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CHINA'S AIR AND SPACE REVOLUTIONS

By Lt. Col. Thomas R. McCabe, USAFR (Ret.)

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Brig. Gen. Billy Mitchell

On September 12, 1918, at St. Mihiel in France, Col. William Mitchell became the first person ever to command a major force of allied aircraft in a combined-arms operation. This battle was the debut of the US Army fighting under a single American commander on European soil. Under Mitchell's control, more than 1,100 allied aircraft worked in unison with ground forces in a broad offensive—one encompassing not only the advance of ground troops but also direct air attacks on enemy strategic targets, aircraft, communications, logistics, and forces beyond the front lines.

Mitchell was promoted to Brigadier General by order of Gen. John J. Pershing, commander of the American Expeditionary Force, in recognition of his command accomplishments during the St. Mihiel offensive and the subsequent Meuse-Argonne offensive.

After World War I, General Mitchell served in Washington and then became Commander, First Provisional Air Brigade, in 1921. That summer, he led joint Army and Navy demonstration attacks as bombs delivered from aircraft sank several captured German vessels, including the SS *Ostfriesland.*

His determination to speak the truth about airpower and its importance to America led to a court-martial trial in 1925. Mitchell was convicted and resigned from the service in February 1926.

Mitchell, through personal example and through his writing, inspired and encouraged a cadre of younger airmen. These included future General of the Air Force Henry H. Arnold, who led the two million-man Army Air Forces in World War II; Gen. Ira C. Eaker, who commanded the first bomber forces in Europe in 1942; and Gen. Carl A. Spaatz, who became the first Chief of Staff of the United States Air Force upon its charter of independence in 1947.

Mitchell died in 1936. One of the pallbearers at his funeral in Wisconsin was George Catlett Marshall, who was the chief ground-force planner for the St. Mihiel offensive.

ABOUT THE MITCHELL INSTITUTE: The General Billy Mitchell Institute for Airpower Studies, founded by the Air Force Association, seeks to honor the leadership of Brig. Gen. William Mitchell through timely and high-quality research and writing and presentations on airpower and its role in the security of this nation.

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CHINA'S AIR AND SPACE REVOLUTIONS

China as an emerging air and space superpower

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China as an emerging air and space superpower

The transition of the People's Republic of China from the wheelbarrow age into a partially modernized economic superpower obviously amounts to a strategic revolution for the United States and the world. It is difficult to avoid the conclusion that—as the military dimension of this—China has embarked on a course intended to establish itself as, at a minimum, the dominant military power in East Asia and the Western Pacific. Central to this is their undertaking multiple simultaneous and interlocking revolutions in air and space capability. While in the past China may have been handicapped by the technological limitations of their equipment,[1] this is steadily becoming less and less the case.

This paper will review the Chinese pursuit of various revolutions in air and space technology. When viewed as a whole, the list is staggering:

- A revolution in advanced military combat aircraft, including stealth aircraft
- A revolution in support aircraft
- A revolution in Unmanned Air Systems
- A revolution in long-range precision-guided missiles, including anti-ship ballistic missiles
- A revolution in air defense
- A revolution in ASAT systems
- A revolution in aircraft carriers
- A revolution in manned space systems

A REVOLUTION IN ADVANCED MILITARY COMBAT AIRCRAFT

Until fairly recently, the People's Liberation Army Air Force (PLAAF) and the People's Liberation Army Navy Air Force (PLANAF) were largely equipped with variants of unsophisticated, short-range, single-role 2nd or 3rd gen-

eration Soviet designs, such as the F-6 (MiG-19) and the F-7 (MiG-21). This began to change in the 1990s when the Chinese acquired the Russian 4th generation Su-27 Flanker-family fighters. Recently it changed again, more rapidly, with the Chinese development and production of large numbers of their own versions of Su-27 designs and their own 4th generation designs. In producing these, they have reached past cloning foreign (especially Russian) aircraft and now design and build modified or new military aircraft and systems with limited or no foreign assistance. They have done this with the following:

- FLANKER Family. These are derived from the Russian Su-27 design (and probably its Su-30 derivative). The Chinese are producing several of their own redesigned versions in the J-11 family, which includes both single-seat and two-seat versions of the J-15, intended for carrier operations[2, 3, 4, 5] and the J-16.[6]
- J-10 FIREBIRD Family. Often compared to the F-16, the Chinese have produced at least three versions (the J-10, J-10A, and J-10S two-seat trainer[7]) and are testing another version, the J-10B.[8] The FC-20, intended for export, may be another variant.[9]

Beyond the 4th generation aircraft, China is continuing to design or upgrade and produce other combat aircraft. These include the JH-7 Flounder fighter-bomber, which may have a partially stealthy variant, the JH-7B, under construction;[10] the JF-17/FC-1 light fighter for export;[11] an upgraded version of the H-6 [Chinese version of the Tu-16 Badger] with the ability to launch the CJ-10 strategic cruise missile,[12] and the L-15 advanced trainer. They may also be working on a new bomber.[13]

Finally, China is working on combat aircraft with stealth characteristics. They have recently started testing prototypes of the J-20, an aircraft larger than USAF's F-22 Raptor, [14] with at least limited stealth.[15] In 2009 it was announced that this aircraft would be operational in 2017-19,[16] a time frame the US has recently endorsed.[17] In addition, the Chinese have recently started testing a second stealth fighter, widely called the J-31.[18]

Coupled with these is the development and deployment of the full spectrum of advanced munitions, which over time are also becoming steadily less dependent on imported designs and technology. Especially ominous is their deployment of increasingly long-range air-to-air missiles with ranges that at least rival the range of currently deployed US air-to-air missiles.[19, 20] Development (or purchase) of an extremely long range (200 nm) air-to-air missiles, such as the K-100/172 advertised by the Russians,[21, 22] would be an obvious asymmetric counter to American air power and especially dangerous to our support aircraft.

A REVOLUTION IN SUPPORT AIRCRAFT

Support aircraft (transports and tankers) have historically been something of an afterthought for China. This may be starting to change.

Their present force of strategic transports consists primarily of a small number of Il-76s bought from Russia.[23] They attempted to buy a large batch (38 aircraft) of Il-76 transports and Il-78 tankers from Russia, but the deal died due to problems on the Russian end.[24] The Chinese are now working on their own military transport designs. The logical conclusion is that if they are working on their own designs, they intend to procure them in large numbers.

The largest of these is the Y-20, a four-engine transport with a 40-metric-ton cargo capacity.[25] The Chinese may have recently started testing the prototype.[26] When perfected the airframe could obviously be used in a multitude of roles, including a tanker.

The Y-9, intended to be a C-130J equivalent,[27] has evidently recently entered service.[28] They may be testing a redesigned version with new engines and a glass cockpit,[29] although this may be additional information on the original design.

Over the longer term, we must note that China has declared the intention to build a world-class commercial aviation industry. However, so far they are evidently having trouble producing even a small world-class-quality airliner.[30] Although they may be working on a four-engine transport the size of a Boeing 767,[31] the largest aircraft publically intended for production is the C919, equivalent in size to a Boeing 737 or an Airbus 320, which makes it too small to be an effective air-to-air tanker or military transport. Further, like the rest of the Chinese civil aviation industry,[32] it is heavily dependent on foreign suppliers for subsystems and its design is evidently a generation behind the upgraded 737 and 320 designs now being prepared for production. However, it will give the Chinese at least a modest foot in the door of civil aircraft production and provide a basis to build on. We should note that, as in the Soviet/Russian example, problems with civilian production will by no means prevent them from producing world-class military equipment.

A REVOLUTION IN UNMANNED AIR SYSTEMS

The Chinese are pursuing a major unmanned air system (UAS) development effort. (In August 2011 they held a public unmanned aerial vehicle (UAV) technology competition, the International UAV Innovation Grand Prix, near Beijing.[33]) In November 2010 they had at least 25 UAV models on display at a South China air show.[34] As with manned combat aircraft, there may often be multiple parallel designs from different institutes targeting the same role, but even if the Chinese do not actually produce all the designs, the efforts do indicate a potentially impressive UAS technology base.

China also reportedly is developing several analogs to the American Global Hawk, high-altitude, long-endurance reconnaissance UAV. One of these, the innovative Xianglong design, recently started testing.[35]

The Chinese evidently are paying a great deal of attention to the medium-altitude, long endurance (MALE) UAV role. Their efforts include the Wing Loong, reportedly roughly equivalent to the American Predator.[36] They are also reported to be developing the Yilong UAS, also similar to the Predator,[37] along with the CH-4[38] and the ASN-229a[39] and possibly another, smaller, version of the Xianglong.[40] Both the Wing Loong and the Ch-4 have hardpoints for carrying small weapons.[41]

In addition, they are working on the WJ-600, an unmanned combat air vehicle (UCAV) supposedly with stealth features, [42] advertised in an ocean-reconnaissance role[43] intended to hunt US aircraft carriers.[44]

The Chinese also are reportedly working on at least two other stealthy UCAVs. One of these is the Anjian (Dark Sword).[45] First reported several years ago, its current status is uncertain, but since the role has not gone away, so it is reasonable to assume work on the design continues. At least one other UCAV design, the Warrior Eagle, has been reported, and it is also reasonable to assume they are working on additional competitive designs.[46]

Finally, China may have converted at least 200 of their retired F-6 fighters into drones or UAVs,[47] with an obvious potential use as sacrificial tools to drain supplies of defensive systems.

However, aside from some reports of a regiment of long-range high endurance UAVs controlled by the Chinese General Staff, [48] evidently few UAVs have actually been deployed with Chinese forces so far. Many of the designs may only be mockups, prototypes, or design concepts.[49] But the potential is there to harvest over time.

A REVOLUTION IN LONG-RANGE PRECISION-GUIDED MISSILES

Along with their so far modest force of strategic ballistic missiles, China has deployed a large force of unguided tactical ballistic missiles, mostly under the 2nd Artillery Corps, for use against land targets. Beijing has recently started to expand the capabilities of this force with precision-guided long-range cruise missiles and ballistic missiles, with the cruise missiles evidently much more widely deployed. Assuming the Chinese can make precision guidance systems for their ballistic missiles effective—the DF-15C reportedly has a terminally guided warhead for use against fixed targets[50]—we must expect them to augment or replace their present systems with upgraded ones. Further, very recently, there have been reports they are working on even longer-range variations—or new missiles—called the DF-25[51] and the DF-26.[52]

Long range cruise missiles

China is currently building and deploying “large numbers” (reportedly 200-500 in 2012)[53] of CJ-10/DH-10 and DH-10A long range (up to 2000 km) ground-launched[54] land attack cruise missiles.[55] The DH-10A is reportedly

at least partially stealthy and equipped with a sophisticated guidance system.[56]

China is also developing a next-generation cruise missile, the HN-2000, designed to be stealthy, equipped with advanced sensors (millimeter wave radar, imaging infrared, laser radar, and synthetic-aperture radar), and employing a guidance system based on the Chinese Beidou satellite navigation system. Reportedly, the missile also has a supersonic terminal flight phase and an expected range of 4,000 kilometers.[57]

Anti-ship ballistic missiles

The US claims China has reached initial deployment of the DF-21D antiship ballistic missile (ASBM), with a radar guided antiship warhead, although, as of December 2010, China had not yet conducted (or the West had not seen) an over-water test of the entire system.[58] In 2011, the Chief of the PLA General Staff Department, Gen. Chen Bingde, said it was still in development.[59] As of 2010 the Chinese reportedly were having trouble integrating ASBMs with targeting and command and control systems.[60] Getting the system to work would be a potentially revolutionary development.

Finally, although reports are ambiguous, the Chinese may have started deploying non-nuclear electromagnetic pulse (EMP) warheads on some of their missiles.[61] This would convert even inaccurate weapons into a much greater threat.

A REVOLUTION IN AIR DEFENSE

In the past, China's strategic air defense consisted primarily of limited-range surface-to-air missiles (SAMs) for point defense. That has been changing rapidly. The logical conclusion for recent Chinese deployments is that they are deploying an integrated air defense system (IADS)—based especially on modern, long-range SAMs—that could reach well beyond the Chinese mainland coast.

Along with being one of the major buyers of advanced Russian SAMs, including SA-20s,[62] and intending to buy SA-21/S-400s in the future,[63] China is currently producing and scaling up production of at least four advanced medium-range SAMs: the HQ-9 (Chinese-built SA-10), the HHQ-9 (naval version of the HQ-9),[64] the HQ-15 (upgraded SA-10),[65] and the HQ-18 (Chinese-built SA-12).[66] Beijing claims to have tested the SA-20 (Russian designation S-300PMU-2) to intercept tactical ballistic missiles.[67]

The Chinese also are building the FT-2000 missile system. The mobile version uses an HQ-9 missile with an antiradar seeker intended to target electronic warfare aircraft. It also reportedly has the ability to intercept tactical ballistic missiles.[68]

We should note that the type 051C Luzhou guided missile destroyer carries Russian-made long-range SA-N-20 missiles,[69] and the 052 Luyang II air de-

fense frigate carries 48 HHQ-9 missiles in vertical launch cells.[70, 71] Assuming that the Chinese can integrate these seaborne SAM systems with their land-based IADS (admittedly a major "if"), that integration would potentially extend the reach of the IADs even further offshore than coastal sites.

Additionally, the Chinese have deployed or are working on at least two advanced antiaircraft sensor systems. They have acquired several passive sensor systems, including four Kolchugas, from Ukraine.[72] China, along with Russia, is also developing a new generation of VHF radars, which can potentially track stealth aircraft.[73]

Finally, although information is fragmentary, the Chinese appear to be working on an anti-ballistic missile (ABM) capability. They have successfully tested ABM missiles,[74] including one recently,[75] and are working on an exoatmospheric ABM,[76] but it is likely the program is only in its early stages. As previously mentioned, they reportedly have tested two types of air defense missiles to intercept tactical ballistic missiles.

A REVOLUTION IN ANTI-SATELLITE CAPABILITY

The Chinese recognize that space systems are a critical American asset and a major potential US vulnerability.[77] Therefore, they are developing a wide variety of anti-satellite (ASAT) systems and dual-use technology with ASAT potential. Their ASAT capability probably already exceeds that of the USSR in the Cold War.

- In 2007 China launched multiple tests of a ground-based direst-ascent ASAT missile, at least one of which was successful. Intriguingly, the Chinese ABM and ASAT may be part of the same program.[78] Evidently Beijing launched another ASAT test in January 2010 and may be planning a further one in the near future.[79]
- Over the last several years, both American and French satellites have been hit with dazzle lasers from China. (Such incidents have been reported at least as far back as 2006.[80]) No permanent damage has been reported, but it must be taken as an indication that the Chinese are experimenting with ASAT lasers and can be expected to develop more powerful ones.[81]
- The Chinese have been testing satellite rendezvous techniques, both in 2010 [82, 83] and more recently with the unmanned Shenzhou 8 mission in November 2011, which rendezvoused with the Tiangong-1 orbiting laboratory.[84] While both of these tests were performed over a considerable period of time (the maneuvers for the 2010 rendezvous took several weeks,[85]) the basic technology has obvious ASAT development potential.

Finally, the Chinese may be developing a multistage spacecraft launch system mounted on a version of the H-6. While the spacecraft to be launched are reportedly small (50 kg) this technology also has obvious ASAT development potential.[86]

A REVOLUTION IN AIRCRAFT CARRIERS

The Chinese Navy is in the early stages of developing an aircraft carrier force. They have reconditioned the former Russian VARYAG—recently commissioned into the fleet as the LIAONING[87]—and, as previously mentioned, they are testing the J-15 carrier fighter, including making landings and takeoffs from the carrier.[88]

Evidently they tried to buy four sets of carrier arresting gear from the Russians.[89] Conservatively assigning one to the VARYAG and another for experimentation, that implied plans for at least two more carriers. Although the Russians refused to sell the systems, the Chinese evidently have built their own.[90] Reportedly they intend to build "up to three" of their own carriers,[91] possibly in the next five years.[92] Other reports say they may intend to eventually build four to six carriers,[93] possibly including nuclear-powered carriers.[94]

A REVOLUTION IN MANNED SPACE SYSTEMS

China's recent advances in manned space systems are worth mentioning because, even though China's space program is nominally civilian, it is actually military-run. Any "civilian" space technological and industrial capability potentially would be a dual-role capability. In fact, Chinese strategic writings speak of the pursuit of space dominance through integrated military and civilian operations.[95]

The Chinese manned program already duplicates many capabilities of the early US Apollo program. They are the third country to independently orbit manned spacecraft. Their first manned launch, in 2003, has been followed with three more manned launches in 2005, 2008, and 2012.

The 2008 launch, Shenzhou 7, had a crew of three, two of whom performed extravehicular activity.[96] Both the unmanned Shenzhou 8 (launched in November 2011) and the manned Shenzhou 9 (launched in 2012) rendezvoused with China's mini spacelab, the Tiangong-1.[97], [98] They also both evidently performed military functions on their missions.[99] China has launched two unmanned lunar probes, in 2007 and 2010.[100]

Further, China has announced ambitious plans for the future, including building a small space station (about 60 metric tons) starting around 2020.[101] Additionally, within the next five years, China plans to launch a three-stage lunar research program, involving probes that orbit, land, and return samples. [102] There also is evidence that Beijing is at least considering a manned lunar program,[103, 104] which will require building much larger boosters than it has at present.

Of probably more direct military significance, China is researching an aerospace plane, possibly similar to the US space shuttle.[105] That work may include both a manned system and an unmanned system. China already

claims to have successfully launched a "prototype space fighter."[106] Applying updated technology could give these a flexibility the US shuttle never had. This will especially be the case if they use an aircraft for a first stage.

CONCLUSIONS

Using largely straight-line extrapolations, by 2020 China can reasonably be expected to have at least the following:

- More than 1,000 4th generation multirole tactical aircraft and a start on deploying two (or more?) 5th generation tactical aircraft and a fully panoply of modern weapons, with increasingly long range, to go with them.
- At least a limited airlift capability.
- At least a rudimentary and possibly a significant UAS capability.
- A modern IADS covering the most important regions of China and extending to cover the Taiwan Strait and possibly much of Taiwan.
- A large force of long-range precision-guided ballistic and cruise missiles, including a substantial force of antiballistic missiles and precision-guided ballistic missiles able to cover the seas around China and threaten US and allied bases as far away as Guam.
- A significant (possibly major) anti-satellite capability and potentially a significant capacity for space warfare.
- A rudimentary (but emerging) force of aircraft carriers carrying at least 4th generation aircraft. China may also have a significant amphibious capability,[107] a subject not covered in this paper.
- A manned space capability that will approach, if not surpass, the capabilities of the mature American Apollo system and quite possibly both manned and unmanned shuttles.
- The research, development, and industrial capability necessary to support all this.

If integrated with modern command, control, computer, and communications intelligence, surveillance, and reconnaissance (C4ISR) systems, applied with an effective joint strategy, and used effectively—admittedly very big "ifs"—this should be more than adequate to overwhelm any defenses Taiwan can plausibly mount.[108] All too plausibly, it will be enough to overwhelm American and Japanese base defenses on Okinawa, pose a major threat to surface ships operating within the First Island Chain (in the Yellow Sea, Taiwan Strait, East China Sea, and at least much of the South China Sea), pose at least some threat to American or Allied bases as far away as Guam, (range may be the limiting factor against Guam),[109] and require that any American military counteraction to a regional Chinese military move will risk a major war.

And given the will and resources, the Chinese have no obvious reason to stop there.

The Chinese have obviously undertaken a comprehensive development

program of aerospace capabilities that reaches pretty much across the board. While these cannot be considered crash programs, they are clearly pursuing methodical and rapid modernization of their air, air defense, missile, and space capabilities. Further, although not covered here, we should note they are updating their C4ISR capabilities (C4IKSR to the Chinese, who include "kill" in the mix[110]) to build a system capable of joint net-centric operations and able to provide targeting for Chinese standoff weapons, including some degree of real-time targeting for their ASBMs. They are also working to build modern military transport aircraft and have announced the intention to build a world-class civilian aviation industry.

Although only partly completed, in the aggregate all of these provide the Chinese with the potential for revolutions both in aerospace technology and in military capabilities. At the level of individual systems, much of the equipment they are currently deploying or will be deploying in coming years may be roughly equivalent to many current US systems. Further, even if their equipment may be somewhat behind ours, this means much less than it did once, since in aerospace terms, a lag of 20 years now means much less than it did in, for instance, 1970. (Being, overall, 20 years behind present American military technology would still yield the technological level to wage a Gulf War I—a formidable capability.)

We must also remember that our own aerospace technology for the most part has been on a plateau for the last 30 years and that the deployed forces of the US and its regional allies in the western Pacific are at most updated versions of 1980s systems and are likely to remain so for at least the coming decade. This means that over time, we must expect that the material and technological disadvantages the Chinese have historically faced will become less and less of a disadvantage, while we and our allies will not necessarily be able to rely on superior technology to compensate for inferior numbers. Meanwhile, our ongoing fiscal and economic situation will make both recapitalizing our aging equipment and pursuing new technology enormously difficult.

Finally, we must also note that the Chinese are not only duplicating many of our capabilities; they are also building capabilities we don't have. And even if they are duplicating our capabilities, it does not mean they will necessarily use them the same way we might. The Chinese "Assassin's Mace" is as much a concept and an approach to conflict as it is a weapon system or systems.[111]

IMPLICATIONS—BUILDING FOR FUTURE REVOLUTIONS

While the Chinese have partially transformed their economy into a modern one, significant or major parts of it still remain to some degree dependent on foreign inputs. Aside from the fact that we can expect this to change over time, this may be much less of a limit than it might appear at first glance. If they can buy, or steal, the advanced technology they need and duplicate it, it may well be adequate for their needs, while saving huge

amounts of time and research and development money. There are advantages to not being first.

In addition, the ability to exploit and especially to clone sophisticated technology is not an ability to be taken lightly. Further, over time their designs increasingly have come from domestic Chinese sources. In any case, the number of new and modified aircraft and missile designs and prototypes being developed simultaneously is impressive and indicates a large and competent design capability. Presumably they won't produce all the designs. But the fact that they can and will produce a significant part of them—and in substantial or large numbers—means that we are seeing the rapid emergence of a major military aerospace production power, which we must expect to become, if it is not already, the second largest in the world.

The Chinese have made clear that they intend to become a scientific and technological superpower. How fast they can do this is uncertain. While much is made about the huge numbers of engineers and scientists they are supposedly training, the Soviets in the 1960s made similar claims, which turned out to be overstated.[112] Nevertheless, the Chinese are evidently making great investments in growing their scientific and technological base at a time when substantial portions of America are skeptical of science if not openly hostile to it. We should not take their efforts lightly. It is already clear that their efforts have been enough to ensure, as with ASBMs, that not all future revolutionary changes in technology or applications will favor us. In the longer term we will need to watch for technological surprise.

Finally, we must note that all that has been done so far has been done on an economy a third to half that of the US—shades of the USSR! What will they be able to do if and when the size of their economy matches or surpasses that of the US in the next decade or so, and their military spending matches or surpasses that of the US without having to pay American military manpower costs?

In conclusion, the days when the United States could take its status as the world's premier air and space technology superpower for granted may not be over, but it clearly is time not to be complacent. As during the Cold War, we must realize that our status cannot be taken for granted and must keep a wary eye on the competition. Above all, we need to recognize that this will be a long-term competition, and we will need to keep our own tree of aerospace innovation, especially for tactical systems, well watered at a time when there is minimal low-hanging fruit to be harvested in the near future.[113] We need to change that for combat aircraft and systems, and soon.

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