CHAPTER 11

MAKING SENSE OF CHINA'S MISSILE FORCES

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Since the start of the country's nuclear weapons programs, China's leaders have emphasized the development of missile forces. This interest in missiles was initially focused on the development of intercontinental ballistic missiles to deliver nuclear weapons but has since expanded to include a large and expanding force of conventionally armed short-, medium-, and intermediate-range ballistic and cruise missiles for regional military operations.[1] In the past two decades, the People's Liberation Army (PLA) Rocket Force (formerly the Second Artillery)—the military organization responsible for operating China's nuclear and land-based conventional missile forces—has been transformed from a small force operating liquid-fueled nuclear-armed ballistic missiles to a much larger and more modern force increasingly equipped with solid-fueled ballistic missiles. The majority of these missiles are now conventional rather than nuclear.

Changes in China's missile forces cannot be understood without referring to the broader context in which they are occurring. Jeffrey Lewis has argued that changes in China's missile forces have usually been a function of broad changes in China's political environment and bureaucratic structures, with ideological and strategic considerations of only secondary and

tertiary importance.[2] The most recent military reforms have continued in this trend by demonstrating the importance of broader political and organizational changes in altering the structure and policies of China's missile forces. The reforms also raise the possibility of a more powerful and independent Rocket Force, a development that could increase the salience of strategic considerations in how China develops, sizes, and postures its missile forces. Depending on its institutional preferences, a more powerful Rocket Force might change China's missile forces in important ways, such as prioritizing conventional missions over nuclear missions or lobbying for nuclear forces to begin adopting the more assertive operational practices common to conventional elements.

This chapter attempts to answer some of the questions raised by the technological and organizational changes sweeping China's missile forces. First, it reviews the history and evolution of China's missile forces as guided by technological and bureaucratic influences. Second, it describes key features of the organizational structure and operational practices of China's missile forces on the eve of the 2016 reforms. Third, it examines the impact of the recent military reforms on the missile forces. Finally, it assesses the implications of recent changes for the future of China's missile forces, including its orientation toward either the nuclear or conventional mission sets and its relationship with other military units. The chapter employs a range of sources, including unclassified and declassified reports from the U.S. Government, Chinese state propaganda, displays of missile forces in parades and on state television, disclosures on social media, commercial satellite imagery, computer models, and open-source Chinese press reports on missile force organization, exercises, and capabilities.

Evolution of the Second Artillery Force

The Second Artillery was created in 1966, just 2 years after China's first successful nuclear test at Lop Nor.[3] Though work had begun on missile systems a decade earlier, the Second Artillery was assigned responsibility for wielding these weapons. At its founding, the Second Artillery was not an

official military service [*junzhong*, 军种], but rather an "independent branch [*bingzhong*, 兵种] that is considered equal to the services."[4] For decades, the Second Artillery operated a small and relatively unsophisticated force of liquid-fueled nuclear-armed missiles. The modern incarnation of China's missile forces, the PLA Rocket Force, operates a larger force of increasingly mobile solid-fueled missiles armed with nuclear and conventional warheads.

The following section examines some of the key bureaucratic and technological drivers that have influenced the evolution of China's missile forces and the organization charged with operating them.[5]

Bureaucratic Changes

The evolution of China's missile forces has been significantly influenced by bureaucratic changes, as different organizations have guided the country's nuclear and missile policies. During the first several decades, China's decisionmaking about nuclear weapons and ballistic missiles was dominated by the bureaucracy responsible for defense research and development, the National Defense Science and Technology Commission (NDSTC) [*guofang kewei*, 国防科委] led by Nie Rongzhen from 1958 to 1975 and Zhang Aiping from 1975 to 1982. In this early period, the Second Artillery, which was not established until 1966, does not seem to have been a powerful or important player in shaping China's nuclear forces.[6]

NDSTC remained the dominant force, although its influence waned in the 1980s with the retirements of Nie and his deputy, Zhang. By the late 1990s, NDSTC, under the leadership of Nie's son-in-law, was weak enough to be replaced in 1998 with a PLA entity, the General Armaments Department (GAD) [*zong zhuangbei bu*, 总装备部]. This change was intended to make the weapons research and development process more responsive to the demands of an increasingly professional PLA and its constituent services. However, there are reasons to believe that the GAD remained a powerful and somewhat independent bureaucratic entity. Despite the significance of the creation of the GAD, it did not usher in dramatic changes in China's nuclear armed-missile force.[7]

Technological Changes

Technological advancements have been one of the key drivers of change in China's missile forces. As part of its ongoing nuclear modernization efforts, China has largely replaced its silo-based and roll-out liquid-fueled missiles with mobile solid-fueled missiles, has deployed new conventionally armed missiles, and has taken steps to improve the ability of its missile forces to penetrate adversary ballistic missile defenses.

China's first generation of ballistic missiles were liquid-fueled—the DF-2, DF-3, DF-4, and DF-5. The DF-2, with a range of approximately 1,000 kilometers, provided a rudimentary regional deterrent capability until it was phased out of the force in the 1980s. The regional deterrent was bolstered by the intermediate-range DF-3, credited with a range of roughly 3,000 kilometers, though this missile is believed to have recently been completely removed from the force. The DF-4, with a range of at least 5,500 kilometers, extended the reach of China's missile forces to Moscow and Guam. The silo-based DF-5, with an estimated range of more than 12,000 kilometers, formed the backbone of China's intercontinental force, providing the ability to strike the continental United States.

While some of these missiles were in development from the early 1960s, in March 1965 China established a plan to develop four missiles in 8 years [*banian sidan*, 八年四弹], culminating in an intercontinental ballistic missile (ICBM).[8] While some sources describe these four missiles in terms of their progressively longer ranges—the ability to strike Japan, followed by the Philippines, then Guam, and ultimately the continental United States—the real innovation embodied in the *banian sidan* plan was structuring the ICBM program around incremental technical goals. In retrospect, the DF-1 represented successful copy production, while the DF-2 was an indigenized Soviet missile. The subsequent missiles represented technical advances. The DF-3 was the first effort to cluster engines and use storable propellant (unsymmetrical dimethylhydrazine instead of liquid oxygen). The DF-4 was the first effort at staging, using a DF-3 as a first stage. Ultimately, the DF-5 integrated all these technical achievements

into a full-range ICBM, making a number of technical improvements that allowed Chinese designers to create the massive missile.[9]

China completed these developmental goals in order, and largely on time. In the case of the DF-5, the successful test in 1971 was followed by a long period of disruption during the Cultural Revolution. China would conduct a full-range test in 1980 as part of the "three grasps" campaign to complete the unfinished business of the 1960s and 1970s—an operational ICBM, a submarine-launched ballistic missile, and a communications satellite.[10] An important cautionary note is that the completion of flight testing does not signal the end of development. Flight testing appears to continue as long as a missile is in service, though after deployment flight tests move from research organizations, such as the China Academy of Launch Technology [*zhongguo yunzai huojian jishu yanjiuyuan*, 中国运载火箭技术研究院], to the operational tests by either the Second Artillery's equipment department or operational brigades.[11] China often continues to make evolutionary improvements following the successful production of a missile. For example, after initial DF-3 testing and deployment, China conducted a second flight test series in the mid-1980s to produce the longer range DF-3A.

The DF-4 and DF-5 both remain in the PLA Rocket Force inventory. China undertook a program to improve the DF-5 in the mid-2000s, which the U.S. Intelligence Community calls the DF-5A. In September 2015, China paraded a missile marked DF-5B that reportedly has multiple warheads. China's nuclear-armed ballistic missiles are, in general, too small to be able to carry multiple warheads. The DF-5 was long understood to be a possible exception to this rule. It is China's largest ICBM and is massive, with a throw weight of a few thousand tons. The reentry vehicle for China's smallest nuclear warhead, developed for the road-mobile DF-31 ICBM, weighs 500 kilograms. U.S. analysts have long noted that China might be able to place three or possibly four such warheads on the DF-5. The appearance of the DF-5B during the September 2015 parade suggests that China has done it.[12]

In January 1985, the State Council and Central Military Commission reorganized China's missile programs to develop a new generation of

solid-fueled missiles to replace the nuclear-armed liquid fueled missiles of the 1965 *banian sidan* plan. China's current generation of strategic missiles dates to this period: the 1,750-kilometer range DF-21/JL-1 to replace the DF-3; the 7,000-kilometer range DF-31/JL-2 to replace the DF-4; and the DF-41 ICBM to replace the DF-5. China had begun research on solid-fueled ballistic missiles in the 1960s, work that was focused on development of a submarine-launched ballistic missile. Work proceeded slowly through the 1970s, culminating in a March 1985 meeting where Nie's deputy and successor, Zhang Aiping, apparently ridiculed the notion of a sea-based deterrent by arguing that a Chinese submarine armed with the JL-1 would have to travel to the Arabian Sea for Moscow to be within range.[13] China subsequently emphasized the land-based variant, the DF-21.[14]

In the mid-1980s, Deng Xiaoping extended the timeline for the construction of the second submarine, a decision that amounted to cancelation of the program. The *Xia*-class submarine has never gone on patrol and is usually described as not operational and not deployed. It is possible that Chinese leaders might order the submarine armed with nuclear weapons in an extreme crisis, but this seems unlikely in the normal course of events. China continued development of a land-based variant of the JL-1, successfully testing the DF-21 in 1985.[15] Although China reportedly stood up the first DF-21 operational test and evaluation unit in 1985 in Jilin Province, the widespread conversion of the DF-3 to DF-21 units did not begin until the late 1990s. Establishment of operational test and evaluation units and flight testing occurs well ahead of full rate production and initial operational capability.

China first tested the DF-21 in May 1985. It then began a range extension program in August 1985, which eventually produced the DF-21A. (Development on the JL-1 appears to have stopped after an aborted program in the mid-1980s to develop underwater ignition.[16]) Testing on the DF-21 continued through the mid-1990s, with deployments beginning in the mid-1990s and continuing as the DF-21A gradually replaced older DF-3A missiles.[17] The range and deployment locations of the DF-21A suggest that it serves a regional deterrent role.[18] While research and development of the

DF-31/JL-2 began in the mid-1980s, flight testing of the DF-31 started in August 1999.[19] Flight testing was probably completed by the mid-2000s. The JL-2 sea-launched variant suffered a series of testing failures until the most recent cycle of testing in August 2012, which appears to have been successful.[20] (China has constructed at least four *Jin*-class ballistic missile submarines and appears to have deployed the JL-2 on them as of 2017.[21] Given the limited range of the JL-2, which cannot reach the continental United States from its base on Hainan Island, there is speculation that China may move on to a longer range version of the missile, usually called the JL-3). The original DF-41 program gave way to a range-extended DF-31, called the DF-31A, which has been operationally deployed with the Rocket Force.

Only in recent years has China resumed work on the DF-41. It has tested the DF-41 six times since 2012, with a noticeable increase in the pace of testing since August 2015. There are reports that China is considering rail-mobile deployment for the DF-41. China explored rail-mobile basing modes for the DF-4 during the mid-1970s but concluded that basing the DF-4 in caves under high mountains was a more feasible approach. Rail-mobile deployment would offer some advantages; as missiles become larger, road-mobility becomes a challenge, both for the transporter itself and for the supporting network of roads and bridges. The DF-41 can reportedly accommodate multiple warheads.[22] Based on the limited public information about the size of China's nuclear warheads, the DF-41 would need to resemble the U.S. Peacekeeper missile in size to accommodate about four reentry vehicles.

The Second Artillery was originally established to operate China's nuclear deterrent, but China has also developed and deployed a substantial force of conventionally armed missiles. This began in the mid-1980s, and the missiles were intended for export as the defense industry came under budgetary pressure. These missiles, initially the DF-15 and DF-25, appeared in Pakistan as the Shaheen I and Shaheen II. China has developed a large number of short-range ballistic missiles (SRBMs), although the current Rocket Force inventory appears to comprise variants of the DF-11,

DF-15, and DF-16 missiles.[23] (The DF-16 appears to be a heavily modified DF-11.) In addition to this series of conventionally armed SRBMs, China has deployed conventional variants of the DF-21 and a land-attack cruise missile called the CJ-10. China is also developing a new intermediate-range ballistic missile, the DF-26. The DF-26 is likely to be a two-stage missile that offers longer range and greater throw-weight than the DF-21 and DF-25. China also displayed a transporter-erector-launcher with a missile canister for the DF-26 in its August 2015 parade to commemorate the end of World War II. The narration provided on Chinese television pointedly noted that the missile could carry both conventional and nuclear warheads.[24]

Finally, China is taking steps to improve the ability of its nuclear forces to penetrate missile defenses. In January 2014, and again in August, China tested a hypersonic glide vehicle. Some open-source information seems to suggest that the test was a failure, while other sources argue that it succeeded.[25] The U.S. National Air and Space Intelligence Center has stated that the hypersonic glide vehicle under development "is associated with [China's] nuclear deterrent forces."[26] One possible clue is in the name of the system. The Chinese designation appears to be "DF-ZF," which probably stands for [*dongfeng zairu feixingqi*, 东风-再入飞行器] or "DF-Reentry Vehicle."[27]

This description of the evolution of China's ballistic missile force indicates that the technology push that marked the first generation of Chinese missiles is alive and well. The Chinese defense industry continues to produce incremental improvements on fielded systems, including range extensions, improvements in accuracy, and the ability to employ different types of conventional and nuclear warheads.

The Second Artillery on the Eve of the Reforms

Thanks to the bureaucratic and technological drivers described thus far, the Second Artillery that existed on the eve of the 2015 military reforms differed markedly from the Second Artillery at its founding. This section reviews key aspects of the force structure and operational features of the Second Artillery on the eve of the reforms. We discuss Second Artillery leadership and the

organization of its missile bases and subordinate missile launch units. These features appear largely unchanged following the reforms, with the exception of improved integration of conventional Rocket Force missile brigades with the new theater commands (TCs). We close with a brief discussion of China's sea-based and aircraft-launched nuclear weapons.

Structure

The organizational structure of the Second Artillery (now the PLA Rocket Force) is more complicated than a simple table showing the number of missile launchers or missiles. Far more than a single truck is needed to conduct launch operations. A brigade of missile launchers requires support vehicles, as well as an infrastructure to maintain the vehicles, missiles, and warheads and to support the people who perform these tasks. As a result, it is necessary to consider the Rocket Force as an organization.[28]

The Rocket Force is commanded by a full general, who from 2004 to 2017 was also a member of the Central Military Commission. The Rocket Force political commissar is a theater leader grade officer and chairs the Rocket Force Party Committee. The commander serves as vice chairman of the Party committee.[29] The force is divided into six bases (sometimes called armies) numbered 61–66, each led by an army leader grade officer.[30] Bases 61–66 oversee subordinate launch brigades and support regiments. The Rocket Force also oversees a separate base, Base 67 (formerly Base 22), which is responsible for maintaining China's stockpile of nuclear warheads. The Rocket Force leadership also oversees three training bases and an engineering base headquartered in Luoyang. The engineering base, which was established in 2012, oversees a command in Hanzhong, Shaanxi, that is primarily responsible for tunneling; a collocated "engineering technology general group" in Luoyang, Henan, responsible for facility installation; and a specialized engineering brigade for disaster response that is garrisoned north of Beijing.[31]

Each missile base has between three and five subordinate missile brigades, with most bases operating a mix of conventional and nuclear

brigades. The exception is Base 61 (formerly Base 51), which operates only conventional missiles and may have up to eight missile brigades. Within this organizational structure, command authority is exerted from the base, down through brigades, battalions, companies, and platoons.[32] Though most of China's missile bases command both nuclear and conventional brigades, these two forces appear to be subject to somewhat separate command and control arrangements. The Rocket Force's nuclear units are believed to report directly to the Central Military Commission, while there is evidence that conventional units may now be under the operational command of the theater commands.[33]

Table 1. China's Ballistic Missile Inventory

U.S. Designation	Chinese	Propellant	Mode	Range (km)	No. of Launchers	
CSS-2 Mod 2	DF-3A	Liquid	Transportable	3,000	?? (limited mobility)	
CSS-3	DF-4	Liquid	Silo and transportable	5,500+	10–15	
CSS-4 Mod 2	DF-5A	Liquid	Silo	12,000+	About 20	
CSS-5 Mod 1	DF-21	Solid	Road-mobile	1,750+	Fewer than 50	
CSS-5 Mod 2	DF-21A	Solid	Road-mobile	1,750+		
CSS-5 Conventional	DF-21C	Solid	Road-mobile	1,750+	Fewer than 30	
CSS-5 Mod 5	DF-21D			1,500+	Unknown	
CSS-6 Mod 1	DF-15/ M-9	Solid	Road-mobile	600	90–110	
CSS-6 Mod 2	DF-15A	Solid	Road-mobile	850+		
CSS-6 Mod 3	DF-15B	Solid	Road-mobile	750+		
CSS-7 Mod 1	DF-11/ M-11	Solid	Road-mobile	300	120–140	
CSS-7 Mod 2	DF-11A	Solid	Road-mobile	600		
CSS-8	B610	Solid/liquid	Road-mobile	150		
CSS-9 Mod 1	B611	Solid	Road-mobile	150		Dual launcher
CSS-9 Mod-X-2	B611M	Solid	Road-mobile	260		
CSS-10 Mod 1	DF-31	Solid	Road-mobile	7,000+	5–10	
CSS-10 Mod 2	DF-31A	Solid	Road-mobile	11,000+	More than 15	
CSS-11 Mod 1	DF-16	Solid	Road-mobile	800+		
CSS-14 Mod-X-1	P12	Solid	Road-mobile	150		Dual launcher

Table 1. China's Ballistic Missile Inventory (cont.)						
U.S. Designation	Chinese	Propellant	Mode	Range (km)	No. of Launchers	
CSS-14 Mod-X-2	BP12A	Solid	Road-mobile	280		
CSS-X-15	M20	Solid	Road-mobile	280		
CSS-X-16	SY400	Solid	Road-mobile	200		8 rocket MLRS
	DF-26	Solid	Road-mobile	IRBM		Reported to be dual-capable.
CSS-X-20	DF-41	Solid	Road- or rail mobile	ICBM	Not yet deployed	
CSS-NX-3	JL-1	Solid	Submarine-launched	1,700+	Not yet deployed	
CSS-NX-14	JL-2	Solid	Submarine-launched	7,000+		
	JL-3	Solid	Submarine-launched			Rumored to be under development
	YJ-63	LACM	Air-launched			
	CJ-10/ DH-10	LACM	Ground-launched			

Key: ICBM: intercontinental ballistic missile; IRBM: intermediate-range ballistic missile; LACM: land attack missile; MLRS: multiple launch missile system.

Notes: Table compiled by Jeffrey Lewis. The author gratefully acknowledges his contributions. Public U.S. Government reports suggest that all DF-3A systems may have been phased out of the force.

Each brigade has launch battalions and/or launch companies that operate a limited number of launchers. A launch platform in this context can be a silo (as in the case of the DF-5), a cave rollout to launch site (such as the DF-4), or, for mobile missiles, a transporter-erector-launcher. Table 1 chronicles China's ballistic missile inventory. The missiles and launchers also require significant communications, intelligence, and maintenance support. The structure of brigades differs for fixed-site missiles and mobile missiles, as well as for conventional and nuclear missiles. As a result, the number of missiles per brigade may vary greatly between conventional missile brigades (up to 36 launchers with as many as 6 missiles per launcher), mobile nuclear-armed missile brigades (between 6 and 12 missile launchers per brigade), and fixed-site nuclear-armed missiles (6 or fewer silos or cave

rollout sites.) This reflects differences in the number of battalions, companies, and launchers assigned to each unit.

When looking at unclassified U.S. Government estimates, it usually makes sense to estimate that each nuclear-armed mobile missile brigade has approximately eight launchers—although average does not necessarily accurately reflect each unit. For example, the National Air and Space Intelligence Center assesses that China has 5 to 10 DF-31 missiles and "more than 15" DF-31A missiles.[34] Using an average of eight, China probably has one DF-31 brigade and two DF-31A brigades. Using the structure of bases, brigades, and launch units, a rough order of battle for the Rocket Force is presented in table 2.

Table 2. PLA Rocket Force Organization

Base (Previous)	Brigade (Previous)	MUCD (Previous)	Location	System
61 (52)	HQ	96601 (96151)	Huangshan, Anhui	
	611 (807)	96711 (96161)	Chizhou	DF-21
	612 (811)	96712 (96163)	Jingdezhen	DF-21A
	613 (815)	96713 (96165)	Shangrao	DF-15B
	614 (817)	96714 (96167)	Yong'an	DF-11A
	615 (818)	96715 (96169)	Meizhou	DF-11A
	616 (819)	96716 (96162)	Ganzhou	DF-15
	617 (820)	96717 (96164)	Jinhua	DF-15
62 (53)	HQ	96602 (96201)	Kunming, Yunnan	
	621 (802)	96721 (96211)	Yibin	DF-21A?
	622 (808)	96722 (96213)	Yuxi	DF-31A
	623 (821)	96723 (96215)	Liuzhou	DH-10A?
	624 (825)	96724 (96219)	Qingyuan	DF-21D
	625 (UI)	96725 (96216)	Jianshui	(UI)
	626 (825)	96726 (96319)	Qingyuan	DF-21C/D? DF-26?
	UI (UI)	96727 (UI)	Puning	(UI)
63 (55)	HQ	96603 (96301)	Huaihua, Hunan	
	631 (803)	96731 (96311)	Jingzhou	DF-5B
	632 (805)	96732 (96313)	Shaoyang	DF-31
	633 (814)	96733 (96315)	Huitong	DF-5A?
	634 (UI)	96734 (UI)	(UI)	(UI)
	635 (824)	96735 (96317)	Yichun	DH-10
	636 (826)	96736 (96318)	Shaoguan	DF-16
	637 (UI)	96737 (UI)	(UI)	(UI)
64 (56)	HQ	96604 (96351)	Lanzhou	
	641 (806)	96741 (96111)	Hancheng	DF-31
	642 (809)	96742 (96361)	Datong	DF-31A
	643 (812)	96743 (96363)	Tianshui	DF-31A
	644 (UI)	96744 (UI)	Hanzhong	(UI)
	645? (UI)	96745	(UI)	(UI)
	646 (823)	96746 (96365)	Korle	DF-21B? DF-21C?
65 (51)	HQ	96605 (96101)	Shenyang	
	651 (810)	96751 (96113)	Dalian	DF-21

Table 2. PLA Rocket Force Organization (cont.)				
Base (Previous)	Brigade (Previous)	MUCD (Previous)	Location	System
	652 (816)	96752 (96115)	Tonghua	DF-21C? DF-21D?
	653 (822)	96753 (96117)	Laiwu	DF-21C
	654 (UI)	96754 (UI)	Dalian	(UI)
66 (54)	HQ	96606 (96251)	Luoyang	
	661 (801)	96761 (96261)	Lingbao	DF-5B
	662 (804)	96762 (96263)	Luanchuan	DF-4? DF-5A?
	663 (813)	96763 (96265)	Nanyang	DF-31A?
	664 (UI)	96764 (UI)	Luoyang	(UI)
	665 (UI)	96765 (UI)	(UI)	(UI)
	666 (827)	96766 (96267)	Xinyang	DF-26?

Key: HQ: headquarters; MUCD: Military Unit Cover Designator; UI: unidentified.

Source: Mark Stokes, "PLA Rocket Force Leadership and Unit Reference," Project 2049 Institute, Arlington, VA, April 9, 2018, based on open-source analysis. The author and editors thank Mr. Stokes for his generosity in sharing this information with us.

Each Rocket Force missile base and missile brigade have a headquarters, with multiple subordinate launch units. As suggested by the use of cave-based rollout sites, the Rocket Force relies extensively on underground facilities—and engineering elements responsible for digging them. Launch units are based above ground on a day-to-day basis in peacetime. Underground facilities are used for storage, as well as missile-warhead assembly, check out, and roll out. Launch units practice deploying to tunnels for short periods of time, a practice that allows the Rocket Force to ride out a nuclear attack as suggested by the country's no-first-use policy. A recent article described a "multiday survival training" exercise in which a launch battalion spent 8 days living in tunnels before conducting an exercise.[35] The article highlights the "poor living environment" of the tunnels for even short periods of time—particularly the challenge of maintaining nutrition. (Cooked meals are prohibited because the heat from a kitchen would reveal the tunnel is occupied.[36])

In addition to the land-based Rocket Force units, the Chinese navy has built at least four *Jin*-class ballistic missile submarines in the past decade. These first submarines are believed to be based in Hainan.[37] Each *Jin*-class submarine has 12 launch tubes to carry the JL-2 submarine launched ballistic missile. The slow development of the JL-2 delayed operational deployment

of the system, but the missile now appears to be deployed on submarines.[38] Major operational questions, such as how China would communicate with ballistic submarines and whether China would conduct continuous at sea deterrence patrols, remain unanswered. It is not clear, for example, whether naval units will develop their own nuclear warhead storage and control system outside of the Second Artillery Base 22 structure, or whether units assigned to navy fleets would receive warheads only in a crisis.[39]

China probably does not currently maintain aircraft-delivered or tactical nuclear weapons. During the 1970s and 1980s, the United States did not identify locations at airfield for nuclear weapons storage or units responsible for nonmissile warhead handling.[40] Some estimates periodically list aircraft as possibly having "secondary" nuclear missions or speculate that China may have an interest in tactical nuclear weapons.[41] There are also reports of work on a new nuclear-capable strategic bomber currently under development.[42] However, despite recent changes to the country's nuclear forces and gradual progress toward a potential nuclear triad, China's nuclear deterrent will continue to be dominated by the Rocket Force.

Operational Features

The operational practices of the Rocket Force have been shaped largely by policy choices of civilian leadership and by the technical characteristics of the force. Civilian leadership has traditionally prioritized strict political control of its missile forces over operational flexibility. This has meant the adoption of a relatively constrained nuclear posture, including operational practices that may reduce operational readiness but maximize political control. Operational practices have also been influenced by technical considerations. For several decades following the creation of the country's missile forces, China's ballistic missile force consisted of only a few immature liquid-fueled stationary missiles. However, as part of its ongoing modernization program, China's nuclear-armed missiles have increasingly become solid-fueled and road-mobile. These technical changes have entailed potentially significant operational changes as well.

China's liquid-fueled ballistic missiles are not kept fueled during peacetime. These missiles used transporter-erectors for the DF-3As,[43] either elevate-to-launch silos or cave-rollout for the DF-4, and silo-basing for the DF-5. A typical rollout-to-launch exercise, as presented on closed-circuit television, demonstrates the operational aspects of launching liquid-fueled ballistic missiles.[44] (This launch exercise took place at a training center, as suggested by the fact that the building in which the warhead is attached is above ground.) Chinese missileers must arm the warhead inside its shelter and complete a checkout of the missile. The missile is then rolled out to the launchpad, where it is erected. The missile is fueled and guidance sets are aligned/programmed. The missile is then ready for launch. This process can take a significant amount of time, lasting hours. For silo-based ballistic missiles, there is no rollout, but the missile must be armed, fueled, and the guidance system must be aligned and programmed prior to launch.

Although the DF-3 (CSS-2) had limited mobility, the introduction of truly mobile solid-fueled missiles such as the DF-21 required new operational practices for the Rocket Force. Mobile operations can be seen in satellite images near Da Qaidam, which previously contained two cave rollout-to-launch sites but is now believed to be a training center.[45] During peacetime, the unit is located in a garrison. In the event of a crisis, the garrison would be a likely target of enemy attack. On strategic warning, the unit could deploy to hardened shelters, a holding area, or proceed directly to a launch site. There are a number of launch sites along the main road stretching from a garrison location. In satellite images, one can clearly see the pad unoccupied, then covered with vehicles in netting and tents conducting a launch exercise, then empty again.[46]

China appears to continue to store nuclear warheads separately from ballistic missiles during peacetime. A description of a mobile missile launch in the Gobi Desert—likely at the Da Qaidam training area—depicts the unit mating the reentry vehicle to the missile on the fifth day of the exercise, following maneuvers in the field, then erecting and launching the

missile. However, it would seem more logical for units to mate warheads before deployment.[47]

The Rocket Force has an extensive system for handling warheads, centered on Base 67 near Baoji (formerly Base 22).[48] Each base has a warhead regiment that performs these functions. China initially stored nuclear weapons in three vaults west of the original nuclear weapons design facility near Haiyan (Koko Nor). Sometime after the late 1960s, warhead storage moved to the Second Artillery unit near Baoji. Base 67 is responsible for storing warheads, transporting them, training units in warhead handling, and communications and maintenance of warheads and special vehicles. The size and composition of these units have remained roughly the same, even as the number of Rocket Force brigades has expanded, suggesting that new Rocket Force brigades are mostly armed with conventional warheads.

Until recently, Rocket Force training has suffered from a lack of realism and a poor emphasis on conducting joint operations. However, in recent years, training has increasingly attempted to emphasize realistic conditions by undertaking more confrontation red-blue exercises and improving its ability to conduct joint operations.

The Rocket Force has taken steps to emphasize and standardize the use of red-blue confrontation exercises.[49] In 2016, the newly established Rocket Force announced the creation of its Blue Army Teaching and Research Section, led by Colonel Diao Guangming.[50] Diao has been quoted as favoring a move toward more complex scenarios in Rocket Force training, stating, "Those whose peacetime training is overly nice will suffer greatly when they take the battlefield."[51] The new section may help standardize future confrontation exercises, which had reportedly suffered in the past as blue teams were assembled ad hoc from various different units.[52] For example, past Rocket Force red-blue exercises have employed "electronic blue teams" confined to a base and presumably capable of simulating only some kinds of electronic harassment from the enemy.[53]

Impact of the 2016 Reforms

China is in the midst of sweeping military reforms that have affected the force structure, organization, and command and control mechanisms of the PLA. The reforms have the dual goals of tightening political control and improving the military's ability to conduct joint operations. The reforms elevated the Second Artillery to full service status and renamed it the PLA Rocket Force. Despite much attention paid to its new name and higher organizational status, the Rocket Force appears to be the service least affected by the reforms.[54] Here we summarize the major reforms to the PLA and assess the impact of those reforms on China's missile forces.

PLA-Wide Reforms

The Rocket Force's creation did not occur in isolation, but in the context of reforms that affected the missions and command arrangements for nearly all the Chinese military. The scope and significance of PLA reforms have been likened to those of the Goldwater-Nichols Department of Defense Reorganization Act of 1986.[55]

The PLA replaced its old system of seven military regions (MRs) with five new joint theater commands. Under the old system, the air force, navy, and Second Artillery maintained peacetime control of their units, with command and control of air force and navy assets transferring to the war zone commander in the event of actual conflict.[56] By contrast, theater commanders will use their theater joint operations command center to work through the army, navy, and air force component headquarters to command all the ground, naval, and air forces assigned to their theaters in both peacetime and wartime. The commanders of the ground, naval, and air components are dual-hatted as deputy theater commanders. The relationship between the services and theater commands appears similar to the U.S. arrangement, with the services responsible for organizing, training, and equipping units as a "force provider" and the theater commands responsible for operational planning and execution (see the chapter by Burke and Chan in this volume).[57] The reforms also established a new

headquarters for the PLA Army, renamed the Second Artillery Force as the Rocket Force and elevated its status to that of a full service, and created the Strategic Support Force and Joint Logistics Support Force.

While the reforms include dramatic changes in the command and control arrangements of the other services, the Rocket Force appears largely untouched. Initial reports emphasized continuity in both China's nuclear policies and Rocket Force command and control arrangements, though more recent accounts suggest greater progress toward integrating China's missile forces with the joint operations command centers of the newly established theater commands.

Apparent Continuity of Nuclear Strategy and Policy

Media reports and official statements consistently emphasize that the creation of the Rocket Force will not entail a change in China's fundamental nuclear strategy, and especially not a change in its no-first-use policy. Reporting on the creation of the Rocket Force, a *China Daily* article stated that China's nuclear policy would remain unchanged: "Reiterating the no-first-use nuclear weapons policy and the country's defensive nuclear strategy, [Ministry of National Defense Spokesman] Yang [Yujun] said China always keeps its nuclear capability at the minimum level required for safeguarding its national security."[58] In describing the Rocket Force, Xi Jinping used language identical to that applied to the Second Artillery in the past, describing the new Rocket Force as "a fundamental force for our country's strategic deterrent, a strategic pillar for our country's great power status, and an important cornerstone in protecting our national security."[59] The same rhetorical formulation was repeated by Xi in his 2012 address to the Second Artillery, suggesting the fundamental role of the new Rocket Force will mirror that of its predecessor.[60]

Command and Control

Rocket Force command and control structures have not changed to follow the new model used by the theater commands to control army, navy, and air force units within their areas of responsibility. Mainland commentary

on the Rocket Force has consistently emphasized the need for strong central control. In announcing the creation of the Rocket Force, media reports have reiterated the importance of centralized high-level command for strategic missile forces.[61] An article in *Rocket Force News* stated that the force is "a strategic military service directly controlled and used by the Central Party Committee, Central Military Commission, and Chairman Xi."[62] These comments suggest that centralized command continues to extend to not only nuclear units but also conventional ones.

Although some theater commanders claimed to control conventional missile forces within their theaters,[63] initial reports about the relationship between the services and theater commands were notable for the paucity of references to the Rocket Force. Media reports noted that the new theater commands would have dedicated forces from the army, navy, and air force but did not mention forces of the newly formed Rocket Force, suggesting that its units will remain with their home bases.[64] The theater commands were reported to have two deputy commanders from "each of the three service branches," not including the Rocket Force.[65] One report did note that 100 Rocket Force personnel have been assigned to TC headquarters as staff officers, suggesting that some mechanisms exist for integrating the Rocket Force into theater planning.[66]

Initial reports on training intended to improve the operational relationship between the Rocket Force and theater commands emphasized *coordination* between the Rocket Force and theater commands, eschewing any language suggesting direct command authority from the theater command to Rocket Force units.[67] A mock order in a training drill used the word *coordinate* [*peihe*, 配合] to describe the unit's activities in relation to TC units [*zhanqu budui*, 战区部队]. A photo essay reporting on Rocket Force joint training hosted on the Web site of the newly created Southern Theater Command stated that Rocket Force units conducted operations "according to newly revised joint operations war plans with the relevant units of each of the other services," again suggesting a role of independent support rather than command subordination.[68]

One indicator of the Second Artillery's relative independence vis-à-vis the military regions prior to the reforms was the fact that the command geography of the Second Artillery did not map directly onto the former MR borders. The Second Artillery had six missile bases commanding launch brigades and a seventh responsible for nuclear warhead storage and handling. Of the six operational bases, four were believed to command launch brigades garrisoned in different military regions. For example, Base 65 (formerly Base 51), headquartered in Shenyang, oversaw not only two nuclear-armed launch brigades garrisoned in the former Shenyang MR but also one nuclear-armed launch brigade garrisoned in the former Beijing MR and one conventionally armed launch brigade garrisoned in the former Jinan MR.[69] A similar command geography involving Rocket Force bases commanding brigades in multiple theater commands appears to be in place after the recent military reforms, though there has been significant reshuffling of missile force units between the various missile bases.[70]

Elevation to Independent Service

In some respects, the formal elevation of the Rocket Force to the level of a service merely codifies its de facto status. The Second Artillery's organizational clout had steadily grown in the last 15 years. Prior to the creation of the Rocket Force, the Second Artillery commander and other senior leaders enjoyed ranks and grades equivalent to that of their counterparts in the services. The Second Artillery had the same constellation of bureaucratic structures as the services, including a Political Department, Logistics Department, Armaments Department, and Command Academy. In 2004, Jing Zhiyuan, then-commander of the Second Artillery, and his navy and air force counterparts became ex officio members of the Central Military Committee (CMC). Wei Fenghe, the first Rocket Force commander, was a CMC member, but his successor Lieutenant General Zhou Yaning and the commanders of the other services no longer have ex officio seats on the CMC.[71]

Many reports on the Rocket Force have emphasized the significance of its higher status as a service. Previous writings about the Second Artillery's

role in joint campaigns noted that while strikes conducted by Second Artillery units would be central to the importance of any operation, the Second Artillery as an institution would largely play an auxiliary or supporting role to the services.[72] However, a professor at the Rocket Force Command Academy predicted that the force would be able to "fight independently" rather than merely "support[ing] other forces, a definition that is incompatible with the Rocket Force's capacity and actual role."[73]

Rocket Force members have stressed the independence and prestige that come with its status. The Rocket Force has reportedly already begun implementing the internal bureaucratic adjustments necessary to elevate it to the status of a full military service,[74] including a rollout of Rocket Force uniforms.[75] Internal Rocket Force reports highlight the fact that Xi personally chose the name of the Rocket Force and bestowed a new flag to the force.[76] An article published in *Rocket Force News* reflecting on the significance of the force's elevation to the level of a military service noted that the "status of the Rocket Force as a military service is getting more important than ever before."[77] The article predicted the Rocket Force would see changes in structure, status, and missions. Specifically, the "value and capability of the Rocket Force should lie in the strengthening of the credible and reliable nuclear deterrence and nuclear counterstrike capabilities referenced by Chairman Xi, along with strengthening the establishment of intermediate-range and long-range precision strike forces and enhancing counterbalancing abilities."[78]

A Rocket Force political instructor, writing about the reforms, stated that the elevation to the level of a military service would bring commensurate transformation of the force's structure and elevation of its mission, arguing that the status as a full-fledged service means that the "Rocket Force is no longer a paper tiger, placing missiles on launch platforms to scare the adversary, but rather is a strategic iron fist ready anytime to launch missiles to intimidate the enemy," perhaps suggesting a greater warfighting role for the force.[79]

Implications for the Future

Significant questions remain about the future trajectory of China's missile forces. This section addresses three key questions. First, to what extent will Rocket Force units be able to successfully participate in joint operations with the military units of other services and those assigned to the theater commands? Second, will the Rocket Force emphasize the conventional or nuclear aspect of its identity, and what implications will this have for its force structure and operational practices? Third, what does the Rocket Force's elevation mean for its relationship with other services and how could this influence control of other strategic weapons systems?

Future Joint Operations

The Rocket Force is part of a broader PLA-wide trend in emphasizing joint operations (see the chapter by Cozad in this volume). Training has appeared to focus on developing the ability to conduct joint operations, something that has long been emphasized but not fully implemented. The Rocket Force has created plans with other services, spelling out how it will coordinate in joint operations.[80] Training has reportedly tried to move away from emphasizing theories and concepts of joint operations and to focus on the actual experience and challenges of conducting such operations.[81] Recently there has been a substantial increase in joint operations training undertaken by PLA Rocket Force units, especially exercises directly involving units of other services.

As recently as 2014, though the former Second Artillery had been emphasizing the concept of joint operations, "few instances of actual joint training were reported." A review of training exercises conducted throughout the entire year of 2014 noted Second Artillery participation in only one exercise, a military-wide exercise identified as "Joint Action–2014."[82] A 2017 report, however, noted a significant increase in joint exercises, reporting that the Rocket Force "has launched hundreds of missiles in live-fire exercises over the past several years to improve its combat readiness. The missiles were fired during about 40 exercises within the force itself, as well

as during more than 30 joint drills between the force and other military branches and regional theater commands."[83] A *Rocket Force News* report on training improvements noted that "multi-arm, multi-service joint exercises and joint training have become the new normal."[84] The Rocket Force and Strategic Support Force have also held discussions on coordinating their respective forces in future joint campaigns.[85]

Despite the recent emphasis on joint operations, the PLA may experience difficulties in integrating Rocket Force units into joint operations. There are reports of challenges involving the force, with particular emphasis on the concepts and practices of personnel. As one brigade commander described it, "It's a problem of old wine in a new bottle."[86] A report on efforts to better coordinate between the theater commands and services noted that while members of the various services had been dispatched to help staff the theater commands and their knowledge of their own service was quite good, their understanding of joint operations exhibited "noticeable gaps."[87]

A significant development is apparent progress in integrating Rocket Force command and control structures with those of the theater commands. Initial reports following the establishment of the Rocket Force suggested that China's missile units had not yet been integrated into the theater joint command and control structures established as part of the reforms. Rocket Force command and control appeared to remain centralized and not delegated to theater commanders, which would hamper effectiveness in future joint campaigns. The greater institutional independence of the Rocket Force vis-à-vis both the theater commands and other services may have exacerbated this problem. Divided command would make it more difficult to coordinate the actions of Rocket Force missile brigades and those forces assigned directly to a theater command in a fast-moving crisis without clear command authorities and an integrated communications network.

However, more recent reports on the relationship between the Rocket Force and theater commands have emphasized efforts to improve jointness, with some language suggesting conventional Rocket Force missile units *may*

be formally under the command of TC joint operations command centers. One recent report in *Rocket Force News* observes, "in the future of combat, all war will be joint, and without jointness there will be no victory."[88] The same account reports that "this base has joined the joint operations chain of command" and that "accelerating [the base's] integration into the TC joint operations command system . . . is a top priority."[89] A 2017 report on joint exercises led by the East Sea Fleet, in describing the need to enhance coordination in joint operations, mentioned the Rocket Force alongside the army and navy, suggesting a similar relationship between each of the services and the theater command.[90] A report on integrating a missile base into a TC joint operations command system noted that "when we cross the threshold into the theater command, we are like one family."[91] Several accounts from Rocket Force sources mention efforts by the missile forces to "integrate" or "build into" TC joint operations command centers and cite the presence of Rocket Force officers within TC joint operations command centers.[92] Articles as recent as early 2018 report that efforts to improve integration between Rocket Force command and control systems and those of the theater commands are ongoing and "exploratory," suggesting that the efforts are as yet incomplete.[93] It is still not entirely clear how and to what extent theater commands will directly command missile units. For example, a sample of recent reports do not explicitly describe direct command by theater commands over missile force units or the attachment of missile force units to them. However, it is clear that the Rocket Force is emphasizing efforts to enhance coordination with the theater commands and other services and is undertaking steps to deepen that coordination.

It is not yet clear how far the PLA will integrate Rocket Force units into the joint operations command and control over the theater commands or why that integration has proceeded more slowly than the integration of units from the other services. There are several possible explanations for the slow pace. PLA leadership might have decided that maintaining the current Rocket Force organization exploits economies of scale and operational synergies. Some of the missile systems operated by the force include

both conventional and nuclear variants. Even missiles of different systems may share logistics, maintenance, and training requirements. Transferring control of conventional units to the theater commands would likely have required the creation of parallel and redundant structures. As one expert notes, "personnel, logistics, and training requirements for only two SRBM brigades proved unwieldy for the army when most SRBM units are assigned to the Second Artillery."[94]

There may also be operational reasons for maintaining current command and control arrangements for conventional missile units. TC leaders probably lack familiarity with missile operations and Rocket Force units. CMC leaders, including Xi Jinping, may also want to maintain tight central control over China's conventional and nuclear missile systems given their unique ability to strike targets abroad and potentially initiate a conflict due to carelessness or poor judgment. The accidental launch in July 2016 of a Taiwanese antiship missile that killed a fisherman provided a sobering reminder that such concerns are not merely academic.[95]

Alternatively, the PLA may intend to fully integrate conventional Rocket Force units into the TC command and control mechanisms, and the relatively slow pace of progress may merely reflect the challenges of integrating units that historically have been more separate from the rest of the military.

Future Force Structure and Nuclear Strategy

A more powerful Rocket Force may also be able to wield greater influence in shaping the country's nuclear strategy and policies. Some experts have suggested that as China's political leadership has become less actively focused on nuclear weapons issues, the PLA may enjoy greater autonomy in the nuclear realm. However, the Rocket Force's influence on China's nuclear strategy and policies may depend on the extent to which the Rocket Force prioritizes either the conventional or nuclear mission set.

At the moment, the Rocket Force appears to treat conventionally armed missiles differently than nuclear-armed ones. The Rocket Force has deployed conventionally armed missiles in much greater numbers than nuclear-armed

missiles. The Rocket Force reportedly already controls more than 1,200 conventional short-range ballistic missiles,[96] compared to an estimated roughly 160 nuclear-capable ones, and it is estimated that more than half of personnel are assigned to conventional forces.[97] In the past decade, officers who comprise Rocket Force senior leadership were most likely to have served in Base 61 (formerly Base 52), the force's premier conventional base opposite Taiwan, and almost no officers have served in both an ICBM base and Base 61. Doctrine for conventionally armed missiles also emphasizes preemptive use, in contrast with China's no-first-use policy for nuclear weapons.

However, the Rocket Force's dual identity presents unique bureaucratic choices, and its approach to the conventional and nuclear mission sets may evolve along one of at least three lines, depending on both the Rocket Force's own institutional priorities and its relative power vis-à-vis other services and civilian leadership. The first is that a more powerful Rocket Force could advocate for the adoption of a more aggressive nuclear posture. The Rocket Force's approach to conventional missiles may represent its preferred doctrine and approach, absent the political interference that accompanies decisions about nuclear weapons. In this scenario, a more powerful Rocket Force would press to make China's nuclear doctrine and forces more closely resemble the country's conventional missile doctrine and forces.[98] This could include lobbying for a host of more assertive doctrinal and operational choices, potentially including the peacetime mating of warheads, increase in alert status, launch-on-warning posture, or abolition of China's no-first-use policy. Evidence to support this hypothesis includes statements from officers in the Rocket Force and former Second Artillery advocating the adoption of a higher alert status throughout the force and a reconsideration of no-first-use.[99]

A second possibility is that a more powerful Rocket Force may be inclined to disregard the nuclear mission and shift more of its resources and attention toward the conventional one. Like many military organizations, the Rocket Force may regard nuclear weapons as a distraction from the core mission. A review of career patterns within China's missile forces suggests

that experience with conventionally armed missile units is more likely to lead to a senior leadership position within the Rocket Force. Officers who have served in units tasked with primarily conventional missions are more likely to ascend to the ranks of senior leadership than officers who have served in units tasked with primarily regional or strategic nuclear missions.[100] There is also evidence of an at least informal hierarchy among the various missile bases, with Base 61 (formerly Base 52), the Rocket Force's premier conventional missile base opposite Taiwan, sitting at the top. In addition, while China has seen only a modest growth in the size of its nuclear arsenal, its conventional forces have expanded dramatically so that, today, an estimated 80 percent of all missiles and half of Rocket Force personnel are assigned to conventional missions.[101] A more powerful Rocket Force may advocate for more emphasis and investment in conventional forces, with the nuclear deterrent persisting in its current form.

Third, civilian leaders may continue to shape operational practices and doctrines (especially in the nuclear domain), regardless of Rocket Force priorities. Despite the extent of military reforms, the impact on the Rocket Force has been notable more for continuity than change. The civilian leadership may still exert significant control over the policies and practices of China's missiles forces and continue to require a relatively restrained nuclear posture.

It is not entirely clear which of these paths the Rocket Force may take. The first two possibilities are not mutually exclusive. China could push for an expansion and prioritization of its conventional missile forces at the expense of its nuclear forces, while Rocket Force leaders simultaneously lobby for a more assertive nuclear posture. The relationship between the Rocket Force and civilian leadership is especially opaque, making it difficult to determine the extent to which the Rocket Force will be able to determine its own institutional priorities and practices. However, there are unconfirmed reports that, with the increasing professionalization of the PLA and the turning of civilian attention to other matters, the Rocket Force may be gaining increased autonomy.[102] If true, this would make it easier for the force to adopt more assertive policies and practices.

Future Interservice Politics over Other Strategic Systems

Elevation to a full-fledged service may give the Rocket Force the institutional prestige and resources necessary to compete effectively with the other services for resources and missions. As the PLA rebalances away from traditional army dominance and slower economic growth leads to slower growth in military spending, interservice rivalry, and competition to control emerging missions, will likely become more intense.

Conventional missions and forces may present such a "growth area" to the Rocket Force. With growing PLA emphasis on conducting joint conventional operations, the force might seek to expand its conventional forces and missions. While China's relatively restrained nuclear strategy may limit the growth potential of the nuclear mission, conventional operations can more easily be used to justify an expansion in force size and mission set.

Conversely, the Rocket Force maintains a comparative advantage over the other services in the nuclear realm. Chinese leadership views about the limited utility of nuclear weapons and guidance to build a "lean and effective" nuclear deterrent imply a cap on the size of nuclear forces and the missions assigned to them.[103] However, the Rocket Force could seek to capitalize on its unique nuclear role in a number of ways. First, it could push China's leadership to expand the role of nuclear forces and argue for an expanded force structure and mission set in ways that could potentially lead to more aggressive changes in overall strategy and policy.[104] The Rocket Force might also make a play for operational control of China's emergent fleet of *Jin*-class ballistic missile submarines (SSBNs). A number of Chinese and American experts have predicted that China's future SSBN force could fall under the command of the Rocket Force, though few have offered specifics about how such a command arrangement might work.[105]

The PLA Navy has little to no experience controlling nuclear weapons, as China built only one hull of the previous generation *Xia*-class SSBN, which never conducted a single operational patrol.[106] To the extent that greater operational experience with nuclear weapons increases confidence and decreases the likelihood of accidents, mistakes, and misperceptions,

centralizing nuclear control under the Rocket Force might improve strategic stability by reducing the risk of accidental or unauthorized launch. Conversely, the Rocket Force has no experience running a naval fleet of any kind, let alone the kinds of complex operations required to operate and protect an SSBN force. Regardless of future command and control structures, Chinese SSBNs would undoubtedly be staffed and operated by navy crews and serviced in navy ports.

Finally, the Rocket Force could push to gain operational control of conventional strategic assets such as the DF-21D antiship ballistic missile or direct-ascent antisatellite capabilities. Both of these weapons are based on ballistic missile systems already operated by the Rocket Force, and their importance as strategic assets argues for strict centralized control.

China's sweeping military reforms have ushered in substantial changes in the relative status and relationships between different parts of the People's Liberation Army. The Rocket Force has arguably emerged as the biggest winner in the reforms. The navy and air force lost operational control of their forces to the theater commands, and the army suffered a reduction in both formal status and administrative power after the dissolution of the General Staff Department. The Rocket Force, on the other hand, has maintained direct control of its nuclear units, boosted its formal organizational status, and strengthened its ability to compete against the other services for resources and missions.

Conclusion

China's missile forces are undergoing significant changes, though it is still unclear how far those changes will go. Organizational reforms, technological developments, and operational changes all raise questions about whether the future of China's missile forces will resemble the past.

Organizationally, the Rocket Force has increased in prestige and, likely, power. For its first few decades of existence, the Second Artillery, the Rocket Force's predecessor, fielded only a few dozen unsophisticated missile systems. Today, it is estimated to command over a thousand total

missile systems. The recent wave of PLA-wide military reforms saw the elevation of the Rocket Force to the level of a full-fledged service, increasing its institutional status and placing it on par with the other military services.

Technologically, China's ongoing modernization program has changed the technological makeup of its missile forces. In the nuclear domain, China's missile forces have evolved from a small and relatively unsophisticated set of liquid-fueled stationary missiles armed with single warheads into a force of increasingly advanced road-mobile solid-fueled missiles, some of which can be equipped with multiple warheads. China is also developing a sea-based leg for its nuclear deterrent, developing and deploying a new generation of SSBNs and accompanying submarine-launched ballistic missiles, and there are initial reports of a next-generation strategic nuclear-capable bomber. Just as significant for the Rocket Force, the country's land-based missiles have increasingly shifted from nuclear to conventional and, increasingly, advanced dual-capable missile systems.

Finally, the Rocket Force appears to gradually be changing its operational practices. It has placed greater emphasis on training under realistic conditions by utilizing red-blue team confrontation exercises. Perhaps most significantly, the Rocket Force has increased its integration with the theater commands and has increasingly emphasized joint operations in its training. These operational changes have, in part, been driven by both the organizational and technological changes described herein. The creation of the theater commands and the PLA-wide emphasis on joint operations have catalyzed the Rocket Force focus on jointness. Similarly, the introduction and expansion of conventional units in the Rocket Force has made the organization more relevant to the kinds of conventional conflicts for which the PLA prepares, especially a possible future conflict over Taiwan. These changes raise several important questions about the future of the Rocket Force.

First, will the Rocket Force change its fundamental policies and practices, particularly in the nuclear realm? With its recent elevation to the level of a full service, the Rocket Force may enjoy greater autonomy in deciding

its future force composition and operational practices. China has historically adopted a comparatively restrained nuclear posture, but this could change.

Second, will Rocket Force units be able to effectively participate in joint operations, and what will an increased focus on jointness mean for the Rocket Force? As discussed, China's missile forces have historically remained somewhat apart from the rest of the PLA, and the Rocket Force has been comparatively slow to integrate with the newly established theater commands. Challenges persist in integrating Rocket Force units into joint operations, and it remains unclear how long it will take to overcome those challenges. The drive to jointness may end up altering the composition and identity of the Rocket Force by leading to a stronger prioritization of the conventional mission set.

Third, will the introduction and expansion of conventionally armed missiles, especially dual-capable systems, increase the escalatory risks of entanglement? Several scholars have noted that the deployment of dual-use missile systems and the possible collocation of conventional and nuclear missiles could create risks of unintentional escalation in a conflict.[107] The risks generated by this kind of technological entanglement could be mitigated or exacerbated by the operational practices under which those missiles are deployed.

Finally, what will the development of other legs of a nuclear triad mean for the future of both the Rocket Force and China's nuclear policies? The introduction of sea- and air-launched nuclear forces could push the Rocket Force to embrace its conventional identity. The introduction of new nuclear platforms could also create new opportunities or pressures for changes in China's nuclear policies. SSBN operational deployments will likely involve mated warheads and missiles, which could lead the Rocket Force to advocate peacetime mating of warheads and land-based missiles. Conversely, a more diverse and dispersed nuclear force could increase China's confidence in the survivability of its second-strike capability, causing it to forgo more assertive changes to its nuclear posture.

Notes

[1] Early Chinese interest in missiles was also driven by a desire to develop surface-to-air missiles to shoot down U.S. and Taiwanese reconnaissance aircraft that China viewed as compromising its sovereignty.

[2] Jeffrey Lewis, *The Minimum Means of Reprisal: China's Search for Security in the Nuclear Age* (Cambridge: MIT Press, 2007).

[3] Bates Gill, James C. Mulvenon, and Mark A. Stokes, "The Chinese Second Artillery Corps: Transition to Credible Deterrence," in *PLA as Organization*, ed. James C. Mulvenon and Andrew N.D. Yang (Santa Monica, CA: RAND, 2002), 517–518.

[4] Michael S. Chase, *The PLA's Second Artillery Force as a Customer of China's Defense Industry*, Study of Innovation and Technology in China Research Brief 2013-15 (San Diego: Institute on Global Conflict and Cooperation, January 2013), 2, available at <https://escholarship.org/uc/item/1tw930nf>.

[5] This section draws on arguments developed by Jeffrey Lewis and Raymond Wang of the Middlebury Institute of International Studies in Monterey. The author gratefully acknowledges their contributions.

[6] This period is described in detail by Benjamin C. Ostrov, *Conquering Resources: The Growth and Decline of the PLA's Science and Technology Commission for National Defense Science and Technology* (New York: Taylor & Francis, 1992).

[7] See especially Evan Feigenbaum, *China's Techno-Warriors: National Security and Strategic Competition from the Nuclear to the Information Age* (Stanford: Stanford University Press, 2003); and Harlan W. Jencks, "COSTIND Is Dead, Long Live COSTIND! Restructuring China's Defense Scientific, Technical, and Industrial Sector," in *The People's Liberation Army in the Information Age*, ed. James C. Mulvenon (Santa Monica, CA: RAND, 1999), 59–77.

[8] The fact that the DF-1 was an SS-2 copy accounts for a discrepancy in Chinese and U.S. designations: the DF-2 is the CSS-1, DF-3 is the CSS-2, DF-4 is the CSS-3, and DF-5 is the CSS-4. U.S. designations are based on the order in which a missile system was identified.

[9] The Chinese distinguish ranges slightly differently than Americans. Whereas the U.S. Intelligence Community categorizes the DF-4 and DF-5 as intercontinental ballistic missiles (ICBMs), Chinese sources distinguish between the two.

[10] Feigenbaum, *China's Techno-Warriors*, 79.

[11] The author is indebted to Mark A. Stokes of the Project 2049 Institute for this observation.

[12] Michael Krepon, Travis Wheeler, and Shane Mason, eds., *The Lure and Pitfalls of MRVs from the First to the Second Nuclear Age* (Washington, DC: Stimson Center, May 2016), available at <www.stimson.org/sites/default/files/file-attachments/Lure_and_Pitfalls_of_MIRVs.pdf>.

[13] John Wilson Lewis and Xue Litai, *China's Strategic Seapower: The Politics of Force Modernization in the Nuclear Age* (Stanford: Stanford University Press, 1996), 27.

[14] China continued with the submarine-launched ballistic missile (SLBM) program, listing it as one of the "three grasps" that represented an effort to conclude the unfinished business of China's first generation of strategic programs: test an SLBM, deploy an operational ICBM, and launch a communications satellite. The first JL-1 test occurred in October 1982. China's *Xia*-class ballistic missile submarine (SSBN) went to sea in 1983, but likely has never conducted an operational patrol. See Lewis and Xue, *China's Strategic Seapower*, 120.

[15] Ibid., 188.

[16] Ibid.

[17] The Office of the Secretary of Defense (OSD) indicated that the DF-21 had largely replaced the DF-3, which remained deployed by a single brigade by 2005. See *Annual Report to Congress: The Military Power of the People's Republic of China 2005* (Washington, DC: OSD, 2005), available at <www.globalsecurity.org/military/library/report/2005/d20050719china.pdf>. Analysis of commercial satellite imagery suggests that all DF-3A units have been upgraded. See Hans M. Kristensen, "Chinese Nuclear Missile Upgrade Near Dalian," Federation of American Scientists Strategic Security blog, May 21, 2014, available at <https://fas.org/blogs/security/2014/05/dengshaheupgrade/>.

[18] Gill, Mulvenon, and Stokes, "The Chinese Second Artillery Corps."

[19] Shirley A. Kan, *China: Ballistic and Cruise Missiles*, 97-391 F (Washington, DC: Congressional Research Service, August 10, 2000), 14–15.

[20] On failure, see *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2010* (Washington, DC: OSD, 2010), 34, available at <www.defense.gov/Portals/1/Documents/pubs/2010_CMPR_Final.pdf>. On technical hurdles see *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2011* (Washington, DC: OSD, 2011), 34, 62, available at <www.defense.gov/Portals/1/Documents/pubs/2011_CMPR_Final.pdf >. On success in 2012, see *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013* (Washington, DC: OSD, 2013), 31, available at <www.defense.gov/pubs/2013_china_report_final.pdf>.

[21] *Ballistic and Cruise Missile Threat 2017* (Wright Patterson AFB, OH: National Air and Space Intelligence Center [NASIC], 2017), 30, available at <www.nasic.af.mil/Portals/19/images/Fact%20Sheet%20Images/2017%20Ballistic%20and%20Cruise%20Missile%20Threat_Final_small.pdf?ver=2017-07-21-083234-343>.

[22] Ibid.

[23] U.S. Government reports make no mention of the DF-25 having ever entered service in China.

[24] *Ballistic and Cruise Missile Threat 2017.*

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[26] Donald L. Fuell, quoted in *China's Military Modernization and Its Implications for the United States*, Hearing Before the U.S.-China Economic and Security Review Commission, 113th Cong., 2nd sess., January 30, 2014, 36, available at <www.uscc.gov/sites/default/files/USCC%20Hearing%20Transcript%20-%20January%2030%202014.pdf>.

[27] For more on China's hypersonic glide program, see Lora Saalman, "China's Calculus on Hypersonic Glide," Stockholm International Peace Research Institute (SIPRI), August 15, 2017, available at <www.sipri.org/commentary/topical-backgrounder/2017/chinas-calculus-hypersonic-glide>; and Lora Saalman, *Factoring Russia into the U.S.-Chinese Equation on Hypersonic Glide Vehicles*, No. 2017/1 (Stockholm: SIPRI, January 2017).

[28] For a good overview of the pre-reform Second Artillery Force, see Michael S. Chase, Daniel Yoon, and Mark A. Stokes, "The People's Liberation Army Second Artillery Force (PLASAF) as an Organization," in *The PLA as Organization v2.0*, ed. Kevin Pollpeter and Kenneth W. Allen (Vienna, VA: Defense Group, Inc., 2015).

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[33] Fiona S. Cunningham and M. Taylor Fravel, "Assuring Assured Retaliation: China's Nuclear Posture and U.S.-China Strategic Stability," *International Security* 40, no. 2 (Fall 2015), 44. The command and control arrangements for the Rocket Force remain opaque and difficult to evaluate. For some evidence and discussion, see David C. Logan, "PLA Reforms and China's Nuclear Forces," *Joint Force Quarterly* 83 (4th Quarter 2016), 58–60. Evidence of more recent integration of Rocket Force and theater command command and control arrangements is discussed in a later section of this chapter.

[34] *Ballistic & Cruise Missile Threat* (Wright-Patterson Air Force Base, OH: NASIC, 2013), available at <www.fas.org/programs/ssp/nukes/nuclearweapons/NASIC2013_050813.pdf>.

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[37] *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*.

[38] *Ballistic and Cruise Missile Threat 2017* (Wright Patterson AFB, OH: NASIC, 2017), 30, available at <www.nasic.af.mil/Portals/19/images/Fact%20Sheet%20Images/2017%20Ballistic%20and%20Cruise%20Missile%20Threat_Final_small.pdf?ver=2017-07-21-083234-343>; "The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics," Office of Naval Intelligence, U.S. Navy, August 2009, available at <www.fas.org/irp/agency/oni/pla-navy.pdf>; "China's Navy 2007," Office of Naval Intelligence, U.S. Navy, available at <www.fas.org/irp/agency/oni/chinanavy2007.pdf>; and Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, RL33153 (Washington, DC: Congressional Research Service, February 8, 2012), available at <www.hsdl.org/?view&did=701351>.

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