97, p. 9.

499 Mei Lin, PLA Methods of Operations Assessed," ***Chung Kung Yen Chiu***, 15 Nov 97, No. 371, pp. 50-60, in FBIS/China, 3/10/98.

500 Chang Jijun, "Remote Sensing Image Data Compression and Its Performance Evaluation," ***Kongjian Jishu Qingbao Yanjiu***, Jul 1994, pp. 37-54.

501 *"*Wo Weixing Yaogan Tuxiang Shuzihua Shebei Shijie Lingxian" (Our Satellite Remote Sensing Digitized Imagery Equipment Leads the World), ***Zhongguo Hangtian***, Jan 96, p. 39; also see "China's Satellite Remote Sensing Image Digitization Equipment Meets Advanced International Standards," ***Keji Ribao***, 26 Oct 95, in FBIS-CST-96-002.

502 *"*China To Use Italian Software to Interpret Imagery," ***Space News***, 2-8 Mar 92, p. 23. Two other Chinese organizations involved in the project include China's Research Institute for Surveying and Mapping and the National Laboratory of Resources and Environmental Information Systems. Peng Yiqi, a senior engineer at the National Remote Sensing Center, led the Chinese negotiations.

503 China is working toward the development of data relay satellites (***shuju zhongji weixing***). China signed agreements with France (1993) and Chile (1994) for joint use of their ground stations. Seeking to transmit imagery directly to theater and field commanders, China's remote-sensing community has also begun to explore development of mobile remote-sensing ground stations. On China's data relay satellite

program, see Zhang Wanbin, "Spaceflight Development Strategy: Mid-Long Term Development Strategy, ***Zhongguo Keji Luntan*** (Forum on Science and Technology), Nov 92, pp. 9-12, in JPRS-CST-93-002; and Cheng Yuejin, "Information Transmission System of Data Relay Satellites," ***Space Technology Information Research***, 1993 in ***CAMA***, 1994, Vol. 1, No. 6. On China's contracting for access to French, Kiribat, and Chilean ground stations, see Wang Chunyuan, ***China's Space Industry and Its Strategy of International Cooperation,*** Stanford University, July 1996, p. 4. LTC Wang serves on the senior staff of COSTIND's foreign affairs bureau. On mobile ground station acquisition, see Wang Mingyuan, "Mobile Remote Sensing Ground Stations," ***Kongjian Dianzi Jishu*** (Space Electronic Technology), 1997 (2), pp. 32-37 in ***CAMA***, 1997, Vol. 4, No. 6. One of the first US mobile imagery ground station, EAGLE VISION, entered the inventory in 1995. China has expressed interest in acquiring a foreign EAGLE VISION-like system from either US or French vendors.

504 ***Dragon in Space***, 24 Jul 99. Its data rate is about 150-300 Mb/s. SWIET is the major tracking and telemetry systems provider for the Chinese space program.

505 As of 1997, the State space budget was about $100 million, or 0.035 percent of the overall GNP.

506 "Luan Enjie Fuzongjingli Tan Hangtian Zhiliang," (Vice-General Manager Luan Enjie Discusses Space Quality), ***Zhongguo Hangtian Bao*** (***China Space News***), 21 Mar 94, p.1.

507 China's space community is assessed to have grossed more than $500 million since the first commercial launch in 1990. China signed agreements with Russia for cooperative development in ten areas, including surveillance systems, propulsion, joint design efforts, scientific personnel exchanges, space systems testing, and satellite navigation systems. See "Wang Liheng Fujuzhang Lutuan Fangwen E'Wu Liangguo" (CASC Deputy Director Wang Liheng Leads Delegation to Russian and Ukraine), ***Zhongguo Hangtian Bao***, 11 Apr 94, p.1. Cooperation with France is focused on small satellite development, space tracking, and attitude control systems.

508 ***Ibid***. Mei Lin, "New PLA Methods of Operations Assessed." ***Chung Kung Yen Chiu***, 15 Nov 97, No. 371, pp. 50-60, in FBIS/China, 3/10/98.

509 PLAAF deficiencies are discussed at length in Kenneth W. Allen, Glenn Krumel, and Jonathan Pollack, ***China's Air Force Enters the 21st Century***, RAND Project Air Force study, 1995, p.112-113.

510 Yuan Jun, "Zhanshu Dandao Daodan Weixie yu Fangyu de Jiben Wenti," (Fundamental Problems Associated With Tactical Ballistic Missile Threats and Defense), ***Zhongguo Hangtian***, Nov 98, pp. 35-40.

511 Liu Mingtao and Yang Chengjun, ***Gaojishu Zhanzhengzhong de Daodanzhan*** (***Missile War In High Tech Warfare***), Beijing: NDU Press, 1993, pp. 4-26; and Wang Jixiang, "Inspiration for Chinese Ballistic Missile Development From the Gulf War," ***Hangtian Keji Qingbao Yanjiu Baogao Xilie Wenzhai***, Apr 94, pp. 49-56 in ***CAMA***, Vol. 3, No. 6.

512 ***Report to Congress Pursuant to Section 1305 of the FY97 National Defense Authorization Act***, p. 4. The report states that most of these missiles are likely to be short- or medium-range systems.

513 The $500,000 per missile figure is from Yuen Lin, "Probing the Capability of Taiwan's Antiballistic Missiles," Hong Kong ***Kuang Chiao Ching***, 16 Aug 98, pp. 54-61 in FBIS-CHI-98-252. In comparison, the cost of three MADS batteries with 180 missiles amounts to $850 million. An AEGIS ship runs about $850 million-$1 billion. Taiwan's FY98 defense budget totaled NT 275 billion (US$ 916 million), amounting to 22.43 percent of the national budget. It is important to note, however, that the value of a missile defense system is judged on the basis of what is being defended rather than the costs of the offensive missiles.

514 It should be noted that recent Beijing-affiliated publications out of Hong Kong have resurrected the issue of the DF-25, a 2,000-km-range system that is armed with a 1,700-kg conventional warhead. The DF-25 allegedly utilizes the first two stages of the DF-31 ICBM. However, author's discussions in Beijing during the 1993-94 timeframe indicated that the DF-25 program had been cancelled in favor of the conventional DF-21. The primary difference between the two systems was the warhead size--the nuclear DF-21 had a throw weight of only 600 kg, while the DF-25 was designed to have a 2,000-kg warhead. The DF-25 was first discussed in John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs," ***International Security***, Fall 1992, pp. 5-40. If based at Tonghua (80301 Unit), the DF-25's 1,700-km range would have permitted strikes against the main islands of Japan, but not Okinawa. Assigning the 1,700-km system under the Luoyang base (80304 Unit) would have enabled strikes against all of Taiwan. Lewis and Hua asserted that the DF-25 was intended to defend claims in the South China Sea. However, to range the Spratly Islands, the system would have had to be based on Hainan Island. Past PLA deployment practices indicate that deployment of theater missiles on Hainan Island is not likely since: a) theater missile units are unlikely to stray too far from their established base headquarters; and b) basing on Hainan renders the units vulnerable to strikes.

515 Duncan Lennox, ed. ***Jane's Strategic Weapon Systems***, Issue 24, May 97, Surrey, England: Jane's Information Group.

516 See Edward R. Harshberger, ***Long-Range Conventional Missiles: Issues for Near-Term Development***, RAND: Santa Monica, 1991, p. 142. For an upper range estimate of 60 meters, see Lin Chien-hua, "What Equipment Should Taiwan Use to Defense Itself," ***Taipei Tzu-li Wan-pao***, 9 Nov 97, p. 2, in FBIS-CHI-97-364.

517 George Lindsey, ***The Information Requirements for Aerospace Defense: Limits Imposed by Geometry and Technology***, Bailrigg Memorandum 27, CDISS, Lancaster University, p. 18. If moved closer to the target, the DF-15 most likely would be launched on a lofted trajectory that would increase the flight time outside the atmosphere, thus increasing the missile's vulnerability to upper-tier systems. On the other hand, a lofted trajectory could increase the missile's reentry speed, reducing the footprint, or defended area, of lower tier systems, such as PATRIOT.

518 Zhao Yunshan, ***Zhongguo Daodan Jiqi Zhanlue, Jiefangjun de Hexin Wuqi***, (China's Missiles and Strategy: The PLA's Central Weapon), Hong Kong: Mirror Books, p. 232. Other sources credit the DF-15 with only as good as a 150-meter CEP. See "Missiles! China Has Them Too!," ***Wen Wei Po***, 1 Jun 99, p. A5, in FBIS-CHI-00169, 22 Jun 99.

519 ***Ibid***. Informed sources assert the Mirror (***Mingjing***) series of books have a mixed record of reliability. Zhao states that the expanded range DF-15 incorporates a more advanced propellant. There is often confusing reporting on an unidentified 1,000-km system--the M-18--that may in fact be the rumored extended range DF-15. While an extended range DF-15 can not be confirmed, there certainly could be a motive for developing a conventional theater ballistic missile with a 1,200-km range. First, a

1,200-km-range system would significantly reduce the defended area or "footprint" of land- and sea-based lower tier missile defense systems due to its reentry speed. Because of its existing infrastructure, one could speculate that an extended range DF-15 brigade could be established under the Second Artillery's Huaihua Base (80305 Unit). Huaihua, situated in western Hunan Province, is just over 1,200 km from Taipei. Secondly, a 1,200-km DF-15 fired from a notional site in the area of Nanping in Fujian Province could easily range Kadena AB, Okinawa, and all of the Luzon Strait (Bashi Channel).

520 See the 1999 ***DoD Report to Congress on the Security Situation in the Taiwan Strait.*** It should be noted, however, that foreign sources familiar with the PLA believe that the 300-km DF-11 has already been fielded by at least two PLA ground force group armies. In addition, a 29 Mar 99 edition of ***Jiefangjun Bao*** discusses the conversion of an unidentified Nanjing Military Region artillery unit to an SRBM brigade. The conversion began in early 1997. The author is indebted to Ken Allen for this information.

521 Zhao, p. 234.

522 ***Report to Congress on Theater Missile Defense Options in the Asia-Pacific Region***, Feb 99.

523 The 700-meter CEP is extracted from ***Jane's Strategic Weapons Systems*** 1998. The conversion of the DF-21 from a strictly nuclear mission to a conventional role was reported as early as 1994 in the Chinese journal, ***Guoji Hangkong*** (International Aviation). Initial indications of a terminally guided DF-21 are from discussions between Richard Fisher, who was a Senior Policy Analyst at the Heritage Foundation, and an engineer from CALT's Beijing Research Institute of Telemetry (704th Research Institute) at the 1996 Zhuhai Air Show. Extensive CASC technical writings on terminally guided theater ballistic missiles tend to substantiate the engineer's comments.

524 Zhu Bao, "Di-Di Dandaoshi Zhanshi Daodan de Fazhan Qushi," pp. 9-19. The CEP is the radius of a circle within which 50 percent of missile fired will impact.

525 John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, and Goals," ***International Security***, Fall 1992 (Vol. 17, No. 2), p. 29.

526 Zhu Bao, pp. 9-19. Development of VLSIC and LSIC technology is one of Beijing's highest priorities. In one effort, China has invested RMB 1.39 in the Huajing Group's Project 908 program, which seeks to miniaturize and mass-produce VLSIC/LSICs. China hopes to develop sub-micron VLSICs in the next few years. See Zhang Longquan, "Huajing Group Builds 'Project 908' VSLIC Production Line," ***Jisuanji Shijie***, 8 Jan 96, No. 2, p.1, in FBIS/CHI, 01/08/96. With the help of Project 908, CASC's Ninth Academy would most likely actually produce the application-specific integrated circuits. The Scud-B payload known as the AEROFON uses an optical sensor during the latter stages of flight to detect and home in on a target.

527 Xie Lei, "Technical Research on Millimeter Wave Guidance," ***Aerospace S&T Information Studies Series Abstracts*** (6), pp. 235-250; and Xie Lei, "Application of Millimeter Wave and Infrared Technologies in Weapons Systems," ***Aerospace S&T Information Studies Series Abstracts*** (7), pp. 241-258.

528 Zhu Bao, pp. 9-19.

529 For a summary of test results, see Sun Mei, "GPS For Evaluating Inertial Measurement Unit Errors," in ***Hangtian Congzhi*** (Aerospace Control), 1995, Vol. 13, No. 1, pp. 69-75, ***CAMA***, 1995, Vol. 2, No.4; also see Wang Shuren, "Principles of Onboard GPS Navigation Transponders," in ***Hangkong Dianzi Jishu***, undated, pp. 20-23. Wang is from the Second Artillery's Academy of Engineering.

530 Li Yonghong, "Ballistic Trajectory Determination Using the Differential Global Positioning System," ***Binggong Xuebao***, 1997 18(4), pp. 372-374. DGPS upgrades the civilian GPS signal though a precisely located GPS station that broadcasts a correction signal on a different frequency to other GPS receivers. In addition to military uses, a DGPS reference station is often used for surveying and maritime safety. Reference updates can be transmitted to the missile via a data link. As part of its Ninth Five-***y***ear Plan, China is constructing 20 DGPS stations along its eastern coast, each with a range of 300 km. The positioning accuracy is 5 meters, a marked improvement from the original positioning system's minimum error of 100 meters.

531 See for example, Bill Gertz, ***Betrayal***, Boston: Regnery Press, p. 249.

532 Zhu Bao, "Di-Di Dandaoshi Zhanshi Daodan de Fazhan Qushi" (Developmental Prospects of Surface-to-Surface Tactical Ballistic Missiles), pp. 9-19.

533 ***Lianhe Zhanyi Di Erpaobing Zuozhan*** (PLA Second Artillery Joint Campaign Operations), unpublished manuscript, 1996, p. 11. The document is believed to be an internal PLA academic paper, but its authenticity has not been established. However, a number of sources have corroborated much of the paper's content. For technical studies, see Yang Xiaolong, Wan Chunxi, and Li Xingcheng, "General Technical Research on Use of Strategic Missile Terminal Submunitions for Blocking Airbases," Space/Missile General Information Network Conference Paper (97021), Oct 97; Yu Renshun, Qi Zhanyuan, Yang Xiaolong, "Guidance Law of Terminally Guided Submunitions for Attacking Runways," ***Zhanshu Daodan Jishu***, Feb 1998, pp. 25-31. Authors are from Bejing Ligong Daxue. For a study addressing submunition dispersal problems, see Yan Dongsheng, "Technical Means for Reducing Dispersal of Mini-Warheads," paper presented at the October 1995 Annual Conference on Flight Mechanics. Xu is from CALT's 13th Research Institute, the entity responsible for warhead development. For other studies on use of missiles against airfields, see Yu Renshun, "Research on Terminally Guided Submunitions for Blocking Airfield Runways," paper presented at Nov 97 conference of National Missile Designers Network, in CAMA, Vol. 5, No. 3; Yang Bingwei, "Structural Design Problems and Test Methods of Anti-Runway Penetrators," in ***Aerospace S&T Intelligence Studies Report Series Abstracts*** (5), 1995.5, pp. 288-303; and Liu Jiaqi, "Penetration Technology for Tactical Missile Warheads," ***Aerospace S&T Intelligence Studies Abstracts*** (5), 95 (5), CAMA 96 Vol 3, No. 6; Yang Bingwei, "Test Methods of Antirunway Penetrators," ***Aerospace S&T Information Studies Series Abstracts*** (6), pp. 213-234. Yang Bingwei, from CALT's Beijing Institute of Special Electromachinery (***Beijing Teshu Jidian Yanjiusuo***), is the most prolific technical analyst on runway penetrators. The PLAAF is believed to have already fielded an antirunway submunition cluster bomb.

534 See, for example, Li Xinyi, "On the Air Supremacy and Air Defense of Taiwan and China: Is Taiwan An 'Unsinkable Aircraft Carrier'?," ***Taiwan de Junbei*** (Taiwan Military Preparations), 1 Jul 96, pp. 11-18, in FBIS-CHI-97-323.

535 Gong Jinheng, "High-Powered Microwave Weapons: A New Concept in Electronic Warfare," Dianzi Duikang Jishu, Feb 95, pp. 1-9. Gong is from the Southwest Institute of Electronic Equipment (SWIEE),

China's premier electronic warfare research entity.

536 For a comprehensive overview of the technologies associated with HPM weapons, see Carlo Kopp, "The E-Bomb--A Weapon of Electrical Mass Destruction," in Winn Schwartau, ***Information Warfare***, New York: Thunder's Mouth Press, 1994, pp. 296-297; also see J. Swegle and J. Benford, "State of the Art in High-Power Microwaves: An Overview," paper presented at the Lasers 1993 International Conference on Lasers and Applications, Lake Tahoe, Nevada, 6-10 Dec 1993. Swegle and Benford point out that the US, Russia, France, and the UK have HPM programs in addition to China. Zhu Youwen and Feng Yi, ***Gaojishu Tiaojianxia de Xinxizhan***, (Information Warfare Under High Technology Conditions), Academy of Military Science Press, 1994, pp. 308-310; "Beam Energy Weaponry: Powerful as Thunder and Lightening," ***Jiefangjun Bao***, 25 Dec 95, in FBIS-CHI-96-039; Outlook for 21st Century Information Warfare," ***Guoji Hangkong***, (***International Aviation***), 5 March 1995, in FBIS-CHI-95-114; "Microwave Pulse Generation," ***Qiang Jiguang yu Lizishu***, May 1994, in JPRS-CST-94-014. CAEP's Institute of Applied Electronics, University of Electronic Science and Technology of China, and the Northwest Institute of Nuclear Technology in Xian are three of the most important organizations engaged in the research, design, and testing of Chinese HPM devices. The PRC appears to have mastered at least two HPM power sources--the FCG and vircator. The greatest challenge is the weaponization process.

537 See Liu Shiquan, "A New Type of 'Soft Kill' Weapon: The Electromagnetic Pulse Warhead," ***Hubei Hangtian Jishu***, May 1997, pp. 46-48. Liu is from the Sanjiang Space Industry.

538 Xu Licheng, "Research on Penetration Depth of Projectile Into Thick Concrete Targets," ***Qiangdu Yu Huanjing***, April 1996, pp. 1-7, CAMA, Vol. 3, No.1; Zhu Bao. Xu is from the Beijing Institute of Special Electromechanics; for discussions on negating hardened targets, see Xu Xiaocheng, "Research on Penetration Depth of Projectiles Into Thick Concrete Targets," ***Qiangdu Yu Huanjing***, 1996 (4), pp. 1-7. Also see Zhu Bao, pp. 9-19.

539 For references to FAE warheads, see ***Lianhe Zhanyi Di Erpaobing Zuozhan***, p. 11; Yuen Lin, "The Taiwan Strait Is No Longer a Natural Barrier--PLA Strategies for Attacking Taiwan," ***Kuang Chiao Ching,*** 16 Apr 96, in FBIS-CHI-96-104; and ***Jane's Strategic Weapons Systems 1998,*** section on the DF-15. Also see John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, and Goals, in ***International Security***, Vol. 17, No. 2 (Fall 92), p. 33. An FAE is a variation of the napalm bomb that hits the ground, breaks open, and creates a mist of flammable liquid. A small, delayed-action explosive then goes off, causing the cloud to ignite. The pressure of the blast is sufficient to wreck aircraft, ships, and equipment as well as being fatal to personnel. The only other device to produce similar results is nuclear weapons. Fortunately, FAE warheads are not as reliable as other types of bombs, and weather conditions can seriously degrade their effects.

540 Zhu Yifan, Zhang Xuebin, and Wang Weiping, "ATBM Intercept Decision Modeling," ***Guofang Keji Daxue Xuebao***, 1 Jan 99, pp. 29-32, in FBIS-CHI-1904, 17 Jun 99.

541 Zhang Minde, "Simulation Research of Defenses Against Conventional Ballistic Missile Re-Entry Vehicles," ***Xitong Gongcheng Yu Dianzi Jishu***, 1997, 19 (4), pp. 45-49. The simulation was conducted by CASCs Beijing Optoelectronic Engineering General Design Department. For general background on saturation, see Harshberger, pp. 169-170.

542 David Fulghum, "China Exploiting U.S. Patriot Secrets," ***Aviation Week and Space Technology***, 18 Jan 93, pp. 20-21

543 Gan Chuxiong and Liu Jixiang, ***Daodan Yu Yunzai Huojian Zongti Sheji*** (General Design of Missiles and Launch Vehicles***),*** Beijing: Defense Industry Press, January 1996. pp. 42-43; and Wu Ganxiang, "Guowai Fanjichang Wuqi," (Foreign Antirunway Weapons), in Xu Dazhe, ***Guowai Dandao Daodan Jishu Yanjiu Yu Fazhan***, Astronautics Publishing House, 1998, pp. 65-76. The control maneuver may be necessary to slow down the reentry speed to allow acquisition of the target image in the ballistic missile's seeker.

544 Gan and Liu, p. 45. Also see Zhang Demin, "Study on Penetration Techniques on New Generation Ballistic Missiles," in ***Xinjunshi Gemingzhong Daodan Wuqi Fazhan Qianjing***, Nov 96, pp. 18-24.

545 Gan and Liu, p. 45.

546 Wang Guobao, "Initial Discussion on Tactical Ballistic Missile Electronic Warfare," ***Hangtian Dianzi Duikang***, Apr 97, pp. 1-7 (CAMA).

547 Bill Gertz, ***Betrayal***, Boston: Regnery Press, p. 254.

548 Li Qiang, "Current Status and Follow-On Development of Laser Cladding Wear-Resistance Coatings," Yuhang Cailiao Gongyi, Jan 97, pp. 13-18. At least one institute involved in the testing is Harbin Institute of Technology. Also see Ji Shifan, "Laser Resistant Protection of Missiles," Daodan Yu Hangtian Yunzai Jishu, May 96, pp. 35-42.

549 Jin Weixin, "Mathematical Modeling of Tactical Surface to Surface Missiles Against TMD," in ***Systems Engineering and Electronic Technology***, 1995, 17 (3), pp. 63-68. Zhang Demin and Hou Shiming, "Simulation Research of Offensive and Defensive Capability of Conventional Manuevering Reentry Missile," ***Xitong Gongcheng Yu Dianzi Jishu***, 1997, 19 (4), pp. 45-49. Full translation in FBIS-CHI-97-272. Zhang is from the Beijing Electromechanical Engineering Design Department, also known as the CASC Fourth Systems Design Department. According to one evaluation, PAC-2+ has a probability of kill of 10 to 25 percent against an unidentified tactical ballistic missile. See Zhao Yuping, "Probability of PAC-2 Intercepting a Certain Tactical Ballistic Missile," paper presented at Nov. 97 conference of National Missile Designers Specialist Network in CAMA, Vol. 5, No. 3.

550 Du Xiangwan, "Ballistic Missile Defense and Space Weapons," in ***Quanguo Gaojishu Zhongdian Tushu, Jiguang Jishu Linghuo***, (National High-Technology Key Reference--Laser Technology Realm).

551 ***DoD Report to Congress on the Cross-Strait Security Situation***, Feb 1999.

552 Wang Jianmin and Zhang Zuocheng, "Jiasu Jibenxing Xiliehua Jincheng Nuli Fazhan Woguo Feihang Daodan Shiye" (***Rapid Progress in Series Development of China's Cruise Missile Industry***), ***Zhongguo Hangtian***, Sep 96, pp. 12-17. Some have estimated that a developing country like China could acquire at least 100 land-attack cruise missiles at a cost of $50 million (i.e., $500,000 apiece). See Dennis M. Gormley and K. Scott McMahon, "Proliferation of Land-Attack Cruise Missiles: Prospects and Policy Implications," in Henry Sokolski, ***Fighting Proliferation: New Concerns for the Nineties***, Air University Press, 1996, pp. 131-167.

553 A land-attack Silkworm can readily fit within a 12-meter standard shipping container equipped with a small erector. See Dennis M. Gormley, "Cruise Missile Proliferation: Threat, Policy, and Defenses" ***Proliferation Roundtable, Carnegie Endowment for International Peace,*** October 9, 1998.

554 Two principles in particular are "basic serialization" (***jiben xingxiliehua***) that calls upon reliance of a basic airframe from which several upgraded variants can be derived. The second basic principle is "***sanbuqi***" that calls for having one system in production, one in applied R&D, and a generation-after-next in conceptual development. The China's space and missile industry generally prefers to make incremental modifications to tried and trusted designs.

555 As a general rule, the Haiying series (HY-2, HY-3, HY-4) is surface-to-ship. The Yingji (YJ) designator is normally air-launched (i.e., YJ-6). There are exceptions--the YJ-8 can be ship or submarine launched.

556 See "Zhongguo Jingmi Jixie Jinchukou Gongsi," (CPMIEC) ***Xiandai Junshi*** (CONMILIT), 25 anniversary edition, 1996, pp. 16-23. The "XY" designation is likely a temporary one. Air-launched LACMs would be expected to have a "Yingji" designation. The initial Silkworm, the Haiying-2 (HY-2), utilized liquid propellant that limited its range to fewer than 100 km. Variants incorporated radar or TV-guided terminal guidance systems. An air-launched variant--the YJ-6 (C-601)--utilized the basic HY-2 airframe. The YJ-6 is launched from the B-6D bomber that has an operating radius of 1,800-2,000 km. Like the HY-2, however, the YJ-6 range is fewer than 100 km. In the 1980s, CASC's Third Academy developed an extended-range Silkworm variant that integrated a turbojet engine (wopen fadongji). The turbojet variant has a range of up to 135 km, is equipped with a 500-kg warhead, and can be launched from the B-6D or from shore. See Wang Jianmin, "Jiasu Jibenxiliehua Jincheng Nuli Fazhan Woguo Feihang Daodan Shiye," ***Zhongguo Hangtian***, Sept. 96, pp. 12-17.

557 Teal Group Corp., "Chinese Anti-Ship Missiles," in ***World Missiles Briefing***, Fairfax, Virginia, Teal Group Corp, May 1995, p. 2. One should not discount the possibility of extending the range through modest elongation of the fuselage that would provide space for additional fuel.

558 Shirley Kan and Robert Shuey, "China: Ballistic and Cruise Missiles," ***CRS Report for Congress***, 21 Mar 97 (97-391), p. 11. For the Israeli connection, see "Israel To Equip Chinese Cruise Missile With Penetrator Warhead," ***Flight International***, 5-11 Feb 97, p. 13.

559 Undated China Precision Machinery Import & Export Corporation marketing brochure, "C-201W Coast-to-Ship Missile System." The "W" probably stands for "wopen," or turbojet engine. According to Chinese aerospace publications, the US Tomahawk Land-Attack Missile (TLAM) B utilizes a turbojet engine and has a range of 500 km. The TLAM-C adopts a more efficient turbojet (***woshan***) engine which extends to the range to 1,200 km. A turbofan engine (***woshan fadongji***) could significantly enhance the range of China's land-attack cruise missiles. China's aviation industry has produced turbofan engines since the 1960s. The WS-7, a variant of the Rolls-Royce Spey Mk 202 engine, is used to power the H-7 fighter-bomber.

560 See Jason Glashow and Theresa Hitchens, "China Speeds Development of Missile With Taiwan Range," ***Defense News***, 4-10 Mar 96, p. 1; and Duncan Lennox, "China: Offensive Weapons," ***Jane's Air-Launched Weapons***, Surrey, United Kingdom, Jane's Information Group, 1996. By contrast, the US Standoff Land-Attack Munition (SLAM) is equipped with a 220-kg warhead. Tomahawks have between a 320 and 480-kg warhead.

561 Si Xicai, "Research on Long-Range Antiradiation Missile Passive Radar Seeker Technology," in ***Zhanshu Daodan Jishu*** (Tactical Missile Technology), 1995, Vol. 2, pp. 42-52; other studies on specific

approaches to ARM technology include Yang Huayuan, "Study on Superwideband High-Accuracy Microwave DF System," in ***Daojian yu Zhidao Xuebao***, Feb. 95, pp. 7-12. There are also strong indications that SAST's system engineering organization, the Shanghai Institute of Electro-Mechanical Engineering, is carrying out preliminary R&D on a long-range, air-to-air, antiradiation missile for targeting airborne early warning platforms, such as the US E-3 AWACS or Taiwan's E-2Ts. Engineers note critical technologies for development of a long-range ARM include a passive seeker with a sensitivity of greater than 100 dB, as well as monolithic microwave (danpian weibo), gallium arsenide, very-large-scale, and very-high-speed integrated circuits (MMIC, GAAS, VLSIC, VHSICs). The seeker makes up for greater than 50 percent of the R&D and production costs for an ARM. At least one Second Academy entity that has conducted work on antiradiation missile-seeker technology is the Beijing Institute of Remote Sensing Equipment (probably the CASC 25th Research Institute).

562 ***Jane's Strategic Weapons Systems***, 1998, People's Republic of China; ***Jane's Air-To-Ground Missile Programs.*** There are several systems which CASC appears to be studying to serve as the basis for an indigenous version: The US AGM-88 HARM utilizes a solid motor and has a range of 40 km. The UK's ALARM has a range of 70 km; Israeli's STAR-1 uses a small turbojet enginer, has a range of 100 km and weighs only 182 kgs. Chinese engineers note the Kh-31P has both long-range (i.e., 200 km) air-to-air and air-to-ground variants.

563 Lu Xiaohong, "Launch Technology for Air-Launched Antiradiation Missiles," ***Astronautics Information Research***, HQ-97038, Astronautics Publishing House, Dec 97. Lu is from Third Academy's Beijing Institute of Special Machinery, which is responsible cruise missile launching technology.

564 For one reference on land attack cruise missile and supporting GIS efforts, see Xu Haijiang, "Cruise Missile Mission Planning Research," ***Astronautics Information Research***, HQ-97020, in CAMA, Vol. 5, No.1, Dec 97. The author is from the Beijing Institute for Electromechanical Engineering.

565 A GPS receiver is available in the US for as little as $5,000, a radar altimeter for $2,500, and an IMU for $20,000 to $30,000. A flight-management computer could involve a miniaturized $2,500 commercial system with software to permit flight control, autopilot functions, onboard system monitoring, and flightpath and course navigation.

566 This process is described in Edward Harshberger, ***Long-Range Conventional Missiles: Issues for Near Term Development***, Santa Monica: RAND, 1991, pp. 46-50. Also see Zhou Rui, "Image Guidance Aimpoint Selection System," ***Zhanshu Daodan Jishu***, Jan 96, pp. 32-36.

567 Zhong Longyi, "Zuhe Daohang Xitong he Bingxing Duoji Xitong Zai Xunhang Daodanzhong de Yingyong," (Application of Combined Navigation Systems on Cruise Missiles) in ***Hangtian Qingbao Yanjiu (China Information Research)***, 1993 (3), pp. 432-445. Zhong is from the Third Academy's 8357 Research Institute, responsible for cruise missile control systems. One of China's first research projects on digital image processing, written by Sun Zhongkang and Shen Zhenkang, was published by the PLA National Defense University in 1985.

568 Guan Dexin, "The Investigation of Compatible Receiver for GPS and GLONASS," ***Xitong Gongcheng Yu Dianzi Jishu***, 1996, Vol. 18, No. 7, pp. 69-74; and Sheng Jie, "Demonstration of Navigation Performance of GLONASS/GPS Composite Receivers," ***Weixing Yingyong***, Feb 94, pp. 56-59.

569 Zheng Wanqian, p. 43; The PLA likely has been developing an imagery library that could support DSMAC targeting for several years. TERCOM requires highly sophisticated digital mapping systems and powerful computers. COSTIND and the Second Artillery have made significant achievements in both areas. See Wang Yongming, "Introduction to Military Electronic Maps," ***Xiaoxing Weixing Jisuanji Xitong***, (Mini-Micro Computer Systems), Aug. 95, pp. 12-18, in FBIS-CST-96-001. Wuhan Technical University of Surveying and Mapping is one institute involved in digital mapping. Also see Jing Shaoguang, "GPS/SINS Integrated Navigation System for Cruise Missiles," ***Xibei Gongye Daxue Xuebao***, 1997, 15 (1), pp. 79-83. At least one State Laboratory is dedicated to R&D on scene matching technology--the Image Information Processing and Intelligence Control Laboratory, Imaging Institute, under Huazhong University in Wuhan.

570 One Taiwan source explicitly asserts land-attack cruise missiles will be assigned to the Second Artillery. See "Mainland Acquisition of Russian Weapons Viewed," ***Lien-Ho Pao***, 29 Apr 96, in FBIS-CHI-96-086; In support of this new mission, the Second Artillery's Fourth Research Institute has been modeling the ability of cruise missiles to penetrate air defense systems. See Sun Xiangdong and Qin Xiaobo, "Operational Efficiency Analysis of Cruise Missiles Against SAMs," in ***Xitong Gongcheng Yu Dianzi Jishu*** (Systems Engineering and Electronics), Oct 96, pp. 59-63, in FBIS-CST-97-013. Sun and Qin are from the Second Artillery's Fourth Research Institute.

571 Liu Kejun, "Information Warfare Challenge Faced by Navy," ***Zhongguo Dianzi Bao***, 24 Oct 97, p. 8, in FBIS-CHI-98-012.

572 Tian Baolong and Li Wengang, "Feihang Daodan CAM Chejian Danyuan Xitong" (Cruise Missile CAM Workshop Unit System), ***Zhongguo Hangtian***, April 1993, pp. 44-46; Xu Haijiang, "Virtual Reality and Its Application in Development of Cruise Missiles," in ***Feihang Daodan***, 1996 (8), pp. 1-9; Wang Zhenhua, "Parallel Computation on Supercomputers for Axisymmetric Interaction Flow," ***Yuhang Xuebao*** (Journal of Astronautics), Jan 95, pp. 43-45, in JPRS-CST-95-005.

573 Li Weiliang, "Jiang Zemin dao Beijing Fangzhen Zhongxin Zhouyan" (Jiang Zemin Inspects Beijing Simulation Center), ***Zhongguo Hangtian Bao***, 17 Jan 94, p.1; Li Li, "Chinese Simulation Technology Among Leaders Worldwide," ***Liaowang Zhoukan***, 16 Aug 93, pp. 4-5, in JPRS-CST-93-017. American aerospace representatives who have been allowed access have remarked that the CASC Beijing Simulation Center is very close in capabilities to Western simulation facilities.

574 ***London Quds Press***, 9 Feb 99, in FBIS-CHI-1441-99.

575 Stokes, p. 49.

576 If the Chinese are looking to develop a 1,500-km missile, the Russian 1,500-km-range AS-15 could be used as a model. Some modifications would have to be made to enable it to launch from the ground. The Tomahawk has a 450-km range, while the US AGM-86B has a 3,000-km range.

577 Russia's Raduga Design Bureau has reportedly assisted the Third Academy in application of stealth technology to an unidentified air-launched cruise missile. See "Russian Missile Assistance to China," ***Flight International***, 31 Aug 95.

578 In other words, radar that can pick up an airborne target at 200 km will now be able to detect the target at only 50 km, resulting in less reaction time. Undated brochure, "Xikai (Zhongguo) Guangxue

Jishu Youxian Gongsi," (Seek China Optical Technology Company). The brochure notes that the radar-absorbing material, designated BD-21/SF-18, can reduce a target such as a cruise missile to an RCS of 0.1 square meter (-10 dB). The absorbing material and structural modifications can reduce the RCS to -30 dB.

579 Zhang Haixiong, "ADN: Oxidizer for a Low-Signature Propellant," in ***Feihang Daodan***, July 1996, pp. 35-38, in CAMA, 1996, Vol. 3, No. 6; and Lu Xiaohong, "Camouflage and Concealment Technology of Mobile Missile Launchers and Ground Equipment," in ***Harbin Institute of Technology Journal***, Dec 96, pp. 266-277. Lu is from the Third Academy's Beijing Institute of Special Machinery, responsible for cruise missile launchers.

580 See Wang Jianmin, "Work Hard To Develop Cruise Missile Industry," ***Zhongguo Hangtian***, Sep 96, pp. 12-17; Sun Qingguang, "Study on Laser Imaging Guidance," ***Feihang Daodan***, Mar 95, pp. 46-50, in CAMA 1995, Vol. 2, No. 3; Liu Yongchang, "Infrared Imaging Precision Seeker Technology," ***Hongwai Yu Jiguang Jishu*** (Infrared and Laser Technology), 1996, Vol. 25, No. 3, pp. 47-53, in CAMA, Vol. 3, No. 6; Zhao Jun, "Applied Research Into Laser Imaging Guidance Technology Development," ***Hangtian Qingbao Yanjiu***, HQ-96039, in CAMA, 1997, Vol. 4, No.2; and Li Jin, Development of Infrared Focal Plane Array Imaging Technology," in ***Feihang Daodan Qingbao Yanjiu Baogao Wenzhai*** (Cruise Missile Information Research Reports), Dec 96, pp. 190-209, in CAMA, Vol. 4, No. 6. Leading the infrared imaging effort is the Third Academy's Tianjin Jinhang Technical Physics Institute.

581 Sun Qingguang, "Jiguang Chengxiang Zhidao ji Ganrao Moushi de Yanjiu" (Research Into Laser Imaging Guidance and Jamming), in ***Hangtian Qingbao Yanjiu***, HQ-93017, pp. 228-241.

582 Zheng Wanqian, p. 43.

583 Bases are located at Shenyang (80301 Unit); Huangshan (80302 Unit); Kunming (80303 Unit); Luoyang (80304 Unit); Huaihua (80305 Unit); and Xining (80306 Unit). The Second Artillery has one engineering design academy and four research institutes to solve problems associated with operations, TELs, and logistics (First Institute), command automation, targeting, and mapping (Third Institute), and missile and warhead engineering design (Academy of Engineering Design). The Second Artillery's Command College in Wuhan prepares officers for leadership positions within headquarters elements and launch brigades. The Engineering College in Xian educates technicians associated with equipment and technology departments at various headquarters and field units. General Second Artillery organizational information is drawn from numerous sources, to include open and internal (***junnei***) Chinese publications and from discussions while assigned as the assistant air attache in Beijing, China, from 1992 to 1995. Also see ***PLA Directory of Personalities***, USDLO Hong Kong, 1996, pp. 48-51; Bill Gertz, "New Chinese Missiles Target All of East Asia," *Washington Times*, 10 Jul 97, p. 1; Hisashi Fujii, "Facts Concerning China's Nuclear Forces," ***Gunji Kenkyu***, Nov 95, in FBIS-CHI-96-036; "Guangrong Bang" (Outstanding Units)," ***Flying Eagle (Changying)***, 3 Nov 93; "Guangrong Bang" (Outstanding Units), Flying Eagle, May 1992; Lewis and Xue, p. 213 footnote; and Nuclear Weapons Databook, Vol. 5, pp. 324-335. Among sources, ***Flying Eagle***, one of a handful of Second Artillery-associated publications, is most useful in piecing together the organizational structure. Second Artillery organizational issues are also discussed in author's ***Strategic Modernization*** monograph.

584 *"*The Strategic Nuclear Force Organization," in ***Guojia Junzhixue*** (The Science of the State Military System), undated, p. 3.

585 Stokes, pp. 59-61. The 80302 Unit's first conventional SRBM brigade is said to be garrisoned in Leping, Jiangxi Province. According to an unsubstantiated ***Washington Times*** article, the 80302 Unit is replacing its older DF-3 missiles with the DF-21. Whether or not these DF-21s will eventually have a conventional mission is unknown. See Bill Gertz, "New Chinese Missiles Target All of East Asia," *Washington Times*, 10 Jul 97, p. 1.

586 ***Lianhe Zhanyi Di Erpaobing Zuozhan***, p. 4. Another article supports the assertion that conventional Second Artillery units would be subsumed into the theater command structure, but notes that Beijing may direct operations though the Second Artillery chain of command. See Li Junsheng, "Lianhe Zhanyi Didi Changgui Daodan Budui Zuozhan Zhihui Wenti Tantao" (Inquiry Into Joint Conventional Theater Surface-to-Surface Missile Unit Operational Command Problems), in ***Lianhe Zhanyi Yu Junbingzhong Zuozhan***, (Joint Theater and Service Operations) Beijing: National Defense University Press, 1998, pp. 228-231. Li is from an unidentified (probably Second Artillery) Third Research Institute.

587 Ibid, p. 5. During peacetime, these units are subordinate to the base headquarters.

588 Ibid., p. 4. The equipment assurance subunits, the transfer point, and the transport may be the responsibility of a battalion-level "technical unit" (***jishu ying***). A nuclear brigade's technical battalion manages a warhead station (***dantizhan***), an inspection station (***zhuangjianzhan***), and a technical service station (***jishu qinwuzhan***). See "Guangrong Bang," ***Flying Eagle***, undated (probably 1993), p. 11.

589 For reference to a fourth battalion within a Second Artillery brigade structure, see "Guangrong Bang" (Glorious Honor Roll), ***Flying Eagle***, 2 Nov 93, p. 10.

590 Sr. Col. Wang Benzhi, "Didi Changui Daodan Huoli Yunyong de Jige Wenti," (Some Questions Related to the Use of Conventional Surface-to-Surface Missile Firepower), in ***Lianhe Zhanyi Yu Junbingzhong Zuozhan***, (Joint Theater and Service Operations) Beijing: National Defense University Press, 1998, pp. 236-241. Sr. Col. Wang is the Chief of Staff of the Second Artillery Huaihua Base (80305 Unit). One source states that an operational zone could be 20 to 40 square km. It is unclear what echelon would operate in this size zone. See Lu Xiaohong, "Daodan Jidong Fashe Zhuangbei Ji Dimian Shebei Weizhuang Yu Yinshen Jishu Fenxi," (Analysis of Mobile Missile Launch and Ground Equipment Camouflage and Stealth Technology), in Xu Dazhe, ***Guowai Dandao Daodan Jishu Yanjiu yu Fazhan*** (Study and Development of Foreign Ballistic Missile Technology), Beijing: Astronautics Press, Oct 98, pp. 193-202.

591 Mao Guanghong, "On Electromagnetic Management of the Modern Battlefield," ***Jiefangjun Bao***, 21 May 96, p. 6, in FBIS-CHI-96-134.

592 Zhang Jian, "Analysis of ECCM Principles of Spread Spectrum Unified Satellite Tracking, Telemetry, and Control Network," ***Hangtian Dianzi Duikang***, Apr 97, pp. 26-30. Zhang is from the China Academy of Engineering Physics' Electronic Engineering Institute. Also see Wei Chenxi, "ECCM Measures for Military Communications Satellites," in ***Hangtian Dianzi Duikang***, March 1997, pp. 31-34.

593 Qin Zhongping and Zhang Huanguo, "ALT: Algorithim for Attacking Cryptosystems," ***Jisuanji Xuebao***, Vol. 20, No. 6, pp. 546-550, in FBIS-CHI-97-311; and Zhou Hong and Ling Xieting, "Encryption by Inverse Chaotic Systems," ***Fudan Xuebao***, Jun 97, Vol. 36, No. 3, pp. 301-308, in FBIS-CHI-97-281.

594 Gan and Liu, pp. 42-45.

595 Lu Xiaohong, "Camouflage and Concealment Technology for Mobile Launchers and Ground Equipment of Strategic and Tactical Missiles," Aerospace Industry Press, HQ-96034, 1996. The key institute for CCD technology related to missile launchers is the Beijing Institute of Special Machinery. Wen Longzhi, "Evaluation of the Strategic Missile Survivability," in ***Aerospace Science Intelligence Studies Report Abstracts***, No. 5, 1995.5, pp. 353-368.

596 Li Chunshan, "Introduction and Explanation of the National Military Standard 'Camouflage Requirements for Surface-to-Surface Missile Weapon Systems'," in ***Hangtian Biaozhunhua*** (Space Standardization), 1994, Vol. 5, pp. 12-15. Li is from the Beijing Space Systems, Engineering Design Department.

597 Kang Qing, "IR Stealth of Buried Targets," ***Hongwai Jishu***, 1996, 18 (6), pp. 21-24. Kang is from the PLA Academy of Logistics Engineering.

598 R&D of synthetic aperture radar satellite jammers is the speciality of Southwest Institute of Electronic Equipment (SWIEE). See Chen Ning, "Jamming Technology Against Synthetic Aperture Radar Satellites," ***Hangtian DIanzi Duikang***, 1997 (4), pp. 45-48.

599 Chou Kuan-wu, "China's Reconnaissance Satellites," ***Kuang Chiao Ching***, 16 Mar 98, pp. 36-40, in FBIS-CHI-98-098. Kuang Chiao Ching, or Wide Angle, is a Hong Kong-based publication with close ties to the PRC military establishment. Official US Government reports are consistent with this assessment. The 1998 Report to Congress on PRC Military Capabilities (pursuant to Section 1226 of the FY98 National Defense Authorization Act) states "China already may possess the capability to damage, under specific conditions, optical sensors on satellites that are very vulnerable to damage by lasers. However, given China's current interest in laser technology, it is reasonable to assume that Beijing would develop a weapon that could destroy satellites in the future."

600 Wu Jinliang, "Range Testing of Satellite Communication Countermeasures," in ***Electronic Countermeasure Technology and Intelligence Reform Abstracts***, Nov 1995, pp. 96-101. Reference to a Chinese study on GPS jammer is included in author's unpublished report, ***China's Space and Missile Industry***, Jun 1995.

601 Stokes, pp. 72-78. One should note that in the 1980s, the US considered modification of the Pershing-2 for ASAT missions, a system similar to the DF-21.

602 Xu Hui and Sun Zhongkang, "Temperature Differences Between Satellites and Satellite Decoys," ***NUDT Journal***, 94, Vol. 16, no. 3; also see Li Hong, Identification of Satellites and Its Decoys Using Multisensor Data Fusion," ***Xiandai Fangyu Jishu***, June 1997, pp. 31-36. Li is from the NUDT Electronic Technology Department.

603 ***DoD Report to Congress on the Cross-Strait Security Situation***, Feb 1999.

604 Wang Chunyuan, ***China's Space Industry and Its Strategy of International Cooperation***, Stanford University: Center for International Security and Arms Control, July 1996, p. 4; "China Building Satellite Tracking Station on Tarawa," ***Asian Defense Journal***, March 1997, p. 66; and "Satellite Command Station Operational in Kiribati," ***Zhongguo Xinwenshe***, 14 Oct 97, in FBIS-CHI-97-287.

605 Trip report, NASA visit to China, 12-22 June 1991. For example, China plans to develop a 500 meter aperture radio space telescope for deep-space exploration. With a price of approximately $25 million, the system, which will be based in Guizhou Province, will support primarily civilian academic research, but could also be used to supplement China's space surveillance network. CAST and the China Academy of Sciences are involved. See "Beijing Plans To Develop 500 Meter Radio Telescope," ***Xinhua***, 9 Apr 98, in FBIS-CHI-98-099.

606 A 1993 edition of the Second Artillery journal ***Flying Eagle*** discussed a "comprehensive satellite early warning information management system" (***erpaobing weixing linkong yubao zonghe xiaoxi chuli xitong***) that began operations in as early as 1991.

607 ***Lianhe Zhanyi Di Erpaobing Zuozhan***, p. 17.

608 Ibid, p. 10; and Guan Lin'gen, "Brief Analysis of Combined Fire Assault," ***Jiefangjun Bao***, 21 Apr 98, p.6, in FBIS-CHI-0519-98. Some Western observers have asserted the initial phase would include strikes against the general population and infrastructural targets, such as power plants, fuel, industry, and transportation hubs as a means to weaken overall national resolve. However, the effects from these targets would take a while to materialize. The PRC objective would be to achieve military dominance over Taiwan within two weeks to a month, before negative international economic and political developments can occur. For comments on the importance of strikes against enemy intelligence and electronic attack facilities in support of information dominance, see Yang Zhiguo, "Didi Changgui Daodan Budui Zhanfa Chutan" (Initial Discussion of Surface-to-Surface Missile Unit Doctrine), in ***Lianhe Zhanyi Yu Junbingzhong Zuozhan***, (Joint Theater and Service Operations) Beijing: National Defense University Press, 1998, pp. 242-245. Sr. Col. Yang is Chief of Staff of the Second Artillery's Luoyang Base (80304 Unit).

609 The PLAAF appears to be placing more emphasis on developing a deep-strike capability. In 1995, the PLAAF conducted a major strike exercise in the Lanzhou Military Region. The exercise involved a Red force strike package that conducted a night mission from a distance of 1,000 km to strike the Blue force's airbase. In Oct. 95, a conference, chaired by GSD DCS LTG Wu Quanxu was held at LMR HQ to review the exercise and associated doctrinal development issues. A more complex strike exercise was carried out in northwest China in September 1996 (Exercise 96-9) when the PLAAF used multiple types of aircraft (i.e., A-5s, B-6s, F-7s, F-8IIs, and SU-27s) organized into composite formations. The strike package included electronic countermeasures, strikes against enemy missiles, airfields, and radars. This is an initial indication that the PLAAF could be shifting from an exclusively air defense mission to one including long-range strike missions. Like the USAF, the PLA views offensive counterair missions as an integral aspect of air defense. Lanzhou MR exercise areas appear to serve as the primary test bed for evolving doctrinal development. See Mei Lin, "PLA Methods of Operations Assessed," op.cit. and Zhang Lianfu, "'96-9' Yanxi," ***Zhongguo Kongjun***, May 1998.

610 Sr. Col. Wang Benzhi, pp. 236-241.

611 ***Lianhe Zhanyi Di Erpaobing Zuozhan***, p. 10.

612 Guan Lingen, "Brief Analysis of Combined Fire Assault," ***Jiefangjun Bao***, 21 Apr 98, p.6, in FBIS-CHI-0519-98. In comparison, allied forces in the Gulf war used 137 theater missiles (TLAMs/CALCMs) during the first 24 hours of the conflict. Each wave consisted of about 50 missiles.

Western reporting indicates the PLA currently has only one brigade consisting of 150 to 200 SRBMs. See Tony Walker and Stephen Fidler, "China Builds Up Missile Threat," ***Financial Times***, 10 Feb 99, pg. 1.

613 Guan Lingen, "Brief Analysis of Combined Fire Assault," ***Jiefangjun Bao***, 21 Apr 98, p.6, in FBIS-CHI-0519-98.

614 See Sun Xiaohe, "Jiaqiang Huoli Xietiao, Fahui Zhengti Weili" (Strengthen Firepower Coordination, Give Play to Comprehensive Power), in ***Lianhe Zhanyi Yu Junbingzhong Zuozhan***, (Joint Theater and Service Operations) Beijing: National Defense University Press, 1998, pp. 281-285. Sr. Col. Sun is Deputy Director of the Guangzhou Military Region Service Arms Department.

615 ***Lianhe Zhanyi Di Erpaobing Zuozhan***, p. 10. Also see Wang Xuejin and Zhang Huaibi, "Didi Changgui Daodan Budui Zuozhan Zhidao Sixiang Fenxi," (Analysis of Conventional Surface-to-Surface Missile Operations Guiding Thought) in ***Lianhe Zhanyi Yu Junbingzhong Zuozhan***, (Joint Theater and Service Operations) Beijing: National Defense University Press, 1998, pp. 223-227. Wang and Zhang call the strike phase the "operations implementation phase" (***zuozhan shishi jieduan***).

616 Most of the critical targets in a Taiwan scenario are static and would not change significantly over time. Therefore, a satellite revisit rate of a few days, or even weeks, could be sufficient. China's commercially acquired imagery could meet its strategic targeting requirements. However, with the possible exception of Russia, Beijing could not rely on foreign sources of imagery after initiation of hostilities. For follow-on tactical strike missions, domestic imaging satellites would be needed for theater reconnaissance and warning. The projected 5-meter spatial resolution of China's EO/SAR satellite constellation would support most PLA targeting requirements.

617 Open sources indicate the DF-15s are most likely transported to assembly areas via rail. While the DF-15 TELs are road mobile, the DF-15 MAZ-543-like TEL is limited to a maximum of 63 km an hour on open highway. Barring major infrastructure investments, road conditions and traffic in this area, however, are not ideal for rapid and distant deployment of 20-ton TELs and a quiver of three-ton missiles. In addition, road travel significantly increases the chances of detection. There is a major 15-year project under way to expand the rail network in Fujian and Jiangxi Provinces that will increase the number of available launchsites and complicate the tracking of the missiles on the ground. Highest priority is being given to linking Nanping to Hengfeng/Shangrao, creating a racetrack bounded by Yingtan, Shaowu, Nanping, Shangrao/Hengtian, and back to Yingtan. Funding in part is being provided by Japan. See "Fujian Seeks Foreign Funds for Railroad Construction," ***Xinhua***, 12 Feb 96, in FBIS-CHI-96-029; and "Fujian Governor Announces Plans for Six New Railways," ***Xinhua***, 1 Aug 97, in FBIS-CHI-97-213. For comments on Leping garrison, Yong'an launchsite, and use of rails, see "Defense Ministry Analyzes 4th Missile Launch," ***China Broadcasting Corporation News Network***, 13 Mar 96, in FBIS-CHI-96-051.

618 ***Lianhe Zhanyi Di Erpaobing Zuozhan***, p. 17. Theater command authorities would determine a deployment pattern that would be centered on the brigade's mobile command center. Also see Richard D. Fisher, "China's Missiles Over the Taiwan Strait: A Political and Military Assessment," paper presented at Sep 96 Coolfont Conference on the PLA, pp. 1-30. For reference to a unit having an assigned operating area, see Sr. Col. Wang Benzhi, pp. 236-241.

619 Zhu Bao, pp. 9-19.

620 Zhang Hu, "Application of GPS in Missile Maneuvering Positioning," ***Zhongguo Yuhang Xuehui Fashe Gongcheng Yu Dimian Shebei Wenzhai*** (China Astronautics Society Launch Engineering and Ground Equipment Abstracts), Nov 93.

621 Ge Xinqing, Mao Guanghong, and Yu Bo, "Xinxizhan Zhong Daodan Budui Mianlin de Wenti Yu Duice," (Questions and Countermeasures Facing Missile Units in Information Warfare), in ***Wojun Xinxizhan Wenti Yanjiu*** (Studies on Chinese Information Warfare Issues), Beijing: National Defense University, pp. 189-192. The authors are from the Second Artillery's Command Academy in Wuhan. It should be noted that Fujian Province by itself has 16,000 km of fiber-optic cable.

622 Wang Jixiang and Chang Lan, "Guowai Jidong Dandao Daodan Dimian Shengcun Nengli Yanjiu," (Study on Survivability of Foreign Mobile Ballistic Missiles), in Xu Dazhe, ***Guowai Dandao Daodan Jishu Yanjiu yu Fazhan*** (Study and Development of Foreign Ballistic Missile Technology), Beijing: Astronautics Press, Oct 98, pp. 96-108. Wang and Chang are from CALT's systems integration department. The article describes foreign capabilities but concludes with specific recommendations for China. Chinese defense industries have developed a range of tactical communications systems, including mobile 1 to 3 meter very-small-aperture terminal (VSAT) satellite communication dishes and highly directional tactical digital microwave system. VSAT dishes are optimized for Ku- or L-Band satellite communications. Based on author's discussions in Beijing with foreign diplomats in 1995, the Second Artillery has been particularly interested in steerable spot beam satellites. According to its brochure, the tactical microwave system, produced by Shenyang Huitong Electronic Research Institute, has a 50-km range. At the end of 1997, culminating a three-year effort, the Second Artillery's Communications Department completed the acceptance testing of a new digital microwave communications system. VSAT systems are produced by a wide range of manufacturers. One tactical VSAT system, outlined in another brochure, is a mobile 3-meter dish produced by the Nanjing Research Institute of Electronics Technology. Use of digital microwave at the company level would indicate that launchers could be limited to an operating area of within 50 km of the battalion command center. It is not clear, however, if such a communications mode would be assigned to such a low echelon. For reference to the automated C2 system, see Han Tiejun and Li Qinsuo, "Didi Changui Daodan Budui Zuozhan de Jiben Yuance," (Fundamental Principles of Conventional Surface-to-Surface Missile Unit Operations), in ***Lianhe Zhanyi Yu Junbingzhong Zuozhan***, (Joint Theater and Service Operations) Beijing: National Defense University Press, 1998, pp. 232-235.

623 See Wang Jixiang and Chang Lan, pp. 96-108. Pre-Gulf war estimates assessed that it would take approximately one half hour to move a transporter-erector-launcher after it launched its missile. The reality was that the Iraqis were able to do this in four to five minutes.

624 A brigade consists of at least four battalions probably with three to four companies. Each company likely is responsible for at least one launcher. If one assumes a notional structure of four battalions per brigade with four companies/launchers each, then a brigade would be able to execute a raid size of at least 16 SRBMs at one time. Seven Second Artillery brigades, equipped with a mix of SRBMs, LACMs, and MRBMs, could notionally achieve a raid size of at least 112 theater missiles. Three salvos would utilize 336 missiles. Remaining theater missiles in the PLA arsenal would likely be kept in reserve for other contingencies and/or to support naval operations and amphibious landings. The Chief of Staff of the 80305 Unit in Huaihua, Hunan Province, refers to only two salvos in the opening phases of a conflict (see next footnote). See Sr. Col. Wang Benzhi, pp. 236-241.

625 ***Lianhe Zhanyi Di Erpaobing Zuozhan***, p. 17. The concept of synchronized, multiaxis strikes is a fundamental principle of Second Artillery conventional doctrine (***duodian, duofangxiang, tongshi tuji***). Other important operational concepts discussed by Sr. Col. Wang from Huaihua include "***xushi bingyong, shengdong xiji***," (literally "use reality, make a noise in the east, but strike to the west"); and "***xiaojiange, duoboci tuji***" (literally "cut time and strike in multiple waves"). The first calls for integration of simultaneous launches from different launch azimuths and use of infrared radiation "disruption" to confuse enemy satellite early warning systems and complicate enemy attack operations. The second includes use of two strike waves, the first "screening" the second by exploiting "time lags" (***shijiancha***) in missile defenses. See Sr. Col. Wang's "Didi Changgui Daodan Huoli Yunyong de Jige Wenti."

626 Ibid.

627 "The U.S. Military's Three Choices on Intervention," in ***Taiwan de Junbei***, 1 Jul 96, pp. 76-79, in FBIS-CHI-97-302.

628 See Li Xinyi, "On the Air Supremacy and Air Defense of Taiwan and China: Is Taiwan An 'Unsinkable Aircraft Carrier'?" ***Taiwan de Junbei*** (Taiwan Military Preparations), 1 Jul 96, pp. 11-18, in FBIS-CHI-97-323. For a general discussion on the combined use of ballistic and land-attack cruise missiles, electronic warfare, and air strikes, see Yuan Lin, "The Taiwan Strait is No Longer a Barrier--PLA Strategies for Attacking Taiwan," ***Kuang Chiao Ching*** (Wide Angle), 16 Apr 96, No. 283, pp. 14-19. ***Wide Angle*** is a Hong Kong-based publication with close association with the PLA.

629 The PRC has closely studied the effectiveness of missile defense systems and is investing in developing the capacity to jam Taiwan's PATRIOT-like Modified Air Defense System radar. See, for example, Xiao Shunping, Wang Guoyu, and Ma Jianwu, "Detection Simulation Modeling for PATRIOT Radar Networks," ***Guofang Keji Daxue Xuebao (Journal of the National University of Defense Technology)***, 1 Jan 99, pp. 33-36, in FBIS-CHI-1924, 17 Jun 99.

630 Estimated missile requirements are drawn from Edward R. Harshberger, ***Long-Range Conventional Missiles: Issues for Near-Term Development***, RAND: Santa Monica, 1991, p. 183.

631 Sr. Col. Wang Benzhi, "Didi Changui Daodan Huoli Yunyong de Jige Wenti," (Some Questions Related to the Use of Conventional Surface-to-Surface Missile Firepower), in ***Lianhe Zhanyi Yu Junbingzhong Zuozhan***, (Joint Theater and Service Operations) Beijing: National Defense University Press, 1998, pp. 236-241. Sr. Col. Wang is the Chief of Staff of the Huaihua Base (80305 Unit) in Hunan Province.

632 The PLA could attempt to limit the useable segment of a runway to less than the minimum takeoff distance for the aircraft using them. Generally, for example, an attack on a standard 10,000-foot runway would attempt to cut the runway into three segments, permitting only 3,000 to 3,500 feet per segment. One source asserts that it would take 15 to 48 missiles to close a base, assuming a 50-meter CEP. An increase in CEP would reduce the number of required missiles. See David Blair, "How To Defeat the United States: The Operational Military Effects of the Proliferation of Weapons of Precise Destruction," in Henry Sokolski, ***Fighting Proliferation: New Concerns for the Nineties***, Air University Press, pp. 75-94 Also see Sr. Col. Wang Benzhi, "Didi Changui Daodan Huoli Yunyong de Jige Wenti," (Some Questions Related to the Use of Conventional Surface-to-Surface Missile Firepower), in ***Lianhe Zhanyi***

Yu Junbingzhong Zuozhan, (Joint Theater and Service Operations) Beijing: National Defense University Press, 1998, pp. 236-241 Sr. Col. Wang is Chief of Staff of the Second Artillery's Huaihua Base (80305 Unit).

633 For a superb discussion of airbase attacks, see Christopher M. Center, "Ignorance Is Risk: The Big Lesson From Desert Storm Air Base Attacks," in ***Airpower Journal***, Winter 1992, pp. 25-35; and Capt Peter C. Bahm and Capt Kenneth W. Polasek, "Tactical Aircraft and Airfield Recovery, Airpower Journal, Summer 1991, pp. 32-45. It is worthy to note that during the Oct. 73 Arab-Israeli War, Arab repair teams restored runways in just nine to 12 hours. The Iraqis were able to repair runways in as little as four to six hours.

634 See Wang Jixiang and Chang Lan, p. 107.

635 Lu Ting-hua, "Simulated Attack on Taiwan?" ***Tsu-li Wan-pao***, 28 Apr 99, p.1, in FBIS-CHI-639-99, 29 Apr 99.

636 Harshberger, p. 183.

637 Xu Minfei, Zhu Zili, and Li Yong, "Feasibility of Technologies for Use of Ballistic Missiles To Counter Aircraft Carriers," ***Guofang Keji Cankao***, 1997, 18(4), pp.126-130, summarized in ***CAMA***.

638 Wang Guobao, "Initial Discussion on Tactical Ballistic Missile Electronic Warfare," ***Hangtian Dianzi Duikang***, Apr 97, pp. 1-7, summarized in ***CAMA***.

639 See Wang Jixiang and Chang Lan, p. 107. Most vulnerable would be Kadena AB and Yokosuka Naval Base in Japan.

640 For a good summary of Second Artillery CCD practices, see Ge, et al., "Xinxizhan Zhong Daodan Budui Mianlin de Wenti Yu Duice," p. 189-192. Also see Wang Jixiang and Chang Lan, pp. 96-108. Wang and Chang are from the Beijing Institute of Astronautical Systems Engineering, and Lu Xiaohong, "Camouflage and Concealment Technology for Mobile Launchers and Ground Equipment of Strategic and Tactical Missiles," Aerospace Industry Press, HQ-96034, 1996. The key institute for camouflage, concealment, and deception (CCD) technology related to missile launchers is the Beijing Institute of Special Machinery (CALT 15th Research Institute).

641 The system is probably known as the Bodyguard, unveiled at IDEX '97 Arms Show. The brochure notes that the Bodyguard is a mobile system consisting of four vehicles. The Bodyguard can defend a 10-square km area. The ECM system was developed by the Northeast China Research Institute of Electronic Technology. See Liu Hsiao-chun, "Combat Effectiveness of China's Electronic Technology in Perspective--Causing the F-117 Stealth Fighters To Malfunction," ***Kuang Chiao Ching***, 16 Jul 98, pp. 96-98, in FBIS-CHI-2875-98. The organic Second Artillery ECM system is discussed in a very comprehensive account of developments within the PLA by Lin Chong-Bin (Chong-Pin Lin), entitled ***Heba*** (Nuclear Hegemony), p. x.

642 For one of the best Taiwan assessments of the challenges presented by the PLA's growing arsenal of theater missiles, see Teng Hsin-yun, "Another TMD Episode--The PRC Missile Threat and Our Countermeasures as Well as Blind Spots in Taiwan's Defense Thinking," ***Chien-Tuan K'o Chi***, 1 May 99, pp. 100-107, in FBIS-CHI-0872-99, 6 Jun 99.

643 This "area denial" concept is discussed in Thomas G. Mahnken, "Deny U.S. Access?" ***Proceedings***, Sept 98, pp. 36-39. For another evaluation of the implications of increasingly accurate and lethal theater missiles, see Paul Bracken, "America's Maginot Line***," Atlantic Monthly***, December 1998.

644 The six specious arguments are: 1) TMD will cause an arms race; 2) TMD will contradict the ABM Treaty; 3) TMD will encourage Taiwan independence sentiment; 4) TMD can be used offensively; 5) TMD will lead to the militarization of space; and 6) TMD "violates" the Three Communiques. All are based on oversimplifications and half-truths: 1) Arms races generally are caused by one side's rapid buildup in offensive capabilities. One could argue that an accelerated arms race has been under way in the Taiwan Strait since the early 1990s. Undercutting Beijing's overwhelming offensive advantage through viable defenses could enhance cross-Strait stability by raising the costs of using force. 2) Questions surrounding the ABM Treaty only applies to ***upper tier*** systems--US upper tier systems now being tested have been certified as ABM Treaty compliant. 3) The argument that TMD will encourage Taiwan independence sentiment is also misleading. There are more important factors besides defenses that fan the flames of Taiwan independence. PRC policies that alienate Taiwan are most relevant. Besides, active missile defenses would not encourage independence sentiment any more than other weapon systems, such as fighters, surface-to-air missiles, or ships. One could also argue that Taiwan's indigenous capacity for defense is only a minor factor influencing public sentiment regarding greater autonomy since, according to some sources, Taiwan's domestic polity is largely uninterested in defense issues. 4) The argument that active missile defenses can be used offensively is also based on a half-truth. Converting upper-tier interceptors to surface-to-surface missiles could enable strikes against targets at long ranges. However, such a means is not cost efficient due to payload limitations. The argument that missile defense systems incorporate technologies useful to ballistic missiles (i.e., gyroscopes and accelerometers) assumes that: a) Taiwan does not have the indigenous capacity to develop viable inertial measurement units; b) would be willing to violate MTCR assurances granted to the US; and c) would take the trouble to reverse-engineer the guidance technology. 5) The argument that TMD could lead to a militarization of space is partially true. If supported by a robust search, acquisition, and tracking network, ***upper-tier*** systems could be used to strike some satellites in ***low Earth*** orbit. 6) Finally, active missile defenses would not "violate" the Three Communiques. First, the Three Communiques are parallel statements of policy that have little standing in international law. Secondly, the argument that US provision of active missile defenses would revive the US-Taiwan defense alliance, undermining the foundation of US-PRC relations as spelled out in the 1979 Communique, is based on the assumption that TMD would require operational connectivity (i.e., satellite early warning) with the US. This is not necessarily true. While satellite early warning could enhance the effectiveness of missile defenses, systems such as PATRIOT and THAAD can operate autonomously. Missile defenses do not "violate" the 1982 Communique any more than other weapon systems. As Assistant Secretary of State John Holdridge pointed out in his August 1982 Congressional testimony, the US agreement to reduce arms sales to Taiwan was contingent upon Beijing's peaceful approach to resolving the Taiwan issue, generally characterized by its military posture directed against Taiwan. As Holdridge pointed out, a rise in the military threat to Taiwan theoretically would be accompanied by a rise in US security assistance, in accordance with US domestic law under the Taiwan Relations Act.

645 Among numerous references, see Tom Plate, "East Asia, Infected by a New Arms Race, Risks Deadly Miscalculations," ***LA Times***, 7 Jul 99; and Vanessa Guest, "Missile Defense Is Wrong Call on Taiwan," ***LA Times***, 3 May 99.

646 Among numerous references, see Robert Jervis, "Offense, Defense, and the Security Dilemma," ***World Politics***, Vol. 30, No. 2 (Jan 78), pp. 186-214; and Stephen Van Evera, "Offense, Defense, and the Causes of War, ***International Security***, Vol. 22, No. 4, (Spring 1998), pp. 5-43.

647 See Stephen Van Evera's Spring 1998 ***International Security*** article for a comprehensive argument on the dangers of an offense-dominated security environment. In line with this reasoning, one could argue that Taiwan's newly procured F-16s are to blame for intensification of the cross-Strait arms race. However, Taiwan's F-16 fleet is optimized for air-to-air operations, not long-range strike.

648 Hou Xiaoyan, "Taiwan Zhongkeyuan de Yanjiu Linghuo he Chanpin Jieshao" (Introduction to Taiwan's Zhongshan Institute of Science and Technology Fields of Research and Products), ***Feihang Daodan*** (***Cruise Missiles***), Dec 98, p 39. This CASC journal asserts that CSIST is converting the TK-II into a surface-to-surface ballistic missile. The ballistic missile, called Sky Halberd (***Tianji***), allegedly has a design range of 320 km and a 150-kg warhead. CSIST is integrating GPS with their inertial navigation systems in order to achieve a CEP of fewer than 100 meters. Primary targets would be airfields, military ports, and industrial areas. The CASC author also asserts that a second-stage addition to the ***Tianji*** missile would significantly expand the range. As an example of the nuclear weapons development debate, see Liao Hung-hsiang: "Should Taiwan Develop Strategic Nuclear Weapons?" ***Ch'uan-ch'iu Fang-wei Tsa-chi***, 15 Mar 99, pp 18-21, in FBIS-CHI-0018-99, 29 Apr 99; and Liu Chien-hua, "What Equipment Should Taiwan Use To Defend Itself," ***Tzu-li Wan-pao***, 9 Nov 97, p. 2, in FBIS-CHI-97-364, 30 Dec 99. For background on Taiwan's previous nuclear weapons development program, see David Albright and Corey Gay, "Taiwan: A Nuclear Nightmare Averted," ***The Bulletin of Atomic Scientists***, Jan/Feb 98, Vol. 54 No.1.

649 Robert Jervis, "Offense, Defense, and the Security Dilemma," ***World Politics***, Vol. 30, No. 2 (Jan 78), pp. 186-214.

650 For an outstanding discussion on shortcomings of air and missile campaign theory, see Col. Richard Szafranski, "Parallel War and Hyperwar: Is Every Want a Weakness?," in Barry Schneider and Lawrence Grinter, eds., ***Battlefield of the Future: 21st Century Issues***, Air War College Studies in National Security No.3, Air University: 1995, pp. 125-148.

651 See Teng Hsin-yun for a realistic Taiwan assessment of countermeasures.

652 Theoretically, assuming two interceptors are employed for every ballistic missile and a 100-percent probability of kill, a MADS battalion could engage a near-simultaneous salvo of 48 SRBMs directed against targets within its area of coverage. For background on countering theater missile threats, see Joint Pub 3-01.5, ***Doctrine for Joint Theater Missile Defense***, 22 Feb 96. DoD's ***Report to Congress on Theater Missile Defense Architecture Options for the Asia-Pacific Region*** notes there are multiple options for active missile defenses. Twelve land-based lower-tier fire units could provide for partial coverage of Taiwan's most crucial assets. Eleven sea-based lower systems could cover the entire island. Neither lower tier system, however, can counter longer-range threats such as the DF-21. In addition, a maneuvering reentry vehicle that complicates lower-tier engagements would drive Taiwan toward upper-tier solutions. A single THAAD-like unit could engage all known missile threats. The exo-atmosphere Navy Theater Wide-like system can cover the entire island but would not be able to engage shorter range threats, such as the 300-km DF-11, since it would not leave the atmosphere.

653 In this context, missiles include complete systems, technology, or components.

654 "China's Cooperation With Other Countries in Nuclear Energy Exclusively for Peaceful Purposes, Says Spokesman," ***Xinhua***, 26 September 1986.

655 "Chinese Foreign Ministry Spokesman on China's Nuclear Position," ***Xinhua***, 15 February 1996.

656 "China Calls for Promoting Peaceful Nuclear Use," ***Xinhua***, 24 April 1995. The article did not specify what the fourteen countries were.

657 The Vienna-based Zangger committee, founded in 1971 and consisting of thirty-three nuclear or nuclear-related export countries, is the first international organization formed on control over nuclear technology. The committee's goal is to strengthen consultation and cooperation on issues of nuclear nonproliferation and export control under the principles of the NPT.

658 ***China's National Defense***, (Beijing: Information Office of the State Council of the People's Republic of China, July 1998), pp. 32-34. The 1998 defense white paper was not Beijing's first attempt at military transparency. In 1985, the PLA began publishing the ***Shijie Junshi Nianjian*** [***World Military Yearbook***], which provided an overview of militaries around the world. The section on the PLA was only seventeen pages and provided almost no useful information. Each subsequent yearbook, published about every two years, has provided greater detail on matters like organization and training. The Academy of Military Science has also published journals with numerous papers on military trends and how they affect the PLA.

659 The MTCR group was originally established in 1987 with nine member nations. There are currently twenty-nine countries, including Argentina, Australia, Austria, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Russia, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom, and the United States. The MTCR has two primary restraint categories. Category I items have the greatest restraints. These items include complete rocket systems (including ballistic missiles, space launch vehicles, and sounding rockets) and unmanned air vehicle systems (including cruise missile systems, target and reconnaissance drones) with capabilities exceeding a range of 300 kilometers and a 500-kilogram payload threshold; production facilities for such systems; and major subsystems including rocket stages, re-entry vehicles, rocket engines, guidance systems, and warhead mechanisms. Category II items include complete rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets) and unmanned air vehicle systems (including cruise missile systems, target drones and reconnaissance drones) not covered in Item I, capable of a maximum range equal to, or greater than, 300 kilometers. Also included are a wide range of equipment, material, and technologies, most of which have uses other than for missiles capable of delivering WMD.

660 ***China's National Defense***, (Beijing: Information Office of the State Council of the People's Republic of China, July 1998), pp. 32-34.

661 Paul Mann, "China Alleged Top Trafficker in Mass Destruction Weapons," ***Aviation Week and Space Technology***, Vol. 147, No. 5, 42.

662 "Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions: 1 January Through 30 June 1998," Director of

Central Intelligence Nonproliferation Center, Internet. http://www.cia.gov/cia/publications/bian/bian.html#china.

663 "China Set To Upgrade Iran Missiles," ***Reuters***, 19 August 1999.

664 The ROC currently has diplomatic relations with 28 countries: Belize, Costa Rica, Dominican Republic, Commonwealth of Dominica, El Salvador, Guatemala, Haiti, Honduras, Panama, Paraguay, Saint Christopher and Nevis, Grenada, Saint Vincent and the Grenadines, Nicaragua, the Vatican, Macedonia, Liberia, Malawi, Swaziland, Burkina Faso, Gambia, Senegal, Sao Tome and Principe, Chad, Solomon Islands, Nauru, Tuvalu, and the Marshall Islands.

665 Shirley A. Kan, ***Chinese Proliferation of Weapons of Mass Destruction: Current Policy Issues,*** CRS Report for Congress, IB92056, 23 March 1998.

666 Shirley A. Kan, ***Chinese Proliferation of Weapons of Mass Destruction: Background and Analysis***, CRS Report for Congress, 96-767 F, 13 September 1996. The Chinese have also developed other systems, such as the 8610/M-7 (CSS-8) SRBM, solely for export. The 8610 is an HQ-2 surface-to-air missile that the PRC modified for Iran. Shirley A. Kan and Robert D. Shuey, ***China: Ballistic and Cruise Missiles***, CRS Report for Congress, 97-391 F, 27 May 1998. The 8610 refers to the date the program began--October 1986. This is a common practice in China for designating various weapons systems. Since this missile was developed for export, China has openly provided information about its capabilities. Other examples include the K-8 trainer aircraft and FC-1 fighter joint ventures between China and Pakistan. These aircraft programs were developed for the Pakistan Air Force, not the PLA Air Force, with the hope that the PLA would become interested in the program and purchase some of the aircraft at a later date.

667 Dr. Andrew Rathmell, "Iran's Liquid Lifeline," ***Jane's Intelligence Review***, 1 September 1995.

668 "Post-2000 Delays to China's Arms Goals," ***Jane's Defence Weekly***, 21 January 1998.

669 "China Moves To End PLA's Commercial Interests," ***Jane's Defence Weekly***, 23 September 1998.

670 During the late 1980s, aviation ministry personnel cited instances where the PLA would circumvent the spirit of the law by purchasing a new piece of equipment from a factory and then have this "surplus" equipment delivered directly to an overseas customer.

671 This information is based on interviews with Chinese personnel.

672 As noted in Bates Gill's and James Mulvenon's paper for this seminar on "The Chinese Strategic Rocket Forces: Transition to a Credible Force," the Second Artillery Headquarters oversees six launch bases, which are division-sized elements. Each base has two to three subordinate brigades. Each brigade has up to four launch battalions. Each battalion has three to four launch companies. Each company has one missile launcher. Missile brigades are generally structured by type of missiles. In other words, one brigade only has one type of missile, thus facilitating maintenance and specialization. There are at least thirteen brigades, most of which have been existence for 15 to 20 years. Their paper provides a chart depicting the location of these six bases.

673 The Defense Intelligence Agency's July 1979 ***Handbook on the Chinese Armed Forces*** shows artillery and antiaircraft artillery divisions with four artillery regiments.

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