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Developing Airmen

Building a World-Class Noncommissioned Officer Corps

CHIEF MASTER SERGEANT OF THE AIR FORCE GERALD R. MURRAY



TODAY NEARLY 500,000 of America's finest men and women proudly serve as enlisted Airmen in our United States Air Force—a total force made up of active duty, Air National Guard (ANG), and Air Force Reserve (AFR) personnel standing strong to project air and space power around the globe. Our foundation consists of three enduring principles or core values: “In-

tegrity First, Service before Self, and Excellence in All We Do.” We expect all Airmen, both officer and enlisted, to live and lead by these core values, which form the basis for Air Force instructions, policies, guidance, and overall focus. Our leadership has the responsibility for articulating and reinforcing these values because new Airmen must understand the importance of using them to shape their actions.



Chief Master Sergeant of the Air Force Gerald R. Murray

To succeed, America's Air Force has always relied on strong, competent leaders—both officer and noncommissioned officer (NCO). Today's unprecedented global environment requires capable leaders at all levels. Because Airmen play a vital role in the overall success of our force, we must assure that they have the means and support to develop their full potential in accordance with our "Developing Airmen" core competency. To reach this goal, we have an obligation to plan and execute deliberate, well-thought-out steps throughout an Airman's career (see figure). We have made a conscious choice to stay actively engaged in every stage of those careers, never leaving personal and professional development to chance.

As the Air Force chief of staff travels around the world, people frequently ask him how we field such a talented, dedicated, and capable

enlisted corps. It assuredly does not happen by chance. We began to chart this deliberate development path in 1952, just a few years after the Air Force became an independent service. Senior leaders recognized how the drawdown and departure of midlevel leaders following World War II left a cadre of technically oriented personnel; however, it created a gap in the number of experienced NCOs needed to lead the rapid buildup and preparation for the Korean conflict. To close this gap, they established the first formal program of enlisted professional military education (PME) with the goal of educating and training all NCO supervisory personnel. Leaders emphasized the position and prestige of the NCO by fostering initiative and developing military bearing, forcefulness, and self-confidence.

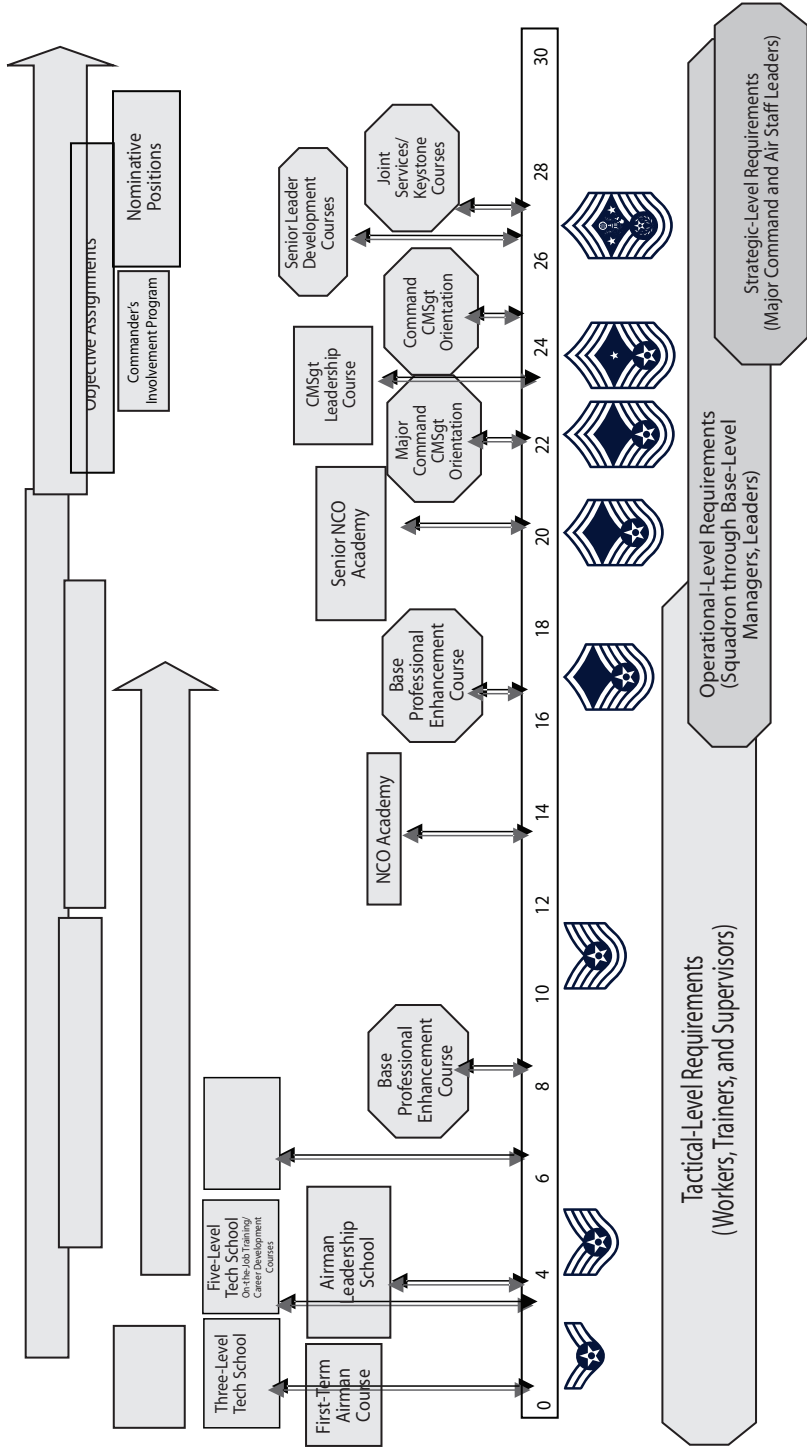


Figure. Development and utilization across a 30-year career



Chief Master Sergeant of the Air Force Gerald R. Murray discusses educational goals with SSgt Christopher Edwards and SMSgt Sandra Smith during a visit to the Air Force Senior Noncommissioned Officer Academy (AFSNCOA). Part of the support staff at the academy, the sergeants manage protocol and scheduling. The AFSNCOA, established in 1972, offers both education and training aimed at enlisted leaders in the E-7 to E-9 pay grades (or equivalent). The school's staff, faculty, and curriculum seek to meet the combat and combat-support needs of the Air Force and Department of Defense. The AFSNCOA has graduated over 45,000 students from America's armed forces and allied nations.

As the decades progressed, so did our focus on enlisted PME. Concepts and principles of leadership and responsibility dominate today's curriculum. In addition to undergoing meticulous technical training, our enlisted Airmen begin formal PME after three years' service. Each unique level varies in intensity, length, subjects offered, and learning objectives. Currently our program seeks to develop leadership abilities and supervisory skills as well as increase the understanding and appreciation of the profession of arms. After completing Airman Leadership School—the first level of PME—Airmen can expect to return to the classroom with almost every promotion.

The Noncommissioned Officer Academy prepares midlevel NCOs for increased responsibility, and the Senior Noncommissioned Officer Academy challenges senior enlisted members to expand their leadership capabilities. This level of PME also enables senior noncommissioned officers (SNCO) to engage actively as

classmates with their counterparts in our sister and allied services. Another recent innovation incorporated into every class involves an exchange between our students and junior officers attending the Air and Space Basic Course at Maxwell AFB, Alabama. This healthy give-and-take of dialogue, ideas, and interaction helps each group understand its distinctive frame of reference and differences in roles and responsibilities. The program not only helps build a better relationship between our NCOs and junior officers, but also promotes the latter's mentoring skills and development.

In the Chief Master Sergeant Leadership Course, the most recent addition to formal PME, those selected to serve in our highest rank polish and prepare their skills as leaders and enlisted-force managers. This course is specifically designed to give them a broader, more strategic view of forces. Since only 1 percent of the active duty enlisted force will have the opportunity to serve as chiefs, we must use

this very limited resource where it will have the most impact. Development entails breadth of experience and application of leadership abilities. Because chiefs hold critical leadership positions within our force, we owe them all the tools they need to excel.

Sam Parish, the eighth chief master sergeant of the Air Force, noted that “professional military education is the single greatest step taken for enlisted men and women in the short history of our Air Force.” We continually look at how we can enhance the formal education provided to Airmen through PME. In recent years, we have embraced mentoring and force development as a better means of improving our capabilities. We must ensure that all who ascend our ranks have access to every tool and opportunity to become strong, effective leaders. From providing daily coaching to conducting base-level workshops in professional leadership, we are maximizing our ability to share knowledge and experiences. The vital task of cultivating tomorrow’s leaders remains a top priority.

Recently we substantially revised Air Force Instruction 36-2618, *The Enlisted Force Structure*, 1 December 2004, to more clearly define the roles and responsibilities of each level of the enlisted force. We must see to it that all Airmen understand what we expect of them, now and in the future. We group Airmen into three distinct tiers, each reflecting increased levels of training, education, technical competence, experience, leadership, and managerial responsibilities.

The *Airmen* tier encompasses the Airman Basic, Airman, Airman First Class, and Senior Airman ranks. Initially these personnel concentrate on adapting to the requirements of the military profession, achieving technical proficiency, and learning how to become highly productive members of our Air Force. After becoming Senior Airmen, they begin to exercise limited supervision and leadership as they prepare for increased responsibilities, while continuing to broaden their technical skills.

Noncommissioned officers include staff sergeants and technical sergeants who, in addition to maintaining their technical growth and becoming expert hands-on technicians, also serve

as first-line supervisors. NCOs ensure that their team members work together to accomplish the mission. Charged with training and developing the Airmen they supervise, these officers also cultivate their own leadership skills in preparation for increased responsibilities.

Senior noncommissioned officers include the top three ranks of the enlisted force: master sergeant, senior master sergeant, and chief master sergeant. As critical components of the Air Force’s ability to project airpower, SNCOs have a great deal of experience and leadership ability that they use to leverage resources and personnel against a variety of mission requirements. Primarily, they seek to fulfill the organization’s mission through the skillful use of teams. They also concentrate on developing their teams and people, both technically and professionally. SNCOs contribute to the decision-making process on a variety of technical, operational, and organizational issues, and a few of them go on to serve at the highest levels of the Air Force as strategic leaders and managers. Because each of these roles is essential to the Air Force’s accomplishment of America’s missions, we exert tremendous effort to ensure that Airmen can successfully fill each position.

Technical training and PME form the core of enlisted development, but the educational process doesn’t stop there. With knowledge comes power, so NCOs need to stay at the top of their game in every respect. We place so much value on formal education that our Airmen gain college-level credits for their military education through the Community College of the Air Force (CCAF).

Founded in 1972, the CCAF is the only degree-granting institution of higher learning in the world dedicated exclusively to enlisted Airmen. As America’s largest community, junior, or technical college, it offers a unique opportunity for motivated, career-oriented Airmen and NCOs to earn a job-related, two-year undergraduate degree. Open to active duty, ANG, and AFR members, and accredited by the Commission on Colleges of the Southern Association of Colleges and Schools, the CCAF awards the Associate in Applied Science degree. Its careful mix of education from diverse sources—designed to fuse technical education

and PME with off-duty education at civilian institutions—equips graduates with information and mental tools needed for enhanced performance within their Air Force specialties.

The CCAF seeks to give enlisted Airmen an opportunity to earn a degree in their Air Force specialty. If they need additional classes to complete the degree, they can take them at any accredited institution; civilian colleges located on Air Force installations offer many of these courses. The Air Force provides active duty members tuition assistance that usually covers the entire cost of an average undergraduate class. Despite ceilings on the amount of funds available each year, Airmen expend very little, if any, of their own money to earn a two-year degree.

Education levels throughout the enlisted force reflect the clear advantage of providing college-level accreditation for military training and funding basic tuition (see table). Seventy-five percent of midgrade NCOs have one to three years of college; 14 percent of the enlisted corps has an associate's degree; over half of our master sergeants have an associate's degree; 47 percent of chief master sergeants have a bachelor's degree; and 13 percent of chief master sergeants have a master's degree or higher. This speaks volumes for the dedica-

tion to learning and the value that SNCOs place on higher education.

Certainly higher rank carries correspondingly more responsibility and workload, making it more difficult to find time to balance work, family, and school. SNCOs set aside time for formal education not only to increase their knowledge in a chosen field and gain a degree, but also to enhance their standing with promotion boards. Although the Air Force requires no degree for enlisted Airmen, SNCO records undergo a board review and grading for promotion. Because earning an associate's degree in their primary career field indicates an increased level of dedication and commitment, career-oriented Airmen fully realize the value of a degree and aggressively pursue it.

For a few select Airmen, our service offers an even more advanced educational opportunity. Beginning in 2002, the Air Force designated eight SNCOs to attend the Air Force Institute of Technology (AFIT), located at Wright-Patterson AFB, Ohio. Traditionally, mostly company-grade officers matriculate at AFIT, the Air Force's graduate school of engineering and management as well as its center for technical professional continuing education. SNCOs in the class of 2004, the first to include enlisted members, received specific follow-on

Table. Levels of education in the enlisted force

Enlisted Education Levels	Junior Enlisted (E1–E4)	NCOs (E5–E6)	SNCOs (E7–E9)
High school only	10,827	431	11
1–3 years of college	106,337	90,144	12,223
Associate's degree	2,688	23,942	16,386
3–4 years of college	686	921	714
BA/BS	1,698	4,568	6,320
MA/MS/PhD	35	439	1,428

assignments to capitalize on their newly acquired science, technology, and systems skills. This program offers great potential for increased rank and responsibility, not to mention the enhanced capabilities that technically trained and focused NCOs will give our force.

Promoting the right Airmen to leadership positions remains an active, ongoing process. From providing career counseling and mentoring to writing concise performance reports, senior leaders aim to groom Airmen to become outstanding SNCOs. We must lay out a clear road map for new Airmen to follow and continue guiding them along the way. By producing technically competent professionals, building solid foundations, and developing strong leaders, we can add outstanding SNCOs to the Air Force.

We often hear that NCOs are the backbone of our service. Because they serve as front-line supervisors, have extensive knowledge of Air Force people and their mission, and exert much influence on their teams, exposing them to the right training, education, and experience is crucial. If we deliberately chart a course to develop the tremendously talented

NCOs within our ranks, we will create strong leaders, managers, and supervisors. Without question, people are our most valuable resource, and we must make them our first priority. We can have the most sophisticated aircraft and hardware on Earth, but if we don't have talented, competent, and motivated people to employ them, they are useless.

Every officer and NCO has a fundamental responsibility to develop Airmen to their fullest potential. We must continue to leverage all the talents of our young Airmen and groom them for additional responsibility. We firmly believe that having the right leaders in the right place at the right time, combined with giving them proper education and training, produces a great force multiplier. These concentrated intangibles start a ripple effect throughout our organizations that is invaluable. The Air Force and its sister services enjoy a unique asymmetrical advantage: instead of "paper-cutting" leaders, we capitalize on the differences each member brings to the team and exploit those distinctions to our advantage in developing Airmen. □

The pendulum in aircraft design swings faster than a grandfather clock. The superior airplane today may be discarded as unsafe or unsound for air combat tomorrow. It is possible, however, to look back over the way we have come, then to gaze skyward today and make some fairly safe predictions about the fighting plane for next spring.

—Maj Gen Henry H. "Hap" Arnold and Col Ira C. Eaker



Introducing the French *ASPJ* and Presenting the Latest *Chronicles Online Journal* Articles

AIR AND SPACE *Power Journal* has published English, Spanish, and Portuguese editions since the 1940s. We added an Arabic edition in early 2005. We are now pleased to announce the imminent debut of the French *ASPJ*. The new journal's audience includes all the world's French-speaking militaries—notably those in Africa. Like the editors of the other editions, the French *ASPJ* editor is a regional expert and native speaker who tailors the journal's content to match audience interests.

Mr. Rémy Mauduit possesses impressive credentials. Originally from Algeria, he has extensive insurgency and counterinsurgency experience in the Algerian War of 1954–62. As a Front de Libération National (FLN) insurgent, he fought against the French for five years until his fellow insurgents, suspecting him of being a spy, imprisoned and tortured him. Escaping his torturers, Mr. Mauduit defected to the French side and became an army lieutenant in a commando unit that hunted his former FLN cohorts. Later, as French president Charles de Gaulle conceded defeat, Mr. Mauduit deserted the French army to join the Organization Armée Secrète (OAS), a renegade group led by senior French army officers who violently opposed de Gaulle's plans to give up Algeria. Mr. Mauduit's OAS career proved short-lived when the French army soon captured and imprisoned him. He emigrated to the United States after his release and traveled extensively throughout Africa during a long business career. Mr. Mauduit is also an accomplished educator and author. For details about how his experiences in the Algerian War re-

late to current counterinsurgency operations, see the book review of his memoirs at <http://www.airpower.maxwell.af.mil/airchronicles/bookrev/berg1.html>.

For the inaugural edition of the French *ASPJ*, Mr. Mauduit has selected and translated previously published English *ASPJ* articles about US military strategy. He is soliciting articles from French-speaking airmen worldwide and will publish them in upcoming quarterly issues as they become available.

The Spanish, Portuguese, and Arabic *ASPJ* editions address the professional-development needs of militaries in at least 46 Latin American, European, African, and Middle Eastern countries. Many air forces, armies, and navies use *ASPJ* in academies and staff colleges because the journals are readily accessible in their native languages. Government officials also find them useful. We hope the French *ASPJ* will prove equally valuable to at least 20 African, European, and North American militaries. Counting the coverage of the English edition, *ASPJ* now reaches over 90 countries in their native languages.

All of the *Air and Space Power Journal* editions promote professional dialogue among airmen worldwide so that we can harness the best ideas about airpower and space power in pursuit of national goals. The *Chronicles Online Journal (COJ)* complements the printed editions of *ASPJ* but appears only in electronic form. Not subject to any fixed publication schedule, *COJ* can publish timely articles anytime about a broad range of topics, including historical, political, or technical matters. It

also includes articles too lengthy for inclusion in the printed journals.

Articles appearing in *COJ* are frequently re-published elsewhere. The Spanish, Portuguese, Arabic, and French editions of *ASPJ*, for example, routinely translate and print them. Book editors from around the world select them as book chapters, and college professors use them in the classroom. We are pleased to present the following recent *COJ* articles (available at <http://www.airpower.maxwell.af.mil/airchronicles/cc.html>):

- Mr. James Michael Snead's "Near-Term Manned Space Logistics Operations,"
- Mr. Michael D. Pixley's "False Gospel for Airpower Strategy? A Fresh Look at Giulio Douhet's 'Command of the Air,'"

- Dr. Mark J. Conversino's "Operation DESERT FOX: Effectiveness with Unintended Effects," and
- Mr. Alexander M. Wathen's "The Miracle of Operation Iraqi Freedom Airspace Management."

The *ASPJ* editorial staff is always seeking insightful articles and book reviews from anywhere in the world. We offer both hard-copy and electronic-publication opportunities in five languages. To submit an article in any of our languages, please refer to the submission guidelines at <http://www.airpower.maxwell.af.mil/airchronicles/howto1.html>. To write a book review, please refer to the guidelines at <http://www.airpower.maxwell.af.mil/airchronicles/bookrev/bkrevguide.html>. □

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Ricochets and Replies

We encourage you to send us your comments, preferably via e-mail to aspj@maxwell.af.mil. You may also send letters to The Editor, Air and Space Power Journal, 401 Chennault Circle, Maxwell AFB AL 36112-6428. We reserve the right to edit the material for overall length.

NARROWING THE GLOBAL-STRIKE GAP

Col George D. Kramlinger's article "Narrowing the Global-Strike Gap with an Airborne Aircraft Carrier" (summer 2005) outlines an interesting near-term idea for global strike. In fact, his article suggests an even better solution for future-generation unmanned aerial vehicles (UAV). That said, in the more distant future, through nanotechnology Colonel Kramlinger's idea comes full circle and again becomes an effective means for global strike.

Long-range unmanned combat aerial vehicles (UCAV) coupled with unmanned tankers could provide continuous presence without the use of large, vulnerable, and expensive airborne aircraft carriers. We could place these UCAVs in extremely long-duration, continuous orbit in close proximity to the target area or anywhere else since they would no longer need to land to accommodate an onboard pilot, and unmanned tankers could refuel them. This arrangement would provide the flexibility to disperse the force and thus make it less vulnerable and visible during hostilities. Effective attack of a target would still require the principle of mass, but we would need to achieve mass only at the precise moment of attack. On the other hand, we could deliberately form the long-range UCAV force in mass to provide force presence, as we do today with the aircraft carrier.

In the distant future, nanotechnology—coupled with effects-based weapons—could enable small, long-range UCAVs to launch nanoweapons or nanoplatforms. This concept uses a similar mother-ship principle outlined by Colonel Kramlinger except for the fact that the mother ship would be a small, long-range UAV. Nevertheless, by then space-based weap-

ons could negate the need for atmospheric-based platforms altogether.

Let's not be bashful. A long-range UCAV force could replace the oceangoing aircraft carrier since the objective behind all of these concepts, both current and future, is the application of appropriate effects—controlled and delivered through the air by any means. (See page two of my unpublished research paper entitled "Unmanned Aerial Vehicles: The Parallel Warrior's Platform in the Military after Next" [Newport, RI: US Navy War College, October 1998].)

Col Russell M. Gimmi, USAF
Randolph AFB, Texas

RETURN OF THE BOMBER BARONS

I certainly agree with Maj Jeffrey W. Decker's article "Return of the Bomber Barons: The Resurgence of Long-Range Bombardment Aviation for the Early Twenty-first Century" (summer 2005) on the importance—indeed, the necessity—of long-range strike to the Air Force mission. I am not nearly as hopeful, however, that we will see any real movement in that direction in the foreseeable future.

As of today, the Air Force has over 2,500 fighter aircraft but only 181 bombers. Over the next decade, the service plans to buy as many as 2,000 more fighters—F/A-22s and F-35s—but there are *no* plans to buy any bombers. The Air Force has issued a proposal—at the prodding of Congress—for ideas on an "interim" bomber that would bridge the gap between the current bomber-force structure and the hypothetical B-3 that will probably not enter the inventory until 2037 (that's right—over three decades from now). Instead of long range, this interim bomber will have an un-

specified “medium” range of about 1,500 nautical miles. Even so, the long-range budget contains no money for such a bomber. The \$100 million cited by Decker is a very far cry from the \$10–15 billion needed to field such a weapon system. Where would the money come from to buy such a plane? Would the Air Force leadership cut fighter procurement to field it?

Increasingly, threat scenarios posit a major war in Asia—the “traditional” threat in the jargon of the current Quadrennial Defense Review. Although it is not polite to say so aloud, one potential adversary in such scenarios might be China. In such an eventuality, the 2,500 short-range fighters of the Air Force would necessarily play only a minor role. After all, where would we find bases that did not lie within range of China’s hundreds of ballistic missiles? Would we seriously consider attempting to conduct a prolonged air campaign entailing 10-hour combat missions flown from Guam in single-seat aircraft? Instead, the dwindling supply of heavy bombers—of which 21 are stealthy B-2s—would be asked to carry the load, but Chinese air defenses, which sport the latest surface-to-air missiles, would prove formidable. Only the B-2—or older B-1s and B-52s remaining well out of range and armed with standoff weapons not yet purchased—could be expected to survive and maintain any type of rational operations tempo.

The Air Force must be careful. For decades it has claimed to be the sole practitioner of long-range strike (exclusive of the Navy’s submarine-launched ballistic missiles and Tomahawk cruise missiles). If the Navy were clever, it would buy strike versions of the joint unmanned combat aerial vehicle and put them on carrier decks, thus giving it a true long-range, penetrating strike capability from close-in bases. The Navy would then become heir to the long-range strike mission that the Air Force seems unwilling to take seriously.

Col Phillip S. Meilinger, USAF, Retired
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AGGRESSIVE ISR IN THE WAR ON TERRORISM

I agree with much of what Lt Col William B. Danskine proposes in his well-reasoned article “Aggressive ISR in the War on Terrorism: Breaking the Cold War Paradigm” (summer 2005). However, I think his suggestion that many nations should embrace the advantages of US intelligence, surveillance, and reconnaissance (ISR) flights over their territory ignores the political pragmatics of the issue. In almost every case, notwithstanding the U-2 flights over the Georgian-Russian border area mentioned in Colonel Danskine’s article, such flights are covert because the host nation doesn’t want to be publicly associated with them. Further, sharing intelligence with host nations is a very difficult but not insurmountable bureaucratic issue to solve. It will take a strong secretary of defense, director of national intelligence, and secretary of state acting on the orders of a confident president—and a few public executions when the bureaucrats drag their feet.

To begin this effort at the level of the US Embassy’s chief of mission will require great coordination and education between the Air Force attaché and the ambassador, to say the least. The ambassador’s priorities probably won’t be the same as the military’s, which will require some intra-embassy political bridge building. On the main point, though, I agree with Colonel Danskine. I find the persistent Cold War mentality evident in all of the services, particularly in recent testimony and briefings about future plans. As the primary provider of ISR, the Air Force must take the lead in breaking out of that mentality. It seems, however, that the solution is a net-centric warfare concept focused on enabling the ground and air war fighter to employ weaponry on fixed and mobile targets. This indeed validates the idea that we’re currently mired in a Cold War mind-set. That’s particularly disturbing since it dictates where our doctrine and dollars will be directed. Yes, a net-centric solution would enable vast amounts of information to be pushed to the lowest levels of the battlefield, but it would also require technology that focuses on the spectrum of threats—not just

the traditional ones, such as the enemy's Integrated Air Defense System or armor order of battle. By that, I mean those threats associated with the global war on terrorism, which Colonel Danskin addresses in his conclusions and recommendations.

Right now the buzzword in the Department of Defense is *capability-based thinking*, but I think the war on terrorism may be a unique case for reapplying *threat-based thinking*. In that paradigm, we must examine how our adversary employs his forces, how his culture dictates his behavior and his view of our culture, where he will likely be most comfortable operating, and what targets of ours he will find most attractive to strike. Then we must truly transform our doctrinal and investment decisions accordingly. Our current doctrine and technology are clearly inappropriate for finding small groups of people planning terrorist activities in Baghdad or Brooklyn.

Unless and until our planning and training move from a Cold War force-on-force mentality to one that tries to anticipate the enemy's actions in a more global fashion, we will continue to repeat our past third-generation-warfare mistakes. But once it is reoriented, that new perspective will drive our employment of ISR and other assets most effectively and with the best capability for all of the war fighters on the right side of the fight.

Lt Col Mike Hammon, USAF, Retired
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US AIRPOWER IN KOREA

Dr. Bruce E. Bechtol Jr.'s article "The Future of US Airpower on the Korean Peninsula" (fall 2005) does not give due consideration to whether US airpower must be in South Korea to deter and, if necessary, respond to North Korean aggression. One can argue that the continued presence of US forces in South Korea, including air forces, complicates the options

of our commander in chief with regard to North Korean nuclear ambitions. The US military presence in South Korea enables North Korea to hold undue leverage in negotiations over its nuclear weapons. North Korea's nuclear weapons, unlike its conventional arms, pose a grave threat to US interests and forces both in Japan and the United States itself. The United States should be free to respond to such a threat without endangering its South Korean allies.

Were US forces not in South Korea and the United States preempted or responded to North Korean nuclear mischief directed at off-peninsula US interests, North Korea would have no pretext for invading South Korea in response to US preemptive or retaliatory strikes on North Korean leadership and nuclear targets. However, the presence of US forces on the Korean peninsula makes South Korea as well as US forces in South Korea the obvious focus of any North Korean retaliation to a US strike. This fact has caused diplomatic challenges and has highlighted differences in US and South Korean approaches to responding to the North Korean nuclear threat.

Recent moves by the US Air Force to position more airpower in the Pacific theater can contribute to an outcome favorable to US interests on the North Korean nuclear issue. US forces in Japan, Guam, Alaska, and other locations can serve as a deterrent to Kim Jong Il's nuclear ambitions as well as bring an effective response to a senseless conventional attack against South Korea. Airpower's reach can give American leadership greater flexibility in dealing with the North Korean nuclear challenge. This may be a wiser application of US airpower, which, as Dr. Bechtol rightly states, can prove decisive. It's time to reconsider the necessity and wisdom of positioning US forces and airpower on the Korean peninsula.

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The Air Force of the Future

AIRMEN HAVE ALWAYS been visionaries—even before an independent US Air Force existed. One of the earliest Airmen—often called the father of the Air Force—earned a reputation as a prophet because of his perceptive insights. More than 20 years before the Air Force became a separate service and long before the term *air superiority* entered Airmen’s parlance, William “Billy” Mitchell was looking forward, into the unknown. In his book *Winged Defense*, he opined that “great contests for control of the air will be the rule in the future.” That brief sentence, penned more than 80 years ago, describes fairly well the modern concept of air superiority. As Mitchell prophesied, gaining and maintaining air superiority has taken its place among the top priorities of present-day combat. It is one thing to marvel at this kind of foresight, but it is another thing altogether to press ahead, as did Mitchell and his fellow airpower pioneers, to fulfill the possibilities of the future. This edition of *Air and Space Power Journal* dedicates itself to precisely that endeavor: peering into the future.

We currently enjoy technological capabilities that allow us to routinely perform heretofore unprecedented feats—seeing in the dark, for example. Furthermore, whereas our air forces of the past often needed multiple aircraft to attack a single target successfully, just one B-2 Spirit bomber can now carry 40,000 pounds of weapons through the world’s most advanced defenses and engage multiple targets. Granted, the dangers associated with plucking an American service member from deep within enemy territory have not diminished over time, but modern combat-search-and-rescue troops have the equipment to do so with exceptional efficiency and effectiveness. To cite a final example, thanks to today’s remotely controlled aircraft,

the Air Force can quietly keep watch over a variety of trouble spots.

In the century since Billy Mitchell began dreaming of exploiting the air for military purposes, we have moved past that medium—into space. Among the contributions of space assets, satellites beyond our atmosphere help ground forces navigate featureless desert terrain and guide “smart bombs” to their targets. Arguably, without these and other advantages offered by space, US armed forces would not have become the world’s preeminent military power. Thus, we may legitimately ask whether or not an independent US Space Force should stand up and, if so, when.

But questions about our future don’t stop there. We can also ponder how the Air Force of the future will organize itself. How will our service educate, train, and equip its people? We face these questions and many others. Possible answers lie within the pages of this journal, where forward-thinking people speculate about a number of intriguing possibilities, from using balloons on the edge of space, to ensuring the operational security of the Internet, to providing technical education for Airmen engaged in space operations, to building a world-class enlisted corps.

The endearing—and enduring—American comedian George Burns, who died at the age of 100 in 1996, left us a treasury of wry observations, including his comment that “I look to the future because that’s where I’m going to spend the rest of my life.” Although, like Mr. Burns, we will spend the rest of our lives in the future, we do not know what it will look like. The US Air Force has come a long way, but we must now decide what comes next. We must become the Billy Mitchells—the prophets and the pioneers—so that we can shape our future. The *ASPJ* staff hopes that the articles in this issue will challenge assumptions, spark new ideas, and help lead us into the future. □



Air Force Doctrine Document 2-1.6, *Personnel Recovery Operations*

COL DARREL WHITCOMB, USAF, RETIRED

AMERICA'S ARMED FORCES have maintained a commitment to recover any isolated personnel from hostile or uncertain environments, and denied areas" (iii). So writes Maj Gen Bentley B. Rayburn, commander, Headquarters Air Force Doctrine Center, in the foreword to Air Force Doctrine Document (AFDD) 2-1.6, *Personnel Recovery Operations*, 1 June 2005. Traditionally, the Air Force's doctrine and force structure have focused primarily on the recovery of downed aircrews. The histories of such events are legend. But experiences during more recent conflicts, especially Operations Enduring Freedom and Iraqi Freedom, indicate that all services must do a better job of integrating doctrine, tactics, techniques, and procedures for the recovery of *any* personnel, whether downed aircrews, trapped special-forces teams, allied forces, or even the Department of Defense's (DOD) civilian personnel or contractors.

One finds the basic guidance for this paradigm shift encapsulated in the draft version of Joint Publication (JP) 3-50, "Joint Doctrine for Personnel Recovery," now in the final stages of coordination. Based on the guidance in that publication, the latest version of AFDD 2-1.6 contains many changes. The new title (formerly *Combat Search and Rescue*) does not denigrate the importance of combat search and rescue (CSAR); rather, it reflects the Air Force's coordinated actions and efforts that support the joint personnel recovery (PR) system as laid out in JP 3-50. The CSAR team or task force—the key Air Force tool for prosecuting recovery missions—remains the foundation of Air Force recovery actions. But PR operations undergird not only

the joint PR system but also the five tasks of reporting, locating, supporting, recovering, and reintegrating. AFDD 2-1.6 lays out in general terms the key considerations and tasks for the three components of PR: the command, control, and coordination node; recovery forces; and isolated personnel. The document stresses the operational level throughout; earlier expansions of tactical detail have been removed.

Although AFDD 2-1.6 reflects increased emphasis on PR throughout the DOD, it seems remiss in one area. Specifically, the document clearly shows that in terms of isolated personnel, the Air Force focuses on its Airmen (as in aircrews). Very recent events, however, suggest that this stance needs some expansion. Granted, aircrew members find themselves at risk in several theaters, but today's enlisted Airmen perform battlefield duties around the globe. Additionally, they serve as convoy guards and conduct local engineering projects among potentially hostile populations. All of these activities put them at increasing risk of isolation.

Working alongside these Airmen are many Air Force civilian employees and contractors, also at risk of isolation. Although *Personnel Recovery Operations* does mention these two groups in passing, it does not address this developing dilemma in any detail. Perhaps the next revision will. Regardless, the latest edition of AFDD 2-1.6 makes apparent the necessity and challenges of maintaining a viable PR capability in a fast-changing world. Because this document represents a significant doctrinal rewrite, anyone involved with the PR mission should read it carefully.

To Learn More . . .

Air Force Doctrine Document (AFDD) 2-1. *Air Warfare*, 22 January 2000.

AFDD 2-1.6. *Personnel Recovery Operations*, 1 June 2005.

Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3270.1A. *Personnel Recovery within the Department of Defense*, 1 July 2003.

Department of Defense Directive (DODD) 2310.2. *Personnel Recovery*, 22 December 2000.

Grier, Peter. "Civilians in Harm's Way." *Air Force Magazine*, July 2005, 52–55.

Joint Publication (JP) 3-50. "Joint Doctrine for Personnel Recovery." Draft, n.d.



In the future, we will require deep-strike capabilities to penetrate and engage high-value targets during the first minutes of hostilities anywhere in the battlespace.

—Gen T. Michael Moseley

The First Rule of Modern Warfare

Never Bring a Knife to a Gunfight[©]

COL RICHARD SZAFRANSKI, USAF, RETIRED*

There is a tendency in our planning to confuse the unfamiliar with the improbable. The contingency we have not considered seriously looks strange; what looks strange is thought improbable; what is improbable need not be considered seriously.

—Thomas Schelling

IT COMES AS no surprise that the first rule of gunfighting is “Never bring a knife to a gunfight. Bring a gun. Preferably, bring at least two guns.”¹ That said, under what conditions might a manned fighter be a gun or a knife in fights of the future? The question addresses manned fighters in general, *not* any particular instantiation of a manned fighter, such as the F-35 Joint Strike Fighter (JSF), the F/A-22 Raptor, China’s J-10, the Eurofighter Typhoon or the Gripen, the Mikoyan Article 1.42 (also known as the Mnogofunktsionalny Frontovoi Istrebitel [MFI, multifunctional frontline fighter]), or the Rafale—although we may use some of them as examples.

In the case of the manned fighters mentioned above, separate countries may be on the other side of the decision river already. Those nations, including the United States, have such confidence in their foreknowledge of the future that they are committing a fair (and increasing) chunk of national treasure—always subject to review—to the capabilities that one version or another of a future manned fighter promises to provide.² Moreover, so confident are we in understanding the future environment that, absent

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limitless treasuries, we also must be forgoing investments in apparently less-valuable military equipment for nonaviation elements of our joint forces in order to purchase a future manned fighter. The fact that air forces around the planet periodically need or want a new manned fighter is a familiar condition. But now let's move to unfamiliar conditions.

Four Simple Premises about the Future

The past is done. Finished. The future does not exist. It must be created microsecond by microsecond by every living being and thing in the universe.

—Edward Teller

This article seeks to enlarge our thinking by creating or defining a few future states wherein manned fighters may have less utility (or little or no utility). Such states would serve as a counterpoint to the futures envisioned or created by planners in the United States and Europe, wherein a manned fighter is an essential element of an armed force. Thus, the article paints pictures of potentially strange and unfamiliar futures, allowing readers to decide whether these states—or combinations of them—are improbable or not. If any do *not* seem improbable, however strange they may be, we must take them seriously in our planning. Not only must we envision an unfamiliar future (all futures are unfamiliar) but also we must test the value or utility of a manned fighter in those environments.

Envisioning these futures entails accepting four simple premises. The first holds that some things will change over time. I think Edward Teller is correct in asserting that there is really no such thing as “the future,” which—unless or until we have better understanding or mastery of the time-space continuum—is a mental construct, an abstraction, or an invention. Thus, we may construct any future or as many futures as we like.

The second premise tells us that the future—this bundle of changes 10, 20, or 30 years hence—will not resemble the present in every regard. That is, given additional discoveries in chemistry, physics, biology, microelectronics, nanotechnology, and so forth, it is inconceivable that materials, structures, computing machines, robotics, propulsion, sensors, and the like would not experience an accelerating rate of change. Rather, we may reasonably and logically assume that human invention and inventiveness will not cease.

According to the third premise, future discoveries in one science or discipline inevitably will converge with discoveries and applications in other sciences and disciplines, just as they do today but at an even faster rate, given increasing connectivity on the planet. At one time, biochemistry, psychopharmacology, and astrobiology did not exist. At one time, telephones were not portable, and cameras were not hosted by personal digital assistants. We can safely say that stranger things are coming.

The final premise is that the scientific discoveries of one epoch foreshadow the military applications of heft in the next epoch. That is, as Malcolm

Dando points out in his book *Biological Warfare in the 21st Century*, the work and discoveries of eighteenth- and nineteenth-century chemists gave us the energetic materials—the explosives—of the late nineteenth and early twentieth century. The work and discoveries of nineteenth- and early twentieth-century physicists eventually gave us the atomic weapons of the late twentieth and the twenty-first century.³ Since today's scientific applications of heft are biology, directed energy, and nanotechnology, we may logically assume, as we invent our futures, that the next epoch will see potent weapons and systems built around at least these elements and their convergence.

Six Futures Unfriendly to Manned Fighters

There are, in round numbers, 6,000,000,000 futurists on our planet. There are so many futurists because every human carries inside her or his skull a set of assumptions about what does not yet exist.

—Alvin Toffler

Recall that no one can predict the future, but anyone can invent a mental construct because all of us do. As some define the term, if a person takes the trash out the night before it is collected, then he or she is a “futurist.” If we accept the four simple premises—that things change, that the future will not resemble the present in every regard, that sciences and disciplines will create convergent applications, and that the scientific discoveries of one epoch foreshadow the weapons of the next epoch—we can now construct six futures.⁴ To sharpen our thinking, these futures are deliberately unfriendly to manned fighters.⁵

One Shot, One Kill from Space

Imagine a world in which sensor technology, nanotechnology, space propulsion, and space-station keeping have converged and advanced to the point that we can detect and track all objects in the atmosphere and then engage them with a single pellet moving toward its target at Mach 26 or with directed energy traveling at the speed of light. To avoid such a weapon, a manned fighter would have to create a companion future wherein an incredibly maneuverable aircraft can fly at hypersonic speed, remain stealthy from all aspects as well as invisible to all sensors, and sense and avoid a centimeter-sized ball bearing or instantaneous energy traveling at least five times faster than its target. If not, the gun may become a knife.

Impenetrable Airspace

The previous vignette described a future in which space occupies the high ground and space superiority trumps air superiority. But space need not trump air. Perhaps the ground can trump air. Air superiority presupposes operating when control of the skies is disputed and having high survivability against multidimensional threats. But envision a future in which combina-

tions of sensors (some on birds and bugs, some on unattended platforms on patrol, some on tethered aerostats, and some in constellations on the ground looking toward the horizon) as well as kinetic and nonkinetic engagement technologies make the air impenetrable to a fighter. Imagine electromagnetic rail guns; highly mobile, man-portable hypersonic missiles; mobile, rocket-powered artillery; lasers; microwave weapons; electromagnetic-pulse weapons; and miniature, unmanned air-and-space vehicles operating in intelligent swarms sucked into air intakes—the mass equivalent of a computer “flood” attack working not on a computer’s operating system, but on the fighter’s propulsion system. Imagine all of them acting together to make the cost of a shot so inexpensive that flying a manned fighter into such a fur ball is economically unfeasible, if not militarily unwise. To these weapons add information operations at the point of origin that extract data from an inertial navigation system—or change it—or that read the head-up display and send it to the defenders. The gun becomes a knife.

Virological and Bacteriological Weapons

Imagine the asymmetry of a future manned fighter squaring off with an enemy’s antiagricultural weapon. A virus is “an ultramicroscopic infectious agent that replicates itself only within cells of living hosts.”⁶ Many viruses are pathogenic; that is, they cause disease in living organisms. Bacteria are “any of numerous unicellular microorganisms, occurring in a wide variety of forms, existing either as free-living organisms or parasites, and having a wide range of biochemical, often pathogenic properties. [Some are] capable of causing human, animal or plant diseases.”⁷

Picture a future in which biology has advanced to the point that virological and bacteriological weapons constitute the new nukes or the poor person’s nukes for deterrence and reprisal. Any attacks on the homeland of an enemy so armed could result in an alteration of the attacker’s ecosystem (or that of the attacker’s ally), even though the retaliatory strike need not be (and probably would not be) acknowledged.⁸ The advantages of this kind of warfare, according to the US Federal Emergency Management Agency, include less physical risk to the attacker, smaller chance of outrage and backlash when attacks are nonattributable (especially since natural outbreaks could be the cause), and fewer technical barriers to creating such weapons.⁹ Under the risk of an enemy waging agricultural, virological, or bacteriological warfare, alliances may weaken—and the gun becomes a knife.

The Bake Sale and the Perfect Storm

In the years well before Operation Iraqi Freedom, many “soccer moms” in the United States, concerned about the relative US investment in guns and butter, sported bumper stickers on their crashproof Volkswagens and Saabs that read, “It will be a great day when our schools get all the money they need and the Air Force has to hold a bake sale to buy a bomber.” Envision a future in which the domestic economic climate is such that senators, congressmen,

and parliamentarians become intolerant of defense expenditures that they and their constituents consider unnecessary.

The political climate in democracies breeds all the conditions—not only for bake sales but also for perfect storms—that future manned fighters (or any other large procurement of military equipment) must fly through. Free speech, high tolerance of diversity and dissent, universal suffrage, the right to elect representatives accountable to their constituents, public debate, perhaps intervention fatigue, transparency, and the oversight of expenditures demanded by good stewardship (as well as *civitas*) all come together when the military speaks of the need for modernization or recapitalization.

Modernization or recapitalization of military equipment must be designed so that this equipment—especially the manned variety—can survive in combat and suffice for decades. To last many years and reduce the risks of operating in the future combat environment, the equipment has to be at the leading or bleeding edge of technology—which demands large expenditures. Because of the enormous sums taxpayers must provide, such programs require a great deal of oversight to ensure high accountability. The more oversight, the more complex and exculpatory the offers or bids from industry.

The more indemnification in the bids, the more the government must pay the contractor if the former causes a delay, makes an engineering change, or alters a schedule. The more changes, the more slips. The more slips, the more costs. The more costs, the more oversight. The more oversight, the more expense and delay. The more expense, the more reviews. The more reviews, the fewer units procured or the less capable the units, as this or that functionality is scrapped to save a few pence. The fewer units procured, the greater the costs. The less functionality, the more pronounced the perception of a “breach of contract” with the electorate. And, of course, if the procurement lasts more than two years, we can throw political parties and elections into the mix. As a consequence, perfect storms inevitably batter all large procurements. The predicate of the problem—the cost of slow procurement processes, policy, or excessive oversight—largely gets ignored, and all the attention and condemnation focuses on the object: that which is being procured.

According to a press report, the complexity of manned fighters (here we use the JSF only to illustrate the challenges in complicated development programs) led the US Government Accountability Office (GAO) to conclude that

the . . . program’s business case is inexecutable because increased costs, schedule delays and reductions in planned purchases have weakened the Pentagon’s buying power.

. . . Development costs have increased from an estimated \$25 billion to \$45 billion. The unit cost has reached \$100 million, an increase of 23 percent since 2001, and a pending Pentagon cost review could uncover further increases. The

number . . . expected to be purchased has gone down by 535 aircraft too. . . . Problems with the aircraft's weight have contributed to delays.

“Program instability at this time makes the development of a new and viable business case difficult to prepare.”¹⁰

In testimony the GAO determined that “regardless of likely increases in program costs, the sizable continued investment . . . must be viewed within the context of the fiscal imbalance facing the nation [United States] over the next 10 years. The . . . program will have to compete with many other large defense programs as well as other priorities external to [the Department of Defense's] budget. The JSF's acquisition strategy assumes an unprecedented \$225 billion in funding over the next 22 years, or an average of \$10 billion a year.”¹¹

Within the context of the world economic system, we must also consider the potential economic engine of China, whose gross domestic product (GDP), according to China, will grow. The *People's Daily Online* reported in March 2005 that “a report released by the Development Research Center of China's State Council predicts China will maintain around 8 percent annual GDP growth rate from 2006 to 2010, China's 11th five-year plan period.”¹²

Unless we believe that we can maintain our present standard of living or that it can continue to rise, then we will have to cut *something* to preserve that standard. Envision a future whose electorate refuses to have bake sales and whose perfect storms destroy procurement after procurement. In a future dominated by perfect storms, the gun may become a knife. If so, then we must learn to become adept—the best in the world—at knife fighting.

Smarter Targets and Target Systems

Envision a future in which targets are as “smart” as the weapons designed to affect them—targets designed with mobility, self-healing, and invisibility. A bridge is indeed a bridge, but a “logistics system” becomes a far more elegant notion. “Net-centric” may focus on the wrong things, but networks and networking are right notions. A smart adversary (we should consider all future adversaries smart) may at this moment be preparing to take advantage of perceived flaws in the air tasking order and our targeting notions. We can cause effects to occur, but a wily foe may frustrate our notions of causality. Did the lights go out because we cut off the electricity or because the adversary ordered them out? The same advances in technology that aid the offense will aid the defense. At the end of the day, if the adversary-defender has a smarter target system than the attacker has a conception of targeting, then the gun becomes a knife.

Better Unmanned Systems

In 1914 George S. Patton, a lieutenant at that time, designed a new saber for the US Army and authored a revision of the service's saber regulations after studying swordsmanship with the French. The cavalry and saber per-

sisted until 1938 even though the saber had proved ineffective during the US Civil War—over seven decades earlier. I. B. Holley writes that “the Surgeon General’s Civil War wound statistics certainly confirmed this view. After months of operations in which the Union forces suffered tens of thousands of bullet wounds, only 18 authenticated cases of sword injury could be identified.”¹³ Regarding the grand doctrinal battle between the cavalry and the tank, he quotes J. F. C. Fuller as saying, “To establish a new invention . . . is like establishing a new religion—it usually demands the conversion or destruction of an entire priesthood.”¹⁴

Today’s priesthood may be the manned aircraft’s College of Cardinals—chiefs of the already-modern air forces of the planet and their acolytes, the iron majors. But what if secular judges, unimpeded by the white-scarf legacy of manned aviation or the authority and perhaps theological biases of air chiefs, look at the hard data and conclude within the next 10 years that unmanned systems outperform manned systems in disputed environments? Unmanned systems weigh 10 percent to 15 percent less than their manned counterparts; cost less; lend themselves to procurement in larger numbers; require no onboard life support; have higher endurance without performance-enhancing drugs; don’t need crew rest, cable TV, or air-conditioning; can bank and accelerate more rapidly; don’t succumb to information overload; don’t host a human vulnerable to exploitation as a prisoner of war; require no costly supporting combat-search-and-rescue capabilities; and don’t flinch, pucker, or have to urinate.¹⁵ If the unmanned aerial vehicle, the unmanned combat aerial vehicle, the joint unmanned combat air system, or the space-to-earth strike weapon outperform the manned fighter, cost less over their life cycles, or sustain themselves more easily, what will the owners of squadrons of future manned fighters do? More likely than not, they will call the knife of manned systems a gun.

So What?

This article has attempted to propose strange and unfamiliar futures in which a manned fighter might be a gun or a knife. As Sherlock Holmes admonishes us in “The Adventure of the Beryl Coronet,” “It is an old maxim of mine that when you have excluded the impossible, whatever remains, however improbable, must be the truth.”¹⁶ It is incumbent upon planners, operators, and those individuals involved in acquisition and policy to ensure that the gun of a future manned fighter does not prove to be a mere knife. □

Isle of Palms, South Carolina

Notes

1. Adapted from *Special Forces List Team House*, <http://teamhouse.tni.net/Misc/gunfight/rules.htm>; and http://www.jimpruett.net/bring_a_gun.htm. The basic rules are as follows: (1) Never bring a knife to a gunfight. Bring a gun. Preferably, bring at least two guns. (2) Bring all of your friends who have guns.

(3) Anything worth shooting is worth shooting twice. Ammo is cheap. Life is expensive. (4) Only hits count. The only thing worse than a miss is a slow miss. (5) If you can choose what to bring to a gunfight, bring a long gun and a friend with a long gun. (6) If you are not shooting, you should be communicating, reloading, and moving. (7) Always cheat, always win. The only unfair fight is the one you lose. (8) Have a plan. (9) Have a backup plan because the first one won't work. (10) The faster you finish the fight, the less shot you will get.

2. In democracies, everything is subject to review. Chapter 2, Title 10, *United States Code (USC)* was amended to require a Quadrennial Defense Review, whose report the US secretary of defense must provide to the Committees on Armed Services of the Senate and the House of Representatives no later than 30 September 2005. The report may affect some past investment decisions. The language of the law (chap. 2, Title 10, sec. 118, *USC*) is as follows:

(a) Review Required.—The Secretary of Defense shall every four years, during a year following a year evenly divisible by four, conduct a comprehensive examination (to be known as a “quadrennial defense review”) of the national defense strategy, force structure, force modernization plans, infrastructure, budget plan, and other elements of the defense program and policies of the United States with a view toward determining and expressing the defense strategy of the United States and establishing a defense program for the next 20 years. Each such quadrennial defense review shall be conducted in consultation with the Chairman of the Joint Chiefs of Staff.

3. Malcolm Dando, *Biological Warfare in the 21st Century: Biotechnology and the Proliferation of Biological Weapons* (New York: Brassey's, 1994), 129.

4. My colleague Dr. Jae Engelbrecht chastises me that a “future” must be the logical consequence of the “drivers” of change, must be coherent and internally reflexive, must have a plausible history showing how the future arose, and must pass hundreds of other tests to be legitimate.

5. These futures are fabricated—invented within the logic of the model of convergent changes. The technologies are extrapolations and combinations constructed without knowledge of what is being worked on where.

6. *TheFreeDictionary.com*, <http://www.thefreedictionary.com/infectious+agent>.

7. Hach Company, <http://www.hach.com/cs/csglosy.htm>.

8. A report on the US Federal Emergency Management Agency's Web site notes that a number of countries have the potential for developing state-sponsored offensive agriterrorism capabilities or programs: Canada, Egypt, France, Germany, Iraq, Japan, Kazakhstan, North Korea, South Africa, Syria, United Kingdom, United States, Russia, Uzbekistan, and Zimbabwe. In addition to plant pathogens, the report cites a large number of animal diseases as risks to cattle, swine, and fowl. Federal Emergency Management Agency, http://www.fema.gov/txt/onp/toolkit_app_e.txt.

9. *Ibid.*

10. “GAO Warns Joint Strike Fighter's Business Case Is Not Executable,” *Inside the Navy*, 8 March 2005.

11. *Status of the F/A-22 and JSF Acquisition Programs and Implications for Tactical Aircraft Modernization: Statement of Michael Sullivan and Allen Li, Directors, Acquisition and Sourcing Management Issues*, GAO-05-390T (Washington, DC: Government Accountability Office, 3 March 2005), 18, <http://www.gao.gov/new.items/d05390t.pdf>.

12. “Forecast: China to Maintain around 8 percent GDP Growth through 2010,” *People's Daily Online*, 21 March 2005, http://english.people.com.cn/200503/21/eng20050321_177555.html. Even so, analyst Richard Cooper reports that “it is not correct, as is sometimes claimed, that the Chinese economy will overtake the US economy in any meaningful sense by 2015 or 2020; at best it will barely reach one quarter the US GDP by 2020.” “Testimony of Richard N. Cooper, Public Hearing on Chinese Budget Issues and the Role of the PLA in the Economy,” U.S.-China Economic and Security Review Commission, 7 December 2001, <http://www.uscc.gov/textonly/transcriptstx/tescpr.htm>.

13. Maj Gen I. B. Holley Jr., “Of Saber Charges, Escort Fighters, and Spacecraft,” *Air University Review* 34, no. 6 (September–October 1983): 3.

14. *Ibid.*, 4.

15. These are the usual arguments trotted out when asserting the superiority of unmanned flying machines.

16. Arthur Conan Doyle, “The Adventure of the Beryl Coronet,” in *The Adventures of Sherlock Holmes* (1891–1892), *Literature Collection*, <http://www.literaturecollection.com/a/doyle/sherlock-holmes/11>.

The Future

Oil, America, and the Air Force

COL RICHARD FULLERTON, USAF*

OIL PLAYED A leading role in conflicts of the twentieth century, and it will continue as a source of global tension in this century. Contrary to public perceptions about oil shortages, embargoes, and fuel cells, energy's future in the Air Force will look much like its recent past.

“The World Is Running Out of Oil”: Wrong

The headlines are frightening, but doomsayers have predicted the end of oil for more than a century. Geologist Kenneth Deffeyes has even put a date on his forecast, announcing that “world oil production will reach its ultimate peak on Thanksgiving Day 2005.”¹ Presumably, worldwide economic chaos will ensue shortly thereafter. Such statements will persist, but we should not allow them to demoralize us. The world still has a lot of oil. The most recent US Geological Survey report places the mean estimate of the world's recoverable oil at three trillion barrels—more than three times the amount the world consumed in the entire twentieth century.² The US Energy Information Administration's best guess about the date of peak oil production is 2037.³ Even if it peaks sooner, that does not imply economic disaster. Furthermore, several years may elapse before we can confirm it has occurred, as production levels off and then starts a long, slow decline. Eventually, oil prices will rise significantly, and other, currently unprofitable, fuel sources will begin to fill a growing share of our energy needs.⁴ *For the foreseeable future, oil will continue to be a primary energy source.*

“The United States Is Running Out of Oil”: Irrelevant

Although only about 3 percent of the world's proved oil reserves are in the United States,⁵ the amount of oil we extract domestically is fundamentally unrelated to our nation's economic vulnerability to oil shocks. Even if the United States were completely self-sufficient in domestic oil production, it would not remain insulated from oil-supply disruptions in the Middle East or anywhere else. The world market determines the price of oil, a fungible commodity, regardless of its origin or destination. Consider the experience

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of Britain, for example. In September 2000, truckers blockaded British refineries, and consumers participated in widespread protests over fuel taxes and the rising price of British gasoline. At the time, Britain's North Sea fields produced far more oil than the country needed domestically, but when the price of oil rose, it did so worldwide. British consumers felt the same pinch in their pocketbooks that we felt in America and that the Japanese felt in Asia. Oil prices move together regardless of production location, which is irrelevant to price shocks (see fig.).⁶ We can remove our economic vulnerability to those international shocks only by eliminating our consumption of petroleum products. *As long as we use oil as a fuel, we will remain inextricably tied to the global oil market.*⁷

“An Oil Embargo Is a Threat to the United States”: Wrong

Since the Middle East has two-thirds of the world's remaining proved oil reserves, Americans fret constantly about another oil embargo. Those worries are misplaced. Just as the global market for oil prevents us from achieving oil independence, so does it ensure that no country has a practical way of embargoing the United States, beyond a merely symbolic gesture. Once a tanker leaves port, the seller cannot control where the oil ends up—oil ultimately flows to whoever will pay for it.

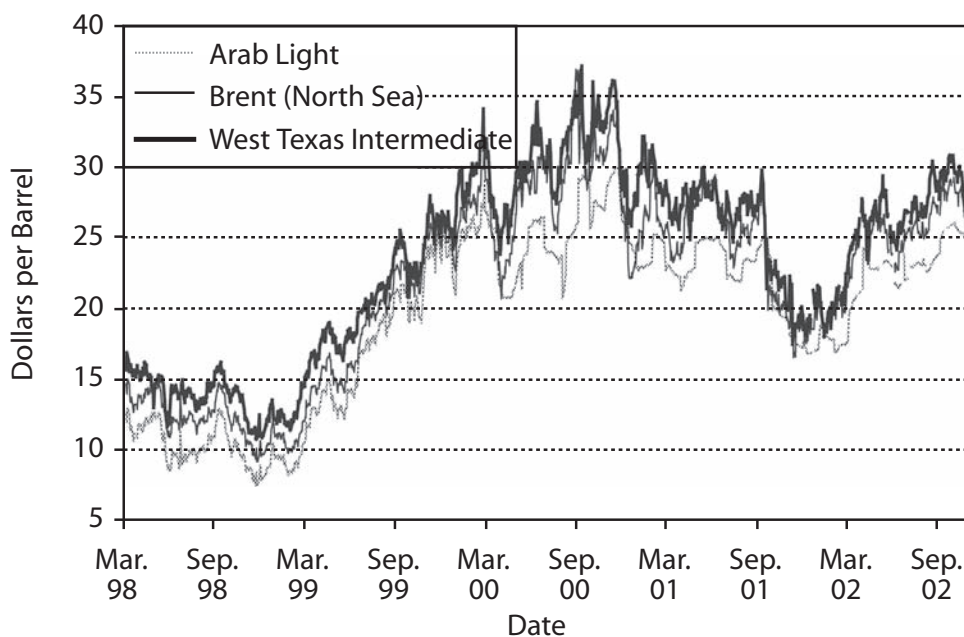


Figure. Crude oil prices, 1998–2002. (Data from “International Petroleum Price Information,” Energy Information Administration, <http://www.eia.doe.gov/emeu/international/petroleum.html#IntlPrices>.)

Most Americans believe that the Arab oil embargo of 1973 validates our vulnerability. But most of them don't have a working understanding of international trade and economics. Primarily, bad domestic economic policies (price ceilings) rather than shortages in the availability of imports caused the long gas lines that the public associates with this embargo. As Jerry Taylor and Peter Van Doren of the Cato Institute have pointed out,

price controls imposed in 1971 by the Nixon administration prevented major oil companies from passing on the full cost of imported crude to consumers at the pump. "Big Oil" did the only sensible thing: it cut back on imports and stopped selling oil to independent service stations in order to keep its own franchises supplied. By the summer of 1973, gasoline prices were exploding, pumps were running dry, and long lines were commonplace. And that was before the Arab oil embargo or production cutbacks were announced.⁸

Saudi oil minister Sheik Ahmed Zaki Yamani even admitted that "[the embargo] 'did not imply that we could reduce imports to the United States. . . . The world is really just one market. So the embargo was more symbolic than anything else.'"⁹

An oil exporter can hurt the US economy only by cutting back production and the sale of oil to everyone. But most petroleum exporters are far more dependent on selling oil than we are on buying it. Petroleum accounts for more than 85 percent of export revenues for Saudi Arabia, Kuwait, Iran, and Iraq. Only a tiny fraction of their land is arable, so they depend on oil to feed their people.¹⁰ Despite the often-heated rhetoric, global politics remain essentially irrelevant in the actual decisions exporters make about whether to sell oil. The two largest exporters in the Middle East—Saudi Arabia and Iran—have quite divergent views about the United States and the West. *Whoever controls the oil in the Middle East will be eager to sell it.*

“Oil Will Continue to Be a Catalyst for Conflict”: Right

Let's review. Oil will remain a primary energy source for the foreseeable future, and two-thirds of the world's proved reserves are located in the Middle East. Energy independence is a myth as long as we consume oil, and our fuel prices will remain inextricably tied to the global oil market. Whoever controls the oil in the Middle East will be eager to sell it. The problem is, whoever controls oil controls a truly staggering amount of wealth.

At \$50 per barrel, the estimated value of recoverable oil in the Middle East comes to roughly \$77 trillion—more than five times the US gross domestic product.¹¹ With that much wealth in the ground, it is hardly surprising that the Middle East has become a center of conflict—and a major war could significantly disrupt the global oil market and our economy.¹² Therefore, US military involvement in the Persian Gulf seeks to maintain security and stability for that market. A peaceful Middle East benefits everyone—importers and exporters alike. But the demand for oil grows fastest in developing countries like China and India. Although oil consumption in the

United States is expected to increase over the next decade at an annual rate of about 1.5 percent, oil consumption in China is forecast to grow almost 6 percent per year.¹³ As the demand for oil increases in populous Asian nations, global prices will rise, and the potential for geopolitical tension and competition for petroleum resources will increase. Since oil will remain a primary energy source for decades to come and since the Persian Gulf region contains most of the world's petroleum reserves, Middle Eastern oil will continue to be a catalyst for conflict. *So if you wear a uniform, consider learning some Arabic.*

“Energy’s Future in the Air Force Will Look Much Like Its Recent Past”: Disappointing but True

In the future, as oil prices rise and supply volatility increases, research and development in alternative energy sources and technologies will proliferate. Although some government entities, such as state and municipality auto fleets, may adopt a few of these new technologies early as a show of confidence and progressive thinking, the public will not flock to them until they become economical. As a result, the transition to new energy sources will take an evolutionary rather than a revolutionary path. Consumers will first gravitate towards more efficient diesel engines and hybrid gas/electric autos, and utilities will move away from oil for electricity generation. Industry will explore and develop previously unprofitable oil fields and bitumen deposits; moreover, it will begin producing escalating quantities of synthetic liquid fuels from natural gas and coal. Improvements in battery technology will spur the commercial development and marketing of plug-in hybrid electric vehicles assisted by gasoline or coal-based methanol engines to give them passing power and long range.¹⁴ Contrary to popular belief, however, hydrogen fuel cells will not become a leading energy source for private autos before the second half of the century—if ever.¹⁵

As the cost of petroleum eventually rises, we will increasingly direct it towards its most valuable uses in chemicals, plastics, fertilizers, and jet fuel. Yes, jet fuel.¹⁶ USAF aircraft in the twenty-first century will burn jet fuel, just as they did in the last half of the twentieth century. Even if new technologies enable hydrogen- or nuclear-powered aircraft, they will remain small in number because our inventory of B-1s, B-2s, C-17s, C-130s, F-15s, F-16s, F-22s, F-35s, KC-10s, RQ-1s, RQ-4s, T-1s, T-6s, T-38s, and other aircraft is simply too large and expensive for the taxpayer to replace. Fifty years from now, the Air Force will probably do many things very differently, but if flying is still part of our mission, we will certainly notice the prominent smell of jet fuel around our hangars and runways. □

Colorado Springs, Colorado

Notes

1. Jane Bryant Quinn, "Gas Guzzlers' Shock Therapy," *Newsweek*, 16 August 2004, <http://www.msnbc.msn.com/id/5636037/site/newsweek/print/1/displaymode/1098>.
2. US Geological Survey, "World Petroleum Assessment 2000, World Assessment Summary," <http://energy.cr.usgs.gov/WEcont/world/woutsum.pdf>.
3. John H. Wood, Gary R. Long, and David F. Morehouse, "Long-Term World Oil Supply Scenarios: The Future Is Neither as Bleak Nor Rosy as Some Assert," US Energy Information Administration, 18 August 2004, http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2004/worldoilsupply/oilsupply04.html.
4. For example, Canadian oil-sands (bitumen) production already exceeds a million barrels per day (MMBD) and is projected to rise to almost three MMBD in the next decade. Other fuels nearing profitability include synthetic liquids (diesel or methanol) made from natural gas and coal, both of which can be produced for under \$40 per barrel.
5. British Petroleum, *BP 2004 Statistical Review of World Energy*, http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/publications/energy_reviews/STAGING/local_assets/downloads/pdf/table_of_proved_oil_reserves_2004.pdf.
6. Chemical compositions (light versus heavy oil) drive the differences in prices. After one accounts for chemical composition and shipping costs, the price of oil is virtually identical worldwide.
7. Although the following fact detracts from the key point, to the benefit of the curious reader, the United States produces about 8.5 MMBD of oil—enough to satisfy about 40 percent of our current demand and vastly more than the military needs. In addition, we have huge coal reserves, representing the energy equivalent of about one *trillion* barrels of oil, which we could convert to high-grade synthetic liquids for the military at less than \$40 per barrel.
8. Jerry Taylor and Peter Van Doren, "An Oil Embargo Won't Work," *Wall Street Journal*, 10 April 2002, <http://www.cato.org/dailys/04-24-02.html>.
9. *Ibid.*
10. Less than 2 percent of the land in Saudi Arabia, Kuwait, and the United Arab Emirates and about 10 percent of the land in Iran and Iraq is arable. Oil revenues account for almost all of the export earnings of these nations. Central Intelligence Agency, *The World Factbook*, <http://www.odci.gov/cia/publications/factbook/index.html>.
11. Duane Chapman and Neha Khanna, *The Fourth Gulf War: Persian Gulf Oil and Global Security*, Working Paper 2004-16 (Ithaca, NY: Cornell University, December 2004), <http://www.comm.cornell.edu/als481/4thGulfWar.pdf>.
12. The Institute for the Analysis of Global Security reports 240 attacks on Iraqi oil pipelines, installations, and personnel between June 2003 and June 2004. See "Iraqi Pipeline Watch," <http://www.iags.org/iraqipipelinewatch.htm>. Including the 2001/2002 recession, oil-price shocks have preceded nine of 10 US postwar recessions. Stephen P. A. Brown, "Oil and the U.S. Macroeconomy" (paper presented at the Western Economic Association International annual meeting, Vancouver, British Columbia, 2 July 2004).
13. *International Energy Outlook 2005* (Washington, DC: Energy Information Administration, Office of Integrated Analysis and Forecasting, US Department of Energy, July 2005), [http://www.eia.doe.gov/oiaf/ieo/pdf/0484\(2005\).pdf](http://www.eia.doe.gov/oiaf/ieo/pdf/0484(2005).pdf).
14. David B. Barber, "Nuclear Energy and the Future: The Hydrogen Economy or the Electricity Economy?" Opinion/White Paper, Institute for the Analysis of Global Security, 24 March 2005, <http://www.iags.org/barber.pdf>.
15. Enormous infrastructure costs as well as technological and cost barriers to the production, transportation, and storage of hydrogen suggest that hydrogen fuel cells will likely remain prohibitively expensive for private autos. After decades of research, fuel cells still cost about \$3,000 per kilowatt of capacity. If fuel cells are to become economically competitive in private transportation, that cost needs to decrease by a factor of more than 50.
16. Jet fuel contains about 130,000 BTUs of energy per gallon. Although coal-based methanol may someday gain popularity as an auto fuel, at 55,000 BTUs per gallon, methanol does not pack enough energy for military aviation.



Editor's Note: PIREP is aviation shorthand for pilot report. It's a means for one pilot to pass on current, potentially useful information to other pilots. In the same fashion, we intend to use this department to let readers know about air and space power items of interest.

The Commander and the Wing Historian

J. C. SULLIVAN*

DURING AN INBRIEFING, I asked Maj Gen Charles N. Simpson, at that time the director of air and space operations for US Air Forces in Europe (USAFE), what services he expected from USAFE's History Office (HO). "I'm not exactly sure what you provide me," he responded. "Frankly, if you cannot provide me real-time service—what I need, when I need it—then you really cannot help me at all." His answer was direct, to the point, eye-to-eye, and delivered exactly as most of us in the history business want our dealings with our commanders. However, the statement was both revealing and alarming. It was revealing because it followed on the heels of comments from Gen John Jumper, then the chief of staff of the Air Force, who challenged the service's historians to "do whatever it takes to be more involved in, and help improve the combat capability of the United States Air Force."¹ It was alarming because if we historians fail to provide our leadership with timely services, then perhaps our career field may soon become extinct!

Expectations of Wing Commanders

An unofficial survey of 20 current and former wing commanders elicited a fairly unanimous understanding of the day-to-day functions of a wing historian.² Most saw the emphasis on maintaining lineage and honors, organizing historical displays, providing material for speeches, and writing the wing's required periodic historical reports.³ Unfortunately, few gave even cursory indications of mirroring General Jumper's call for historians to involve themselves in and help improve the combat capability of the Air Force. Historians improving combat capability? What a concept! Do wing commanders believe that this is possible? In fact, very few commanders saw their historians as combat multipliers. Furthermore, they nearly always found themselves pulling information from historians instead of historians pushing data and historical perspectives forward. Education, however, can significantly improve these issues.

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The Challenges

Sensitive to the call of General Jumper, Mr. C. R. “Dick” Anderegg, director of the Air Force History Office, organized a strategic plan underwritten by the need not only to maintain the stature of the service’s history program, but also to convey the Air Force’s unique historical culture and a deep belief that history can make direct and continuing contributions to tomorrow’s combat capability.⁴ Major command (MAJCOM) historians quickly realized that this new plan required closer interaction among command leadership, wing commanders, and historians. The daily working relationship that exists between the wing commander (or vice-commander in units whose HO reports to the vice- or deputy commander) and the wing historian poses a unique challenge to a MAJCOM historian, who is concerned with timely collection of the periodic wing histories that form the foundation of the Air Force’s historical archives—so critical to future research. Wing commanders see higher headquarters’ suspense dates and want them met. Both historians and commanders need not only to look for ways of meeting those requirements without sacrificing content, accuracy, and quality, but also to increase the use of history as a combat multiplier—a significant challenge!

Overseas historians are positioned to stay abreast of international issues that can demonstrably enhance commanders’ decision making as well as affect the local wing, MAJCOM, the Air Force, and even the Department of Defense. At every opportunity, historians should push the historical perspective of this kind of information to leadership in short studies or bulleted background papers. Again, they must not wait until the tasking arrives.

Although all challenges are exciting, perhaps HOs staffed by only a single individual face the most substantial one: without factoring in rank or experience, expecting him or her to research, compile, and write periodic histories; deploy as part of an air and space expeditionary force; and take on ever-expanding historical-services requirements—not to mention meeting increasing expectations in a de-

creasing amount of time. My point is that if commanders receive less and then settle for less, won’t they ultimately expect less from “history”? The results of this spiral of descending expectations may lead commanders to look to other staff organizations for help in resolving critical issues. Interestingly, the very information those staff offices seek more often than not resides in the databases of HOs.

History as a Combat Multiplier

Clearly, the former chief of staff called on history to become a combat multiplier. Moreover, the Air Force historian signed the strategic plan that restated this goal. Surely wing commanders should welcome the infusion of accurate historical insight into the decision-making process. And historians want to provide their commanders with meaningful historical services. Thus, we have unanimous agreement!

Is it also possible to agree that we should use Air Force history primarily to enhance Air Force operations? Asking historians to do their part in improving the service’s combat capability does not require reinventing the wheel. Historians already provide a number of services to their commanders. For example, Air Mobility Command historians recently worked with their commanders to help develop a plan for transporting special types of military equipment. Specifically, wing historians accessed and interpreted information from Exercise Noble Shirley, a deployment from Ramstein Air Base, Germany, immediately enabling commanders to build a successful scenario calling for 45 C-17s that transported 165 people and more than 1,000 short tons of cargo.⁵

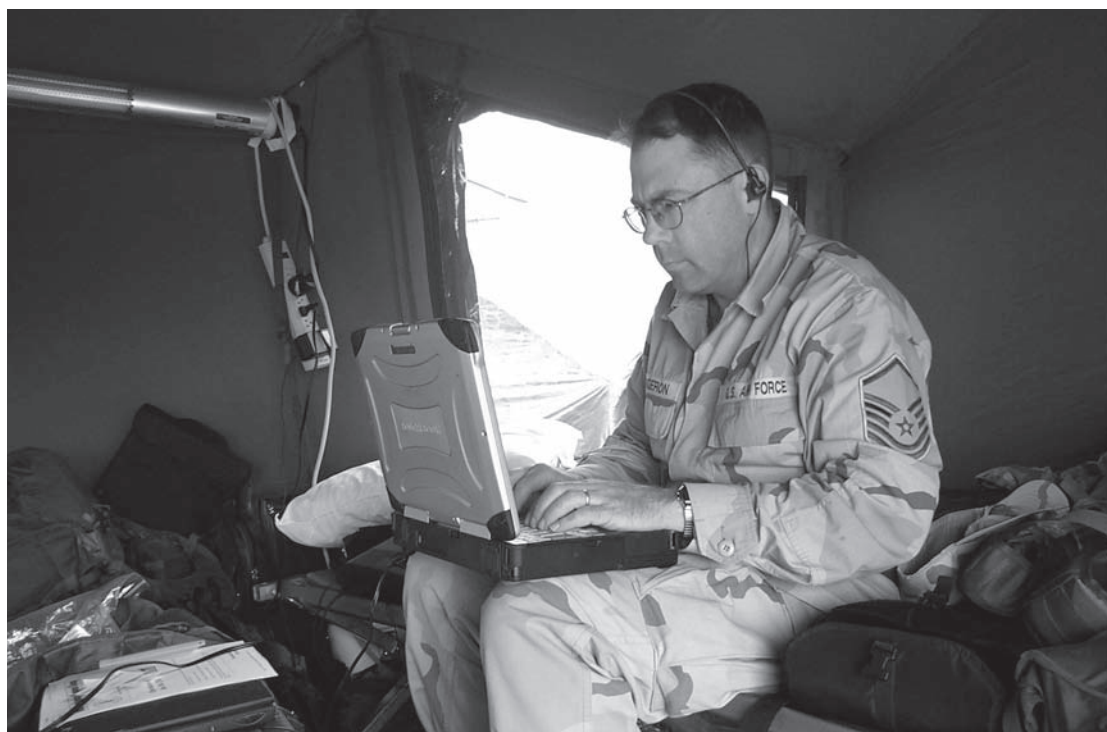
Starting with Operation Desert Storm, hundreds of enlisted historians have deployed “down range,” helping coin the phrase *history as a weapon system*. Their efforts entail four phases: collection, preservation, interpretation, and dissemination. During collection, commanders play critical roles in helping historians, especially by allowing unrestricted access to their e-mails, permitting attendance at staff meetings, and granting oral history interviews.

The fact that today's Air Force historians must possess Top Secret clearances facilitates such complete access. They are also trained to collect, retain, and use classified information found in useful histories and to organize and preserve historical archives in easily accessible systems. Ultimately, civilianization of the program may enhance interpretation, if for no other reason than the assigned historian's longevity and experience. Lastly, the dissemination phase has proved key to historians' efforts to help commanders, particularly in the decision-making process. Because commanders require information at a moment's notice, historians must learn to anticipate and push relevant information before being tasked to do so.

History as a weapon system has also improved combat capability across MAJCOM lines. A historical study on supporting Haitian refugees in Cuba by historians in Air Combat Command proved useful to commanders in USAF when the latter prepared to accept refugees from the conflict in Kosovo.⁶ By care-

fully examining the study, organizational commanders at Royal Air Force Mildenhall, United Kingdom, prepared themselves for the influx of ethnic Albanian refugees. The historian pushed up to leadership the experiences and lessons learned about constructing camps with appropriate sanitation and about logistically supporting humanitarian relief.

In October 2001, the commander of the 366th Air Expeditionary Wing at Al Udeid Air Base, Qatar, needed a statistical compilation of all the people and cargo that had passed through the base. Minutes after leaving the meeting, the wing's historian gave the commander detailed information collected from his records and the Tanker Airlift Control Element that outlined the total number of airlift missions through Al Udeid, as well as the total number of people and cargo tonnage coming in and going out.⁷ Amazed that the historian had such data at his fingertips, the commander went to him thereafter for information ranging from basic history questions about the



MSgt Randy Bergeron, USAF staff historian, deployed to Iraq

Middle East to specific mission data from the flying squadrons.

During a staff meeting in November 2001, Gen Gregory S. Martin, then the commander of USAFE, received a request to deploy the 86th Contingency Response Group (CRG) to Kyrgyzstan. Turning to his MAJCOM historian, he said, "Make sure one of your folks goes with them." The historical study that appeared a few weeks following that mission is required reading for all CRG members before every deployment and is shared by other MAJCOMs.⁸ One year later, the commander made sure that his historian accompanied the CRG when it deployed to Iraq, resulting in yet another useful historical study of lessons learned.⁹ Pacific Air Forces units that deployed in support of recent tsunami-relief efforts successfully used those and other studies written during Operation Shining Hope in Albania.¹⁰ The historical study written after Operation Provide Comfort for Iraq's Kurdish population appeared on Headquarters US European Command's required reading list for all assigned humanitarian-relief planners.¹¹ Similarly, planners used the history of Operation Proven Force to design the evacuation of dependents from Turkey in 2003.¹²

Notes

1. Gen John Jumper (speech, Worldwide Historians' Conference, Wright-Patterson AFB, OH, October 2004).

2. J. C. Sullivan, USAFE/HO, survey of wing commanders and historians, 12 April 2005.

3. Air Force Policy Directive (AFPD) 84-1, *Historical Information, Property, and Art*, 1 May 1997, establishes the requirement that all Air Force organizations, wing and above—including direct reporting units and other specified organizations—must prepare periodic organizational histories (annual or semiannual); Air Force Instruction (AFI) 84-101, *Historical Products, Services, and Requirements*, 12 March 1998, establishes content requirements for those histories.

4. "Air Force History and Museums Program Strategic Plan" (Washington, DC: Air Force History and Museums Program, March 2004).

5. "Noble Shirley," *GlobalSecurity.org*, <http://www.globalsecurity.org/military/ops/noble-shirley.htm>.

6. CMSgt Michael Dugre, ACC/HO, and Mr. Randy Bergeron, USAFE/HO, telephone conversation with the author, 22 April 2005.

7. *Ibid.*

Conclusions

Armed with a new sense of what history brings to the fight, wing commanders will quickly recognize their historians' ability to pull together accurate information from a variety of sources and formulate it into useful products. Moreover, the commander can task the historian to produce easily distributed background and point papers on high-interest topics to keep the constant influx of newly assigned people well informed and, thus, more productive. To get to that point, both commanders and historians must reevaluate their relationship by seeking a better marriage of pushing information by historians and pulling it by commanders.

On the one hand, historians must discard their comfortable role as hunters and gatherers of information by evolving into providers of historical perspective and insight. On the other hand, wing commanders must alter their view of historians as mere keepers of the unit's heritage and accept them as key members of their staffs to whom they can turn for historical insight. As Otto von Bismarck once put it, fools learn from their experience, while wise men learn from other people's experience—that is, from history! □

8. MSgt Randy Bergeron, *Deployment of the 86 CRG to Kyrgyzstan, 16 Dec 2001 to 28 Feb 2002* (Ramstein AB, Germany: USAFE/HO, 2002); and Col Steven Weart, 86th CRG/CC, interview by the author, 12 March 2004.

9. MSgt Randy Bergeron, *Deployment of the 86 CRG to Iraq: Supporting Joint Special Operations Task Force-North, 22 Mar–27 Apr 2003* (Ramstein AB, Germany: USAFE/HO, 2003).

10. Dr. Robert Sligh, *Operation Shining Hope: The United States' Humanitarian Operation in Albania, Apr–Jun 99* (RAF Mildenhall, United Kingdom: Third Air Force/HO, 2001); and Mr. Bill Harris, PACAF/HO, to author, e-mail, 7 January 2005.

11. *History of Combined Task Force Provide Comfort, 6 Apr 91–30 June 1992*, US European Command/ECJ6 classified Web site for lessons learned in Operations Iraqi Freedom and Enduring Freedom.

12. CMSgt Jerome Schroeder and SMSgt Thomas L. Raab, *History of Joint Task Force Proven Force* (Ramstein AB, Germany: USAFE/HO and Seventeenth Air Force/HO, December 1991).

The Foreign Comparative Testing Program

LT COL MARLON CAMACHO, USAF*

NO DOUBT US military personnel deployed overseas in operations such as Iraqi Freedom or Enduring Freedom sometimes notice their coalition partners using a particularly effective piece of equipment during engagements with the enemy. Naturally they probably wonder whether their service has that same device and, if not, how soon the Department of Defense (DOD) could obtain it. In actuality, US war fighters can rapidly (in as little as six months) get their hands on superior foreign equipment and technology they observe while serving in friendly countries around the world. We can do just that by means of the Foreign Comparative Testing (FCT) Program managed by the Comparative Testing Office in the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics.¹ From bullets to aircraft-loading equipment to nanotechnology, the program provides funding for test articles and the testing and evaluation of foreign equipment. Additionally, since the Office of the Secretary of Defense (OSD) and Congress approve the projects, their procurement funding is virtually locked in. Candidate projects are submitted annually to the OSD by June, and that office normally releases funding by mid-October. The FCT Program saves time, money, and effort compared to the lengthy traditional acquisition cycle.

Since its inception in 1980, the FCT Program has funded over 528 projects with \$932

million, resulting in procurements in excess of \$6.7 billion in fiscal year 2005 constant-year dollars. Over the past 20 years, the Air Force has received \$55 million, resulting in procurements in excess of \$1 billion. Through the program, all services and US Special Operations Command have the opportunity to leverage our allies' technologies and quickly provide their war fighters with much-needed equipment. Each service has a program office dedicated to supporting and strengthening the FCT Program, an effort that attracts the interest of war fighters and foreign vendors alike. Representatives from each of the services attend all major international air shows as well as conduct industry tours of various nations, looking for equipment that could satisfy the needs of their personnel.

Successful FCT projects arise from world-class foreign-defense items produced by allied and other friendly countries, strong US user advocacy and support, a valid operational requirement, and solid procurement potential. Many of these projects have reduced the total ownership cost of military systems, cutting overall acquisition and support expenditures. They also have enhanced standardization and interoperability, improved allied cross-service support, and promoted international cooperation and interoperability.

The Air Force has always played a major role in the FCT Program by identifying resources of allied and friendly nations as a solu-

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tion to our shortfalls. Several examples come to mind. In need of a 25,000-pound-capacity loader for use with its cargo aircraft, the Air Force identified two foreign sources with such equipment. After rigorous testing in accordance with its standards, the service qualified a single candidate as having the best value for the Air Force, thus procuring a next-generation small loader (fig. 1). The service also determined that the microelectromechanical system (MEMS) inertial measurement unit (IMU) (fig. 2) offered a solution to the problem of

creating a smaller, lighter, and more efficient guidance system that would allow missile systems to carry a larger, heavier payload. Finally, the Air Force needed more 20 mm ammunition because its existing stock (designated for emergency use only) misfired in chambers, putting pilots and aircraft at risk. After identifying several foreign sources and down-selecting to one, the Air Force is testing the replacement rounds (fig. 3) in accordance with DOD standards and requirements to determine if they will correct the shortfall. □



Figure 1. Next-generation small loader. (From Static Engineering Pty, Ltd., Adelaide, Australia.)



Figure 2. Microelectromechanical system inertial measurement unit. (From BAE Systems, Farnborough, Hampshire, United Kingdom.)



Figure 3. 20 mm replacement rounds. (From Diehl BGT Defence GmbH and Co. KG, Überlingen, Germany.)

Note

1. The Defense Acquisition Challenge Program, a domestic complement to the FCT Program, resembles the latter but focuses on challenging current US technology/solutions with innovative ideas/solutions that could benefit the war fighter. For more information, see Foreign Comparative Testing Program, <http://www.safia.hq.af.mil/fct>; and Comparative Testing Office, <http://www.acq.osd.mil/cto>.



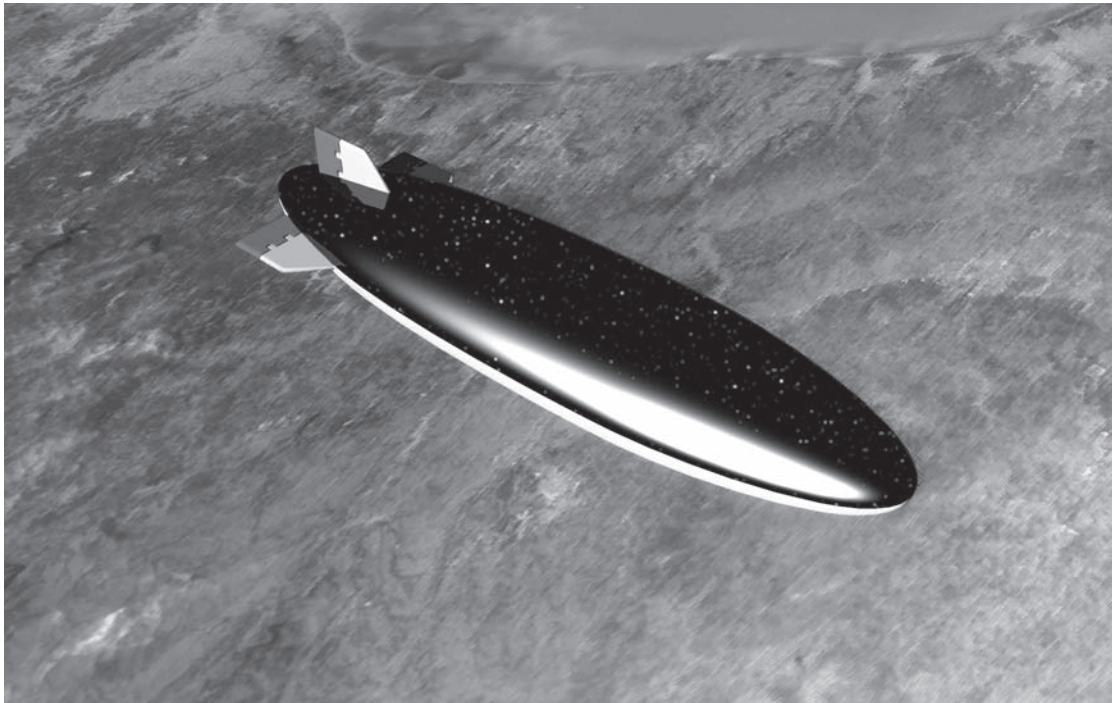
Balloons in Today's Military?

An Introduction to the Near-Space Concept

LT COL ED "MEL" TOMME, USAF

COL SIGFRED "ZIGGY" DAHL, USAF

Editorial Abstract: The near-space region is emerging as an important operational domain for the war fighter. This article is derived from a larger, more fully documented treatise on near-space operations entitled The Paradigm Shift to Effects-Based Space: Near-Space as a Combat Effects Enabler, available at the Web site of Maxwell Air Force Base's Airpower Research Institute: https://research.maxwell.af.mil/papers/ay2005/ari/CADRE_ARI_2005-01.pdf.



We choose to . . . do the other things, not because they are easy, but because they are hard.

—John F. Kennedy
President of the United States, 1962

MILITARY COMMANDERS MUST know, intrinsically, the nature of their battlefields and be able to act swiftly and decisively to changes in that environment. There is nothing new about this fact. History is overflowing with examples of the victory or defeat resulting directly from it.

Twenty-four June 217 BC: As the early rays of dawn crested the steep hills surrounding the crystal blue waters of Lake Trasimene, Roman proconsul Caius Flaminius pulled his heavy cloak closer about his shoulders. A thick fog blanketed the lush plain that held his magnificent, 25,000-strong Roman army. Flaminius, a cunning hunter, was herding his archenemy Hannibal Barca with his advancing troops. A patient general, Flaminius knew better than to engage the wily Hannibal, who was still more than a day's hard ride to the southeast, until the time and conditions were right.

His advisors had urged him to send scouts out in advance of his main body, but Flaminius was concerned about revealing his exact position and thought it better to let Hannibal guess. He knew that Hannibal would soon be caught between the jaws of two formidable Roman forces and defeated once and for all. The Roman general had seen the campfires of the Carthaginians in the distant hills the preceding evening. He thought scouts were completely unnecessary in these conditions and could only work against him. Flaminius was badly misinformed.

High upon a hill, Hannibal Barca watched the barely visible Roman standards as they moved ghostlike through the fog that blanketed the valley below. Hannibal had arrayed his army in such a way as to block egress through the winding trail that cut through the pass to the east, but kept his main fighting force of Iberians and Africans quietly camped on the steep hillsides amongst the boulders and scrub trees.

This was the second morning that Hannibal had been camped in this natural amphitheater, and he had noted the dense morning mists the day prior. His men were less than a half mile from the elite Roman troops, poised for a sudden attack. He sent the command to execute a close-phased attack with signals easily seen

from the high hilltops. Moving through the fog, the Roman army had no warning as the Carthaginian masses sliced into them from above. Before noon, Flaminius, along with 15,000 of his warriors, lay dead. Many thousands more were captured or wounded. "How could this possibly be?" the Roman must have thought. Hannibal knew the values of a robust intelligence network, meteorology, long-range communications, and most importantly, the inherent advantage of owning the high ground.

Jump forward 2,222 years: what would you say if we told you the US military was seriously considering augmenting its intelligence-gathering and communications infrastructures with helium-filled balloons? You would probably say we were crazy. However, it is true, and once we get past the "giggle factor," we think you will agree that the concept has a lot of merit. Like Hannibal, our leaders also know the value of a robust intelligence network, meteorology, long-range communications, and the inherent advantages of owning the high ground, and we are moving out sharply to capitalize in this regime.

The near-space concept, as it is currently called, involves floating payloads into a region of the stratosphere where winds are light and weather virtually nonexistent. From that extremely high vantage point, the payloads have line of sight for hundreds of miles to the horizon, becoming long-range communications relays or providing intelligence over theater-sized areas. The purpose of this article is to show why the near-space concept can become a valuable layer in our nation's system of command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems, with strengths that the other layers do not or cannot provide. The reason we call it near-space is that it provides similar effects to what satellites have traditionally given us without having to go into orbit. Others prefer to call it "far-air." It really does not matter. After all, what is in a name? It is a medium that we need to exploit to get space effects.

Many functions that are currently done with satellites could be performed, for tactical and operational commanders, using near-space

assets more cheaply and with greater operational utility. To fully understand this fact, one must be able to grasp what the word “space” means to the war fighter. Sadly, too many people define space as a *place* where we operate satellites. That mind-set is, in a word, counterproductive. Space is *not* just a place and is *not* based on a specific platform type. To the warrior, space is a medium from which war fighters get *effects*—the proverbial “ultimate high ground.” If it has no direct effect on the battlefield, a war fighter has little use for it, especially in a time of crisis. Typically, space effects are strongly related to C4ISR. Until recently a large fraction of our C4ISR effects has been delivered from satellite platforms. The reason for operating in such a manner was that, in general, no other way existed to obtain similar effects. The extreme costs of space were easily justified due to the monopoly on the ability to provide the needed effects. However, with the advent of near-space concepts, the *same effects* can be obtained in a different way, especially for operational and tactical users. It is the individual effect that is paramount for the war fighter, not the platform or the environment where the platform resides. The *primacy* of the concept of space as a set of related effects, rather than a location or a set of platforms, is a true paradigm shift—and one long overdue.

The near-space operating regime has many strengths. It also has its own weaknesses. This article is a top-level comparison of how space effects can be delivered from near-space, satellites, manned ISR, and unmanned aerial vehicles (UAV). Satellites will be shown to have great strengths for strategic missions where freedom of overflight is required. However, for operational and tactical missions—primarily after or just before commencement of hostilities—we argue that near-space holds strong advantages. Near-space assets that can provide stay-and-stare persistence for days, months, and perhaps even years should soon be available. These mission durations will soon exceed those of UAVs and begin to approach those of satellites. Near-space provides persistence and proximity that orbital mechanics prohibits, with a price tag that space launch cannot approach.

It is important to note that we do not advocate replacing satellite assets with near-space assets. On the contrary, near-space allows our high-dollar strategic assets to do their jobs even better by relieving them of many of the stressors that tactical and operational commanders place on them during times of crisis.

A Dearth of Persistence

So why do we need to go to near-space? Four factors are significant: orbital mechanics, fuel, cost, and weather. These factors deny commanders the one thing they want most in a C4ISR system: stay-and-stare persistence. There are surprisingly few national ISR assets actually orbiting the earth. These assets are frequently needed for higher-priority missions and are so heavily tasked with strategic missions that they may not be readily available to operational or tactical commanders.

Similarly, communications resources, regardless of where the nodes are located, never seem to be available in sufficient quantity. Satellite-based communications are very expensive to field and generally have limited bandwidth and availability. Those assets with continuous availability are extremely expensive to build, and the costs of boosting them to their distant geosynchronous Earth orbits (GEO) put them well beyond the price range of operational and tactical commanders. The existing alternatives—terrestrial communications systems such as cell phone networks—are difficult and time consuming to set up and are not responsive on a moving battlefield. The currently fielded constellation of communications, navigation, and ISR satellites does an exceptionally good job of providing strategic space effects.

However, even as good as they are as currently envisioned and employed, it is impossible for our limited non-GEO assets to provide a constant, staring presence on a timescale of days, weeks, or months over a selected target or area of interest without fielding a much larger constellation of assets. Nongeostationary satellites measure their persistence in pass times instead of hours. For example, most low Earth orbit (LEO) satellites have a specific tar-

get in view for less than 10 minutes at a time and revisit the same sites only infrequently. This kind of persistence is stroboscopic at best. Costing billions or at least millions each, countering the strobe-like view with multiple satellites to provide staring persistence is almost prohibitively expensive. Additionally, satellites can only carry very limited amounts of maneuvering fuel, so their orbits and times overhead are very easily predicted—a fact many of our enemies exploit.

C4ISR space effects are also provided by air-breathing platforms. While much more responsive than orbital assets and capable of returning much higher resolution imagery, due to their limited numbers and limited loiter times, airborne assets still cannot always provide the persistent look needed by battlefield commanders.

Physical limitations due to orbital mechanics and fuel consumption prevent long-term persistence for both orbital and airborne platforms. As a result of being tied to expensive, limited-quantity platforms operating in the traditional media of space and air that do not have the capability to stay on station for extended periods of time, battlefield commanders have only a limited chance of tasking an asset that provides all the information or communications capability they need when and where they need it.

Space and Near-Space

Again, thinking about space as just a location or a set of platforms is an *artificial* constraint that distracts from the whole point of launching satellites into orbit—getting the desired effects for the war fighter. We do not launch satellites just to launch them—space launch is a very expensive proposition. We launch satellites only when we determine them to be the best way to get the desired effects related to their missions *in spite of* their costs.

From the above discussion, it is obvious that there is a gap in our ability to deliver persistent C4ISR effects. There is also a gap in the altitudes covered by military assets, as shown in figure 1. These two gaps can be simultane-

ously filled through the use of near-space platforms. Near-space platforms operating in the altitude gap can provide the missing persistent communications and ISR effects desired by war fighters.

Near-space is well below orbital altitudes. Being roughly defined as the region between about 65,000 and 325,000 feet, it is too low for sustained orbital flight and above the region where air-breathing engines and wings work very well. Operating in near-space offers a number of benefits. Some of these benefits are footprints approaching those of satellites, proximity to the war fighter, survivability, low cost, responsiveness, flexibility, and, above all, persistence. Although our definition of near-space reaches to the boundary of space, we cannot currently sustain operations throughout that entire region. We can, however, comfortably achieve long-term presence in near-space below about 120,000 feet. The lower limit of near-space was not only determined from operational considerations, being above controlled airspace, but meteorological ones as well. The 65,000-foot level is above the troposphere, the region of the atmosphere where most weather occurs. There are no clouds, thunderstorms, or precipitation in near-space. Turbulence and strong winds, the bane of large balloons at lower altitudes, are not the norm in near-space. In fact, there is a region between about 65,000 and 80,000 feet where average winds are less than 20 knots, with peak winds being less than 45 knots 95 percent of the time. Near-space is a much better place for lighter-than-air vehicles to operate than lower altitudes.

The footprint, the area in which the platforms can provide their space effects, covered by near-space assets, is very large. *Footprints are mission driven.* For example, the ground-based node of a ground-to-space (or ground-to-near-space) communications link generally requires the space-based link to be a specified angle above the horizon to ensure connectivity. The footprint for such a mission would be the area on the ground from where the platform would appear to be at least the specified angle above the horizon. To use two near-space platforms as nodes in a communications link

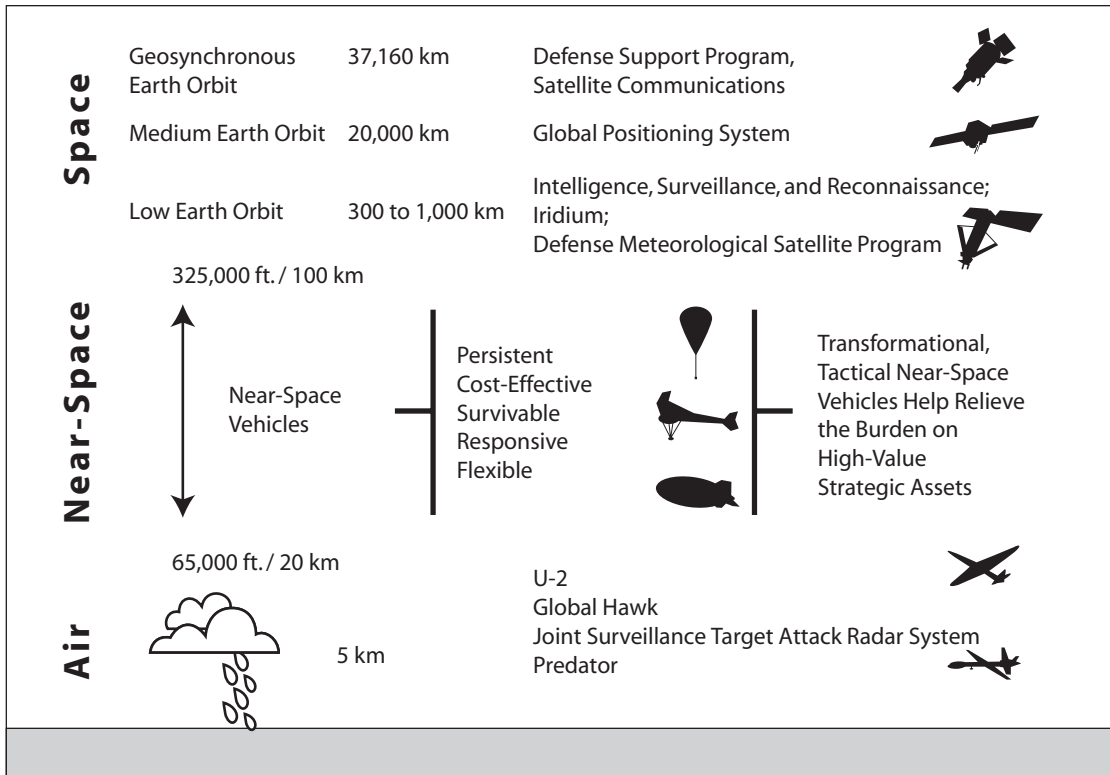


Figure 1. Graphical depiction of the gaps filled by near-space

requires an unobstructed line of sight between the two. In contrast, a signal detection sensor only needs line of sight to the signal source, so its footprint extends to the horizon as seen from the platform.

Figure 2 shows the extent of these footprints covered by platforms at two representative near-space altitudes, one at the bottom of the regime shown over Washington, DC, and the other at an altitude easily within reach of current technology depicted over Colorado Springs, Colorado. As described above, three footprint rings are shown for each platform: ground communications, signal detection, and communications links. It is important to note that most ISR sensors would not be able to image the entire footprint at any one time; those fields of view are sensor, not platform, dependent and are typically much smaller than the possible regions for imaging shown by the footprints.

While near-space platforms are high enough to provide space effects across theater-sized regions, they are much closer to their targets than their orbital cousins. Distance is critical to resolving features in images and receiving low-power signals. Optical resolution is closely related to range—double the distance, halve the resolution. Considering a point at nadir, near-space platforms are 10–20 times closer to their targets than a typical 400-kilometer LEO satellite. This distance differential implies that optics on near-space platforms can be 10–20 times smaller for similar performance, or the same size optics can get 10–20 times better resolution. Similarly for communications, the power received by a passive antenna drops off roughly as the square of the distance to the transmitter. A passive antenna on a satellite that received one watt of power from a transmitter would receive several hundred watts on a near-space platform, implying that it could

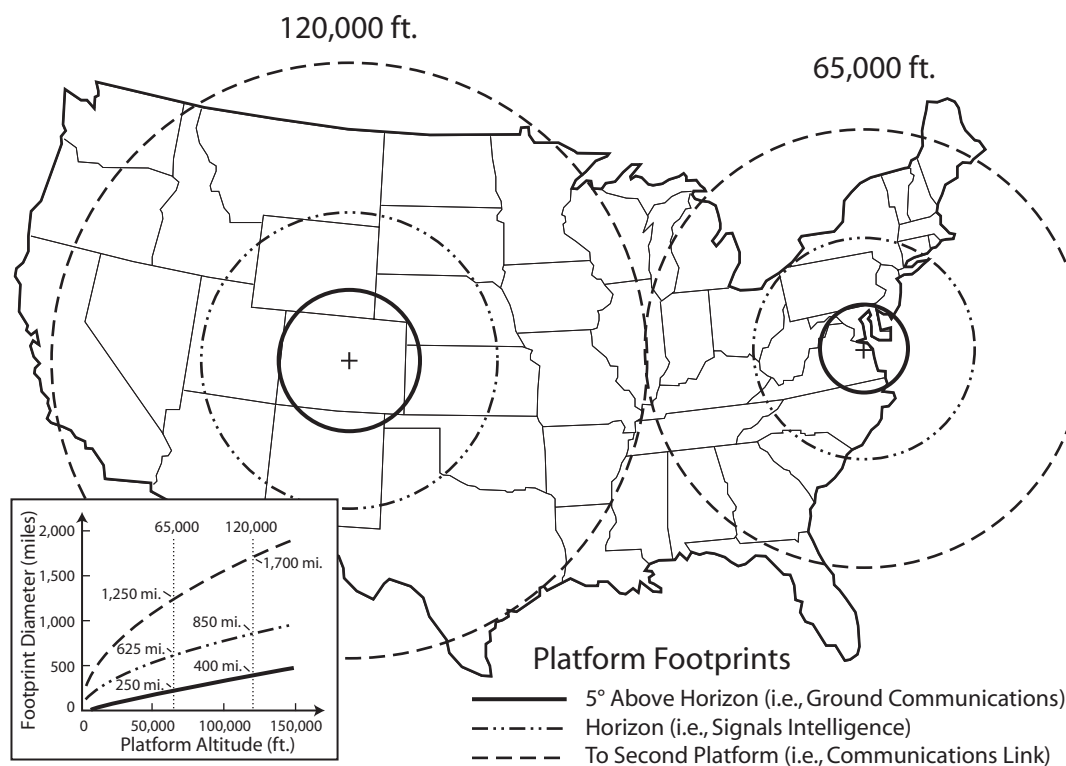


Figure 2. Footprint sizes for platforms at 65,000 and 120,000 feet for three mission restrictions

detect much weaker signals. The signal strength improvement for active systems such as radar would be about a factor of 100,000.

These examples of near-space platforms at nadir are also *best cases* for the satellites. Any off-nadir angle only increases the distance differential, increasing the near-space signal strength and resolution advantages markedly. When you realize that most communications satellites orbit not at 400 kilometers but at 35,000 kilometers above the earth, one to two *thousand* times further than near-space, it is apparent that the received power difference between the two locations is almost unimaginably large.

Though it seems counterintuitive, near-space platforms are inherently survivable. They have small radar and thermal cross sections, making them fairly invulnerable to most traditional tracking and targeting methods. They

also tend to move very slowly compared to traditional airborne targets. At near-space altitudes, they are very small optical targets as well (try spotting a 747 without a contrail during daylight), showing up well only when they are brighter than the background at dawn and dusk.

Thus, the acquisition and tracking problem is very difficult even without considering what sort of weapon could possibly reach them at their operating altitudes. Manned aircraft and surface-to-air missiles (SAM) could be a threat at the lower end of near-space, but even if they were able to acquire, track, and guide on a near-space platform, their probability of kill would likely be low. Economics also discourages such an exchange, as the trade between an inexpensive, quickly replaceable near-space platform and even a relatively cheap SA-2 would rapidly become cost prohibitive.

Although the near-space advantages in footprint size, resolution, received and radiated power, cost, and survivability are significant, perhaps the most useful and unique aspect of near-space platforms is their ability to provide responsive persistence, the ability to deliver their space effects to battlefield-commander-specified locations around the clock with no gaps in coverage. The greatest persistence that a commander can currently expect from an air-breathing asset is about a day or so for a Global Hawk. In contrast, one near-space platform, currently receiving technology demonstration funding, will be able to stay on station for *six months*, and planned follow-ons are projected to stay aloft for *years*.

In all fairness, near-space platforms do have some weaknesses, the foremost being launch constraints and overflight restrictions. Large helium-filled balloons present large cross sections subject to the effects of wind and turbulence during inflation, launch, traverse of the troposphere, recovery, and deflation. Inflation times on the order of hours will probably require the construction of hangars to protect against the wind. These constraints are not showstoppers. Very large balloons (up to 300 times the volume of the Goodyear blimps) have routinely launched for years with similar constraints, and lightweight, inflatable hangars suitable for deployment are commercially available. The susceptibility of near-space vehicles to low-altitude wind means design constraints and employment concepts need to enable missions of sufficient duration to allow for launch and recovery when the weather meets system requirements and may necessitate construction of hangars for some types of platforms. Such considerations are required to ensure seamless coverage of the area of interest. Satellites face similar launch constraints, but those constraints are applied only once—during launch. UAVs and manned aircraft are also subject to similar launch-and-recovery constraints, although their limitations are less stringent than those for near-space platforms. Construction of hangars for near-space platforms is a relatively minor project when compared with construction of the launch infrastructure for other types of platforms.

The last weakness of near-space that we will discuss is overflight rights. One of the chief strengths of satellites is that by treaty they are allowed to overfly any part of the earth. Space is an international domain. Near-space assets, being kept aloft by buoyant forces, are considered air vehicles and are subject to air laws. Sovereign nations control the airspace above their borders. Thus, the deep-look capability we depend on satellites to deliver is not something that near-space can supplant. Even considering these weaknesses, near-space assets can form an additional layer of persistence between satellites and air-breathers, complementing both and making the combination of systems more survivable, capable, and redundant by their presence. They accomplish this by

- staying and staring for much longer than any envisioned airborne asset could ever hope because they have on-station times proposed to be on the order of months or years;
- getting their lift from buoyancy, not from fuel;
- moving slowly enough and at such high altitudes that overcoming drag requires a minimal draw on their power supplies;
- having large footprints that are not offset by the extremely fast orbital speeds and short pass times of satellites;
- improving upon the long-term persistence traditionally provided by satellites while providing the on-call responsiveness of airborne assets; and
- being on-station when and where a battlefield commander needs them.

Near-space assets provide the answer to the needs for organic persistence so poignantly stated by the coalition commanders of recent conflicts.

Technological Enablers and Near-Space Platforms

Until very recently, the distinction of space as a set of effects instead of as a medium was

irrelevant because satellites *were* the only platforms that could deliver space effects. However, a convergence of several technologies has changed the capabilities landscape, now making this distinction an important one. Evolutionary advances in several disparate disciplines have led to a revolutionary advance in capability. Some technologies contributing to this revolution are power supplies including thin, lightweight solar cells, small, efficient fuel cells, and high-energy-density batteries; the extreme miniaturization of electronics and exponential increase in computing power, enabling extremely capable, semi-intelligent sensors in very small, lightweight packages; and very lightweight, strong, and flexible materials that can resist degradation under strong ultraviolet illumination and are relatively impermeable to helium or hydrogen.

Taken alone, the above technologies, in general, are progressing at normal evolutionary rates. There have been few, if any, large and unusually rapid increases in capability in any of the fields. However, when those technologies are combined into a system called a *near-space platform*, the convergence of the technological advances allows a revolutionary, transformational increase in capability. It is the advent of these near-space platforms that requires a reevaluation of the concept of space as it applies to the war fighter from a platform/medium point of view to a mind-set of effects.

A near-space platform is designed to be a sort of "truck." Just as an 18-wheeler's cargo type is unimportant as long as it meets specified weight and volume requirements, a near-space platform's payload type is unimportant as long as the payload mass and power requirements are within specified ranges. Due to the inherent payload flexibility, the following discussion of near-space platforms will not generally include specific payloads. Instead we will describe the two basic types of near-space platforms currently being investigated for military use—free floaters and maneuvering vehicles.

Free floaters are basically the simple weather balloons many people imagine when they think of lighter-than-air. Very inexpensive, they are very straightforward to construct and launch, but lack the station-keeping capa-

bilities of their more complex brethren. Once launched, they are at the mercy of the existing winds. These balloons can take tens to thousands of pounds to over 100,000 feet, but more typical payloads are in the range of tens of pounds. Free-floater systems have already demonstrated commercial viability and military utility as communications platforms. The Air Force Space Battlelab's Combat SkySat program is an example of a free-floater system currently in use.

Other than the continual constellation replenishment necessary to ensure persistent coverage, the biggest drawback to most military free-floater concepts would seem to be that their payloads generally cannot be recovered. The best that could be hoped for was to use a parachute or a short-range paraglider-recovery system to get a payload back. Innovative balloonists have devised a way around this free-floater limitation. By encasing the payload in a high-performance, autonomous glider, we can safely recover and reuse expensive or sensitive payloads. The payload is sent aloft just as it would have been on a conventional free-floating system. However, instead of destroying the payload as it drifts out of theater, as the balloon approaches the maximum range of the glider, the glider is cut loose from the balloon. The payload then autonomously glides back from hundreds of kilometers away, staying aloft for several hours before landing safely on relatively small, unprepared surfaces. Once safely back on the ground, the payload and glider can be quickly reattached to another balloon and floated again. Only the very cheap balloon part of the system is lost on each mission. The Talon TOPPER project, part of the Air Force's Tactical Exploitation of National Capabilities (TENCAP) program, is a concrete example of this concept.

We see free floaters as useful primarily for missions where a horizon field of regard is useful, missions such as communications, moving-target detection, and signals interception where only a line of sight to the signal source is required. With a horizon-sized footprint, highly accurate payload steering is not a critical ability. Free floaters are much less use-

ful for missions requiring precise navigation such as overhead imagery.

As we designed the concept, constellation replenishment is only a stopgap measure on the road to the true promise of near-space. While there will still be niche missions for free floaters in the future, true near-space effectiveness will soon rely on maneuvering vehicles that can fly to and station-keep over specified points. Such platforms are the functional cross between satellites and airborne platforms, providing the large footprint and long mission durations commonly associated with satellites and the responsiveness of a tactically controlled UAV. These vehicles will use a variety of schemes for propulsion, including conventional propellers and unconventional buoyancy-modification schemes that allow vehicles to propel themselves by porpoising through the air at about 30 to 50 knots, enabling them to overcome all but the most unusual near-space winds. No integrated maneuvering vehicle has yet been flown in near-space. However, according to the military's ballooning experts at the Air Force Research Laboratories, the reason for this problem has been a lack of sustained, significant funding required to start such a project rather than an insurmountable technical challenge.

Several programs are currently in the works. The Navy has a lower-altitude pathfinder flying and has established a significant funding line for its near-space follow-on. The Army expects to fly a larger-scale demonstration vehicle in 2007. Many other maneuvering-vehicle concepts are on the drawing board, being

funded by numerous government agencies and the civilian sector. Maneuvering vehicles do not require the continual replenishment of free floaters to provide persistence. Their payloads are large enough to be militarily useful, and they can be recovered for repair and reuse. Maneuvering vehicles are the revolutionary technology primarily behind the paradigm shift to effects-based space. Figure 3 shows some current concepts.

Space Effects in Layers

Again, we do not advocate eliminating satellites or UAVs. However, in many circumstances near-space assets are the better choice for providing tactical/operational communications and ISR space effects for a number of reasons. When cost is the concern, near-space has no peer. Their inherent simplicity, recoverability, relative lack of requirement for complex infrastructure, and lack of space-hardening requirements all contribute to this strong advantage for near-space assets. Requiring only helium for lift, near-space platforms do not require expensive space launch to reach altitude. If the payloads they carry malfunction, they can be brought back down and repaired. Should they become obsolete, they can be easily replaced. Additionally, the infrastructure cost savings involved with near-space are huge. Near-space assets require extremely minimal launch infrastructure. Compare the cost of a simple tie-down and an empty field or an inflatable hangar to building a space-launch complex or even to building a hard-surface

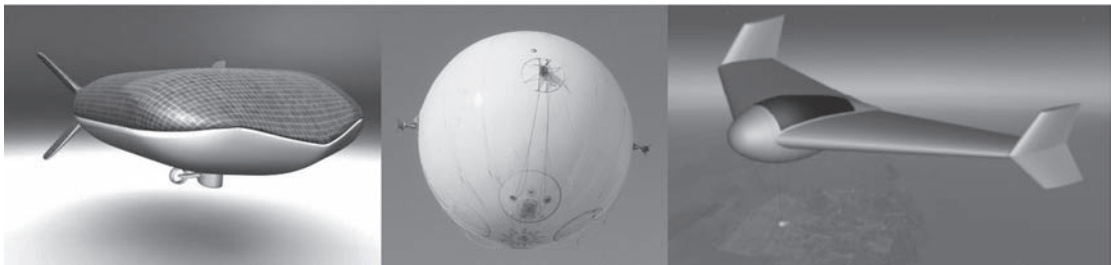


Figure 3. Three proposed near-space maneuvering vehicles. *Left to right:* GlobeTel's Sanswire, Techsphere Systems' AeroSphere, and the New Mexico State University Physical Sciences Laboratory's Advanced High-Altitude Aerobody (AHAB).

runway. The low price of near-space assets enables operational commanders to own and control fleets of them, for the price of a single national asset.

The space effects needed at the tactical and operational levels of war are persistent and responsive communications and ISR, both of which enable command and control. Orbital mechanics prohibit staring-type persistence by individual satellites in any orbit except in the distant (and expensive-to-reach) geostationary belt. Fuel considerations limit the loiter of air-breathing assets to at most a few days. Conversely, many near-space assets are specifically designed to have the ability to stay and stare for months at a time. Near-space's forte will be persistence.

Responsiveness is another self-evident need for commanders. Unforeseen requirements for imagery or communications arise constantly as a result of friction and the fog of war (ask Flaminius). Once on orbit, satellites are all but unresponsive. It takes an enormous amount of energy to change the orbit of a satellite. Satellites are also nonresponsive to launch taskings.

Air breathers, both manned and unmanned, are extremely responsive. They can be launched in minutes to hours, and once on station they can be redirected at will. Near-space platforms are also extremely responsive compared to satellites and almost as responsive as air breathers to launch and redirect. In general, near-space maneuvering vehicles require about a minute per 1,000 feet to ascend, so it takes about two hours for them to be on station at 120,000 feet. They also cruise more slowly than most air breathers, so getting to their assigned stations will take longer. However, once there they can stay for a very long time. Operational risk is substantially reduced because of the single launch-and-recovery cycle that produces months of duration on station. The stay-and-stare capability, wider field of view, and near-UAV-quality resolution provided by near-space assets could easily enable much more effective use of high-demand UAV assets by acting as cuing mechanisms. They can multiply the asset-limited UAV force by sending them only where their additional capabilities for enhanced resolution and force application are needed.

So, if satellites are so expensive and so non-responsive and if they are physically unable to provide persistence, why, then, do we buy them at all? The answer today is the same as it has been since the 1950s—freedom of overflight. The importance of freedom of overflight cannot be overemphasized as a positive aspect of orbital operations. Satellites are the only legal means by which overhead ISR can be performed deep inside the territory of sovereign nations during peacetime. This is of paramount importance, as it enables many C4ISR effects that no other platform can perform. However, once war is declared or hostilities commence, near-space becomes the clear choice to achieve the space effects required for many operational and tactical missions. During hostilities, airspace sovereignty over enemy territory is no longer a consideration—near-space assets can operate above the same locations that air breathers can, subject to similar enemy threats. Near-space assets can then provide organic C4ISR. UAVs provide exactly this sort of local control, but the footprint of a UAV can be much smaller than that of a higher-flying near-space asset, and the near-space platform has the persistence advantage. The following table provides a comparison:

Relative strengths of satellites, near-space platforms, and air-breathing assets

	Satellites	Near-Space Platforms	Air Breathers
Cost		✓	
Persistence		✓	
Responsiveness		✓	✓
Footprint	✓	✓	
Resolution		✓	✓
Overflight	✓		

When one looks at the desired tactical and operational space effects, it is evident that there are large niches where near-space assets perform much better than orbital and air-breathing assets. When one understands that it is *effects* that matter on the battlefield instead

of the platform or medium from which the effects are delivered, near-space makes much more sense for many applications. There are also missions that satellites do extremely well, and for which near-space is not competitive. The point is that a layered approach whose goal is to enable space effects in the most economical, effective way will direct the acquisition of the appropriate platform using the appropriate medium, turning the current acquisitions methodology of medium-then-platform-then-effect on its head.

In conclusion, operationally responsive space really means operationally responsive

space effects. Near-space does indeed seem to be the obvious solution to that problem. It can provide many of those effects more responsively and more persistently than space itself. The shift in mind-set to this concept is of such a magnitude that it will require a substantial rewrite of current military space doctrine. It may also require a reorganization of Air Force and Department of Defense force structure to most efficiently realize the benefits of centralized, seamless effects-based space. Near-space is the catalyst for these significant changes. The paradigm shift must occur. The time for near-space is definitely now. □

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Revised Air Force Doctrine Document 2-4, *Combat Support*

MAJ DAVE GILLIHAN, USAF

IN ORDER TO meet the rapidly changing needs of today's war-fighting commanders, air and space forces must be prepared to respond quickly and efficiently to worldwide taskings. As such, the support to accompany these forces must respond with equal speed and efficiency. The newly revised Air Force Doctrine Document (AFDD) 2-4, *Combat Support*, 23 March 2005, details this important and unique relationship between combat forces and the people, organizations, and systems supporting them.

Gen John P. Jumper, the former Air Force chief of staff, described combat support, which consists of agile combat support (ACS) and expeditionary combat support (ECS), as "the foundation of air and space power." AFDD 2-4 defines ACS as "actions taken to create, effectively deploy, and sustain US military power anywhere—at our initiative, speed, [and] tempo" and ECS as "a subset of ACS that responds quickly and is highly mobile. ECS is the deployed ACS capability to provide persistent and effective support for the applications of Air and Space power on a global basis" (1). These definitions lay the foundation for concepts presented throughout the remainder of the document.

Completely restructured from its previous version, the new AFDD 2-4 presents key ideas much more effectively and incorporates lessons learned from recent operations throughout. The components of ACS have replaced the combat-support

process; specifically, 23 combat-support functional capabilities combine to create eight ACS "master capabilities," which in turn lead to six ACS "master processes" to create the ACS "master effects" (readied force, prepared battlespace, positioned forces, employed forces, sustained forces, and recovered forces) or combat-support products provided to the commander, Air Force forces.

Most of AFDD 2-4 deals with the six master processes (each of which has its own chapter), intended to "produce the desired effects necessary to create, operate, and sustain globally responsive air and space forces" (3). In addition, the document addresses in detail the concept of combat support command and control (CSC2), the means by which Air Force commanders maintain visibility and control over combat support, emphasizing the organizational structure of CSC2 and the unique capabilities of the numerous organizations involved. It also includes a new appendix on contingency contracting, with detailed guidance on contracting authority and contract planning.

ACS, an Air Force distinctive capability, truly forms the basis of our ability to produce the world's best organized, trained, and equipped Airmen. Responsive, mobile, and efficient support for our combat forces, as described in the new AFDD 2-4, is the key to ensuring that our service continues to present war-fighting commanders with the best air-combat capability in the world.

To Learn More . . .

Air Force Doctrine Document (AFDD) 1. *Air Force Basic Doctrine*, 17 November 2003. http://www.dtic.mil/doctrine/jel/service_pubs/afdd1.pdf.
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Technical Education for Air Force Space Professionals

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Editorial Abstract: Space-related education, coupled with the need for technical expertise, is critical in developing and sustaining a space cadre. However, after more than 20 years, Air Force Space Command still lacks an adequate strategy to ensure that its officers possess the necessary proficiency, particularly with regard to graduate education. The authors argue that the Air Force must expand its commitment to securing the “high ground” of space via advanced education for its space professionals.

ACCORDING TO THE *Report of the Commission to Assess United States National Security Space Management and Organization*, released on 11 January 2001, “the security and well being of the United States, its allies and friends depend on the nation’s ability to operate in space.” The commission concluded that, in order to sustain a level of distinct superiority in space, we must “create and sustain a cadre of space professionals.”¹ This article focuses on one of the three areas the commission identified as having a high priority in terms of the requirements to reach this goal: education—specifically, the

status of formal space education within the United States Air Force as regards its historical development, current status, and future needs.

Space-related education, coupled with technical expertise, plays a critical role in developing and sustaining a space cadre. One might well argue, however, that too many current leaders of space organizations do not have the necessary background in technical education. Without leadership to verify or challenge subordinates’ recommendations, problem solving often focuses on the short term, thus deferring creative, forward-looking solutions to the

next—hopefully more technically knowledgeable—commander.²

The areas in which space professionals work are defined as “all specialties that research, design, develop, acquire, operate, sustain or enhance our space systems including communications, intelligence, maintenance, logistics, weather and a host of others.”³ Approximately 25,400 active duty military personnel and civilians as well as 14,000 contractor employees perform these missions, thus earning them the designation space professionals. The space cadre consists of scientists, engineers, program managers, and operators who have the primary responsibility of taking space systems from “concept to deployment,” including approximately 7,000 active duty officers and enlisted members as well as 3,000 civilian, Guard, and Reserve personnel. Air Force Space Command (AFSPC) has identified prerequisite space-education, training, experience, and certification requirements for the space cadre.⁴ However, after more than 22 years of existence, the command still lacks an adequate strategy to ensure that its officer corps possesses the necessary technical expertise, particularly with regard to space-related graduate education.

Historical Perspective

Culturally speaking, the Air Force has often neglected space power in much the same way the US Army neglected airpower in the 1920s and 1930s. Pilots are regarded as quintessential “operators.” In contrast, space professionals evolved not from the warrior culture but from the science and engineering fields. The space-operations career field, from its ballistic-missile origins at the end of World War II, housed a potpourri of science and engineering disciplines—the nature of advanced technology demanded it. The inherent technical approach of space professionals almost preordained a natural tension between the air and space cultures of the Air Force.⁵

Since its inception on 1 October 1982, AFSPC has provided space systems to enhance the effectiveness of the war fighter. After the space

shuttle *Challenger* disaster in 1986, civilian and military confidence in the space program found itself in a state of crisis. Numerous studies and reports reassessed the nation’s space program. The Air Force Blue Ribbon Panel’s assessment of national and Air Force space policies in 1988 yielded the recommendation to “operationalize” space—that is, focus space activities on operations rather than research and development. The operationalization of space began in earnest, and AFSPC took the lead. In 1989 the requirement that new space-operations officer accessions have a technical undergraduate degree fell by the wayside, in keeping with the thinking that the operationalization of space would emphasize documented procedures and checklist discipline and that technically educated individuals no longer needed to perform rote actions. Thus, space operations could begin to rely purely on good training, sound procedures, and strong logistics.⁶

In 1991 Operation Desert Storm, frequently termed “the first space war,” provided space operators an opportunity to prove their worth to the war fighter. Entering the war, technically advanced and complicated space systems and the capabilities they offered remained a mystery to the mainstream Air Force.⁷ However, the ability of space personnel themselves proved ultimately impressive. At the outset of the Gulf War, very few space systems, designed during the Cold War to satisfy strategic requirements, could provide needed support to the war fighter. Nevertheless, technically educated space professionals took advantage of Operation Desert Shield’s five-month duration to totally reorchestrate space and ground segments to create supporting inter- and intra-theater infrastructure. Due to their efforts, “space” became known as a force multiplier by war’s end. To meet the challenge of supporting the war fighter, Air Force leaders recognized the need to modernize space infrastructure, continue technical improvements to space systems, and extend space awareness throughout the Department of Defense (DOD).⁸

In 1993 intercontinental ballistic missile (ICBM) forces and personnel merged with AFSPC. The ICBM career field, as an operations specialty, traditionally had not required

its personnel to have technical education. The new era of budget austerity severely hampered efforts to develop new-generation systems as well as a responsive space-launch capability.⁹ Reductions in the number of military personnel and an enticing technical job market for civilians set the stage throughout the 1990s for a mass exodus of technically educated space operators from the Air Force. Over the next 10 years, in combination with the notion of operationalizing space, the community lost much-needed expertise.

The Space Commission noted that, among 150 personnel serving in key operational space-leadership positions 19 years after the creation of AFSPC, fewer than 20 percent of flag officers possessed a space-career background (fig. 1).¹⁰ In fact, these primarily nonspace flag officers had spent an average of just two and one-half years in space or space-related positions. Furthermore, among officers commanding space wings, groups, and squadrons, only about one-third had space-career backgrounds—and that experience averaged less than four and one-half years in space-related positions. Given the fact that a new military community usually requires about 20 years to develop its own leadership base, the current percentage of field-grade officers with a space background represents a

continuing shortfall.¹¹ This situation highlights the lack of institutional professional career development within the space community.

Graduate Space Education and Training Programs

The Air Force sponsors opportunities for graduate education through the Air Force Institute of Technology (AFIT), the Naval Postgraduate School (NPS), or selected civilian institutions. Both AFSPC and Air Education and Training Command (AETC) manage space-related training programs.

Air Force Institute of Technology

Established in 1919 as the Air School of Application, AFIT started the Astronautics Program—later renamed Astronautics Engineering—in 1958, beginning a long tradition of providing leaders to the space community. The Engineering Council for Professional Development accredited the program at its inception. In the late 1970s, Space Operations Engineering emerged within Astronautics Engineering, and in 1987 it became an 18-month program in its own right, designed to prepare officers for leadership and operations roles involving

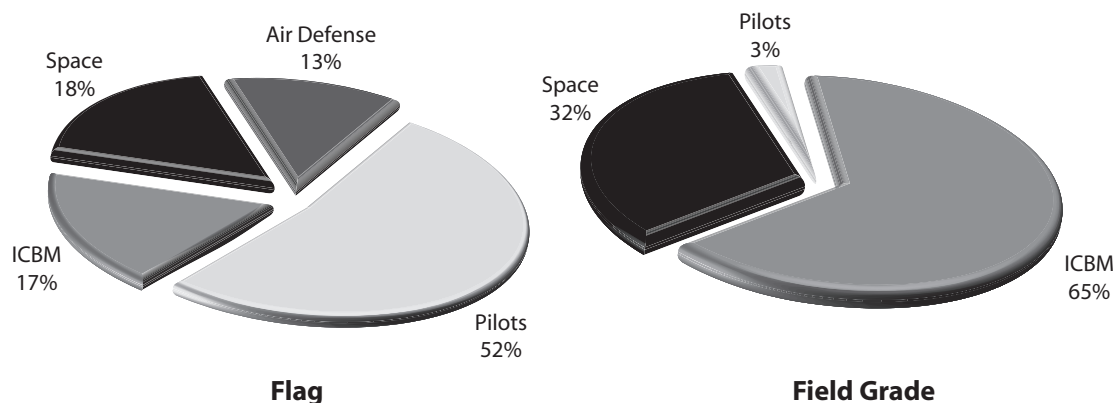


Figure 1. Experience of flag and field-grade officers. (Data from *Report of the Commission to Assess United States National Security Space Management and Organization: Executive Summary* [Washington, DC: The Commission, 11 January 2001], 43, http://www.fas.org/spp/military/commission/executive_summary.pdf; and William Scott, "Molding Space Warriors," *Aviation Week and Space Technology* 7, no. 60 [2004]: 60.)

the use of space-engineering principles and scientific-management techniques in planning, executing, and evaluating space operations.¹² In addition to space education, the program emphasized operations research, probability and statistics, system simulation, effectiveness/trade-off analyses, contracting and acquisition, and operations planning.¹³

In response to AFSPC's development of the Vigilant Scholar Program in early 2000, in the fall of that year AFIT initiated the 18-month Aerospace and Information Operations Program, which prepares students for management and analysis roles in planning, executing, and evaluating space operations, particularly as they relate to the flow of information, while retaining the technical foundation of space science and engineering.¹⁴ AFIT admits an average of five students per year to the program.

In 2003 AFIT's Astronautical Engineering Department restructured its Space Operations Program to form a Space Systems Program, concentrating on space sciences, operational sciences, space engineering, and systems engineering. Each student tailors sequences in systems engineering, information warfare, or operations research.¹⁵ During the same year, the Air Force instituted the Force Development Program with the goal of "[making] that investment in all career fields and all ranks more deliberately than we do today in order to better prepare us for the future and better

meet . . . expectations" and assuring that leaders at all levels have the necessary skills and a deep perspective within functional areas to excel in a rapidly changing Air Force.¹⁶ Intermediate developmental education (IDE), part of the Force Development construct, now constitutes more than just professional military education (PME) insofar as it offers opportunities to combine the PME experience with graduate-level education. In response to the new IDE program, AFIT has developed and now offers master's degrees in a 12-month structured program. AFIT recently developed several nondegree graduate-certificate programs in the areas of systems engineering, directed energy, information security, and measurement and signature intelligence, each of which significantly affects efforts in space and education research.¹⁷

Since 1958 AFIT has graduated more than 14,000 students with degrees in astronautical and space operations and many with master's degrees in astronautical engineering and space operations (fig. 2).¹⁸ The number of graduates drastically declined in the early 1970s, following the cancellation of the Apollo program, and in the early 1990s, which saw the removal of the technical undergraduate degree from the space-operations career field. Consequently, fewer officers had the qualifications to enter technical graduate-education programs during subsequent years.

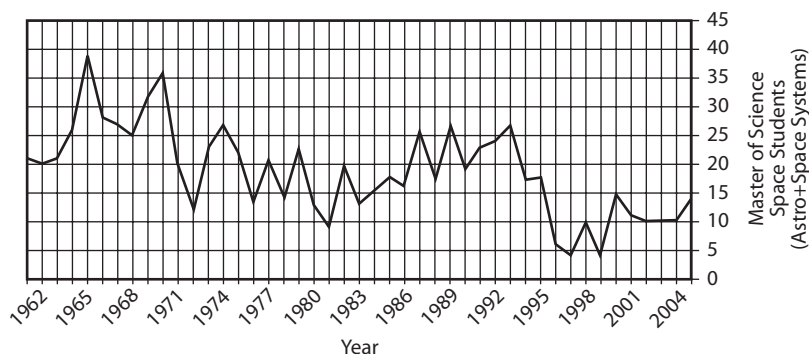


Figure 2. AFIT graduates with master's degrees in astronautical engineering and space operations. (From William Scott, "Molding Space Warriors," *Aviation Week and Space Technology* 7, no. 60 [2004]: 9.)

Naval Postgraduate School

In 1982 the NPS established its Space Systems Academic Group, which developed two 24-month programs: Space Systems Engineering, focusing on acquisition, science and technology, and research and development, and Space Systems Operations, emphasizing requirements and operations. Since then, the NPS has graduated over 560 Navy, Marine, Army, and Air Force officers. The Navy and Air Force formed an alliance between the NPS and AFIT through a memorandum of agreement, signed on 4 December 2002, which spelled out the means by which the two institutions would “meet the advanced education requirements of the Armed Forces of the United States” and created the Space Professional Oversight Board (SPOB), chaired by the director of the National Reconnaissance Office.¹⁹ The board’s objectives include ensuring that officers receive graduate education aligned with service and national-security space needs, preventing unnecessary duplication within curricula, and enhancing joint educational environments regarding space. A working group of the SPOB, the Joint Space Academic Group (JSAG) develops coordinated action between the NPS and AFIT from the board’s recommendations and provides an integrated vision of graduate-level space education.²⁰

Civilian Institutions

Only a very few civilian institutions offer graduate-level space-operations degrees, typically in space studies, air and space studies, or space science: University of Colorado–Colorado Springs, Webster University, University of North Dakota, George Washington University, and Johns Hopkins University. Developed in the mid-1980s, most of these programs sought to attract new space-operations officers pursuing a degree related to their careers. Additionally, schools such as MIT, Purdue, Ohio State, and UCLA offer aeronautical/astronautical engineering degrees.

Space Commission Report

On 11 January 2001, the Commission to Assess US National Security Space Management and Organization published its report, concluding that the United States needed a new and comprehensive approach to national-security space management and organization to promote and protect the nation’s interest in space. Based on this report, Secretary of Defense Donald Rumsfeld tasked James Roche, secretary of the Air Force at that time, to prepare a comprehensive plan for space-career management.²¹ Accordingly, AFSPC’s Space Professional Management Team developed a plan of attack for the Space Professional Development Program to identify the space cadre and define its unique skills; institute stronger, technically oriented space education and training programs; implement a robust, three-level certification program to measure progress throughout an individual’s career; determine education, experience, and certification requirements for each space-cadre billet; coordinate guidance for space-career development with force-development teams; and establish a permanent Space Professional Management Office.²²

Professional Development for the Space Cadre

The National Space Security Institute (NSSI) oversees a new educational curriculum for space professionals, which includes such courses as Space 100, Space 200, Space 300, Advanced Space Training, and Space Support.²³ The NSSI works with the Space Education Consortium (SEC), comprised of civilian universities, to provide interdisciplinary research and education for AFSPC as well as other DOD organizations. This collaboration offers a great opportunity to establish a mechanism for cooperation among DOD, national, and civilian academic organizations. As of May 2004, the SEC consisted of the University of North Dakota, University of Colorado–Colorado Springs, George Washington University, and Johns Hopkins University. Although the NSSI will award only professional-certification levels, the consortium plans to award academic degrees at both the undergraduate and

graduate levels. Gen Lance Lord, commander of AFSPC, has proposed basing the SEC at Peterson AFB, Colorado.²⁴ Using the Acquisition Professional Development Program (which emphasizes education) as a model, AFSPC has developed a Space Cadre Certification Program (which focuses on experience) in an effort to answer shortfalls identified by the Space Commission while maintaining the integrity of the force-development requirements.²⁵

Analysis

Of the more than 2,000 13S billets within AFSPC, only 13 carry Air Force specialty codes requiring an advanced academic degree (AAD), with just 52 so coded in the entire Air Force (see table). The lack of 13S AAD positions clearly reveals that we perform the operational space mission without the benefits of graduate-level technical education. Unit-level commanders have difficulty maintaining incumbency in AAD billets due to assignment restrictions associated with these positions, while simultaneously fostering career-development growth for officers. Often commanders have chosen not to recertify AAD designations to allow more flexible and successful assignment actions, even as they acknowledge the continued requirement for technical expertise. According to the Space Commission, this trend produces a space-community culture unable to sustain a cadre with the necessary technical education to meet demanding technological advances. Research in progress at AFIT to address the shortcomings of the current process used to manage AAD billets proposes the introduction of a more flexible and responsive inventory-management approach.

Air Force doctrine makes a key distinction between the concepts of education and training. Air Force Doctrine Document (AFDD) 1-1, *Leadership and Force Development*, defines education as “instruction and study focused on creative problem solving that does not provide predictable outcomes. Education encompasses a broader flow of information to the student and encourages exploration into unknown areas and creative problem solving.” In contrast, the document defines training as “instruction and study focused on a structured skill set to acquire consistent performance. Training has predictable outcomes and when outcomes do not meet expectations, further training is required.”²⁶ On the one hand, graduate-level education, taking from one to two years to complete and often culminating with an original research endeavor, prepares individuals for careers and includes practice in critical thinking that will last a lifetime. On the other hand, training takes days to weeks to complete, culminates in a certificate of training, and prepares individuals for their current or next job.

The Space Commission report also correctly makes a distinction between PME and technical education, noting that “the core curriculum [of PME] does not stress, at the appropriate levels, the tactical, operational or strategic application of space systems to combat operations.”²⁷ Although the NSSI addresses this shortfall with the Space 100, 200, and 300 courses, these initiatives fall short of the expectations of the Space Commission’s explicit recommendation to recruit technically oriented personnel for space-related career fields and maintain them.²⁸

Table. AAD billets by Air Force specialty code in the US Air Force

<i>Air Force Specialty Code</i>	13S <i>(Space and Missile Operations)</i>	61S <i>(Scientist)</i>	62E <i>(Developmental Engineer)</i>	63A <i>(Acquisition Manager)</i>
AAD Billets	52	465	667	143

Source: Air Force Institute of Technology to Naval Postgraduate School, memorandum of understanding, 15 April 2004.

Who within the space cadre needs a technical education? Clearly, scientists and engineers should have technical undergraduate and graduate degrees. In accordance with the idea of operationalizing space, command policy has not required that operators have such degrees. Part of the rationale is that well-documented procedures dramatically reduce the risk of errors that might put lives in danger or disable expensive, one-of-a-kind assets. Moreover, integrating space operations into the joint-warfare environment demands an ability to communicate requirements and war-fighting contributions in a language that leaders and operators can understand and relate to. Engineering technical approaches and terminologies did not seem useful in “bringing space to the fight.”

But has this attitude gone too far? The Space Commission thought so, stressing the importance of a formal technical education as a basis for comprehending and incorporating new, advanced systems as well as strategic and tactical operations into Air Force doctrine. For example, although procedures and checklists ensure a predictable and verifiable response to actions, the very nature of space operations—most notably satellite operations and space launch—precludes hands-on verification of system responses. Verification often requires interpretation of secondary (e.g., satellite telemetry) or tertiary (e.g., combinations of indications) sources. Oftentimes, non-routine operations create a need for creative and insightful measures.

One should also note, for example, that pilots gain a high degree of practical, hands-on experience with their respective aircraft. They learn to “feel” the aircraft, intuitively sensing subtle changes in performance. Space operators must find alternate approaches to compensate for this lack of practical experience. Since the Gulf War, one approach has called for utilizing contractor personnel with substantial credentials in technical education. A decade of experience, as well as the conclusions from the Space Commission report, testifies to the inadequacy of this approach. Contractor experience, for example, does not imply operational savvy. No other Air Force mission contracts out such a substantial por-

tion of weapon-system expertise as does space operations. In fact, proposing such an approach for aircraft operations (e.g., contractor pilots) would be considered indefensible.

Because AETC is primarily responsible for the professional education of Air Force personnel, one would expect the command to involve itself intimately with AFSPC’s effort to meet the Space Commission’s taskings with respect to investing in training and education. In response to the commission, AETC redesignated Undergraduate Space and Missile Training as the Space 100 course, with some minor courseware adjustments, and will continue to teach it. However, no other substantive changes have occurred in the relationship between AETC and AFSPC with respect to space education.

Recommendations

Although AFSPC is making significant strides in career development and training, the command needs to improve its efforts with respect to education. Toward that end, this article proposes the following recommendations:

AFSPC should establish a permanent liaison with AETC—specifically with AFIT—to address the Space Commission’s concerns about space-cadre education.

The Air Force’s primary institution for “provid[ing] graduate and professional continuing education, research and consulting programs to keep the Air Force and DoD on the leading edge of technology and management,” AFIT also manages officers enrolled in civilian universities, research centers, hospitals, and industrial organizations through its civilian-institution programs.²⁹ AFSPC should provide representatives to the SPOB and JSAG, thus taking into account the needs of AFSPC during initial education-planning activities. The AFSPC representatives will then have direct insight into and influence over all space-related programs and curricula.

AFSPC should institute a phased approach to require technically oriented undergraduate degrees for accession into the 13S career field by 2010.

The Space Commission specifically recommended that “career field entry criteria should emphasize the need for technically oriented personnel, whether they be new lieutenants or personnel from related career fields. In-depth space-related science, engineering, application, theory and doctrine curricula should be developed and its study required for all military and government civilian personnel.”³⁰ AFSPC should incrementally increase the total proportion of accessions with technical undergraduate degrees recruited into the space-operations career field through 2010, after which space-operations accessions should be required to hold a technical undergraduate degree in any of the engineering disciplines, physics, chemistry, mathematics, computer science, or space operations.

In the near term, the space cadre should have the opportunity to pursue advanced education as soon as possible. Expanding AFIT’s IDE program for the space cadre offers an ideal means of addressing the shortage of technically educated midcareer officers. Further, extending this policy to civilian personnel within the space community would effectively mold that workforce. If the estimated 71 percent of government employees eligible for either regular or early retirement by 2010 actually left the workforce, their departure would profoundly drain our civilian resources.³¹ We now have the opportunity to tailor the right mix of education and skills to align both the military and civilian workforces with the Air Force’s strategic priorities.

The Air Force should actively develop curricula for advanced-degree programs in space operations and space sciences at both military and civilian institutions.

Because a significant number of Air Force personnel obtain advanced degrees through civilian institutions, the service should use its leverage to influence the curricula of these institutions and thereby complement development of the space cadre. Under the SEC umbrella, the University of North Dakota, Univer-

sity of Colorado—Colorado Springs, George Washington University, and Johns Hopkins University have already expressed an interest in working with the Air Force to develop their respective curricula. Moreover, panels from AFSPC, US Northern Command, US Strategic Command, the National Reconnaissance Office, and other organizations with an investment interest in the space cadre should help tailor program curricula at AFIT and the NPS and share their efforts with civilian institutions that want to partner with the Air Force. The goal here involves educating the military space cadre by establishing and sustaining credible, applicable programs that civilian institutions understand and recognize, and that complement as well as support AFIT- and NPS-based programs.

The Air Force should reaffirm AFIT and the NPS as the primary providers of graduate education for space professionals.

The SEC has tremendous potential as an affiliate source of space education, but it should not replace AFIT and the NPS. These two institutions provide education and research programs oriented toward defense and offer direct access to space-defense issues, including classified data and research, that no civilian institution can match. Officers converge at AFIT and the NPS from all career fields, possessing a myriad of educational and operational backgrounds. We would lose a tremendous synergy between air and space professional students by isolating one group at a separate institution. Finally, geographically separating graduate education in space (e.g., locating the SEC at Peterson AFB, Colorado, as General Lord advocates) would reinforce the erroneous perception that space operations are a separate war-fighting endeavor rather than part of a larger joint campaign.

The space cadre should include intelligence officers and logistics officers.

The foregoing recommendations address the education of the space professional. However, the current definition for membership in this cadre omits key contributors to the space-

operations mission. Peter Teets, former undersecretary of the Air Force, observes that “space power represents a decisive, asymmetric advantage for the US government and, in particular, for military and intelligence organizations.”³² Space and intelligence are so inextricably woven together that separating them would be a grave mistake. Any changes to policy or education within AFSPC should include intelligence considerations. Recent developments growing out of the findings of the 9-11 Commission may directly affect AFSPC and the space cadre, insofar as 80 percent of the intelligence budget lies within the DOD.³³ We need to remain especially mindful of the potentially huge effect that intelligence reform might have on space operations and its intelligence-gathering sector. Furthermore, since it is easy to overlook logistics considerations during the development and integration of new doctrines, we must address those issues in advance rather than resolve them in hindsight.

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Conclusion

In a letter to Secretary of Defense Charles Wilson in 1955, President Eisenhower stressed the importance of science and technology to the security of the nation: “Because scientific progress exerts a constantly increasing influence upon the character and conduct of war, and because America’s most precious possession is the lives of her citizens, we should base our security upon military formations which make maximum use of science and technology in order to minimize numbers in men.”³⁴ Forty-six years later, the Space Commission advanced that thought, concluding that our nation’s security relies in no small part upon our ability to technically educate a space cadre that can effectively operate in an environment of new, highly complex, and advanced space systems. We must expand our commitment toward securing this “high ground” of space via advanced professional education. □

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Sky Cops

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SEVERAL QUESTIONS COME to mind regarding the function of the Air Force in light of certain world events. Specifically, what role does it have in Iraq today? After the success of airpower during recent wars, will the Air Force have a hard time justifying, maintaining, and/or increasing its current major force-programming levels? What can it do to help bring the current Iraqi situation to a favorable resolution sooner rather than later? Finally, can the Air Force better assist in conducting border patrols, countering the flow of terrorists from one country to another, and aiding in the war on drugs?

We used to use the term *sky cops* for the proud Airmen who guarded our flight lines and their precious air assets, our bases, and the front doors to the Air Force. It is time for our service to start developing a new sky-cops capability. We have all heard the saying “When the Spectre flies, all the bad guys stay home or go home in a box.” The AC-130 gunship does indeed provide the ultimate night-surveillance platform with the added capability of massive, pinpoint kinetic-weapons fire. In a scene that occurs frequently on TV cop shows, two policemen sit in an unmarked car, staking out the bad guys and eating doughnuts. In effect, that is what the Spectre can do; when the bad guys know it’s in the sky, they tend to stay home. Part of the problem in trouble spots in Iraq is that the bad guys can operate with virtual impunity unless we keep a Spectre in their area. But we simply don’t have enough AC-130s to

cover all the hot spots in Iraq. The Air Force must take the capability of the gunship, flatten it out to provide greater coverage, and add monitoring and recording capability. We must also employ communications gear capable of working with the entire spectrum of operators on the ground and various command-and-control entities. The use of smaller, less expensive airframes (and more of them) should become our goal.

The role of sky cop ties in extremely well with the air portion of the common operational picture—a mosaic of individual intelligence and situational feeds pieced together to give combatant commanders and field operators greater visibility of the entire war picture. The Air Force has the responsibility of providing the majority of the feed for the air picture. Fitted with the appropriate intelligence, surveillance, and reconnaissance (ISR) equipment, including low-light TVs, search-and-rescue materiel, and packages for cell-phone intercepts, sky cops could provide more comprehensive and persistent coverage. Developing this capability also has huge potential for eventually paying dividends in homeland defense. In addition to border patrol, we can perfect the ability to provide airport surveillance and security services against potential threats such as man-portable air defense systems.

At no other time in history has the Air Force had such a golden opportunity to test and develop this capability. That is, we have a testing ground where normal rules of society

do not prevail. In Iraq, we are applying airpower in the urban environment in a manner politically inconceivable even for testing here in the United States. Furthermore, some 10,000 insurgents have volunteered themselves as live targets while the Air Force develops, tests, refines, and perfects this capability. We could and should make extensive use of Iraqi reconstruction funds to start this program.

Thus, the following recommendations seem appropriate: recognize that the Air Force can and should provide a sky-cops capability; find a low-cost solution to maintain this capability for future conflicts, homeland defense, border patrol, and current employment in Iraq; and export the capability after refining it. We must build a sky-cop facility in Iraq for combined research, development, and training. To start up that facility, we should send the brightest Army and civilian policemen; forward air controllers (FAC); combat controllers; air-to-ground fighter pilots; homeland-defense experts (including immigration and border-patrol experts from Immigration and Customs Enforcement [ICE]); and doctrine and training-manual developers as well as writing experts to develop doctrine on the fly. We don't have time to wait for the perfect aircraft; instead, we must get aircraft now and then work on refining weaponry and ISR equipment by applying them in the field, making adjustments as we learn lessons. We should procure several prototypes and test each one. We must also concentrate on several key capabilities such as city, border, and pipeline patrol as well as protection of

high-value assets (e.g., oil refineries), recommending that missions be tasked with the sector FAC mentality employed during Vietnam. In other words, we want the same plane and crew operating in the same area—day after day and night after night.

Since Iraqis must become an integral part of the training program, we should adopt a “leave behind” mentality to initial purchases of all aircraft used in direct support of this program and operated in Iraq. Those aircraft would eventually become part of the Iraqi air force inventory. Potential airframes might include a “modular gunship” or mini Spectre (a perfect opportunity for Air Force Special Operations Command/Plans and Programs to jump-start such a program), the OV-10D or a current rendition of it, and a gunship version of the C-23 Sherpa. A member of the Iraqi air force must always be in each aircraft that flies. Specifically, we must assure that the Iraqi sensor operator or weapons-fire officer on board comes from the same area of the country and from the same religious sect as the majority present in the location where we conduct operations. Besides the obvious advantages of knowing the terrain, locales, and so forth, this will help mitigate Shia-on-Sunni (or Kurd-on-Sunni, etc.) blood feuds and the inherent targeting biases that come from pitting sect on sect. After perfecting the program, the Air Force, ICE, and Department of Homeland Security can then step in with programming requests. □

Mahan on Space Education

A Historical Rebuke of a Modern Error

1ST LT BRENT D. ZIARNICK, USAF

Editorial Abstract: The Air Force has shaped a new space-professional strategy that alters many aspects of career development for the service's space cadre. In this article, Lieutenant Ziarnick posits that the ideas of a nineteenth-century Navy officer and sea-power theorist remain relevant to the development of twenty-first-century space professionals—especially those relating to the ongoing debate of technical versus nontechnical education for officers.



IN RESPONSE TO the *Report of the Commission to Assess United States National Security Space Management and Organization of 2001* (Space Commission), the US Air Force has shaped a new strategy to guide the development of its space professionals. This strategy changes many elements of career development that guide the operators, scientists, engineers, and program managers who make up the Air Force's "space cadre." A number of aspects of the strategy, such as measurable certification levels and the tracking of an individual's space-related experiences, will undoubtedly prove quite valuable. One item, however, could have serious military implications.

The strategy's new plan for officer certification "desires" that all officers have a "degree relevant to space." Thus, level-one certification (one to 10 years of space experience) calls for a BA/BS degree relevant to space, and level two (10–15 years' experience) requires a relevant master's degree; the plan "highly desires" that individuals seeking level three, the apex of space certification (more than 15 years' experience), hold a space-relevant master's degree.¹ According to the plan, "space relevant" concentrations "include Engineering, Systems Management, Business Administration, Computer Science, Physics, Chemistry, Mathematics, and Space Operations. The rationale for es-

tablishing this 'desirement' is that it allows for the greatest crossflow among the space billets—[acquisitions] to [operations] and vice versa."² One notes the absence of the humanities and liberal arts: history, philosophy, English, and political science, among others. At first glance, the plan's desires seem agreeable—even attractive. After all, how could having a technical degree hurt a space professional? As a practical matter, it probably does not. However, it is the wrong question to ask.

Such a preference for technical degrees implies that other studies are irrelevant to military space officership. Indeed, at a briefing on the space-professional strategy attended by the author, the speaker, a lieutenant colonel, explicitly stated that he didn't see how Elizabethan history had any applicability to a military space officer. Thus, one should more properly ask whether only technical study has relevance to military space activities.

Should space officers study engineering or physics to the exclusion of history, philosophy, or other nontechnical fields? An affirmative response could have far-reaching ramifications. If leadership favors technical degrees, it might convince many career-minded young officers or cadets to enter the hard sciences despite their preference for a different academic discipline—or they might discourage others from joining the space forces even though such individuals could make important contributions. Twenty years hence, the lieutenants and captains of today will become the leaders of military space forces. Presumably, if the space-professional strategy works as intended, they will have a substantial technical education but significantly less nontechnical expertise than the current leadership. By expressing a preference for space-relevant degrees and hinting that the type of degree may affect promotions, the space-professional leadership, in effect, has affirmed technical education as the only type suitable for a space officer. But is this true?

Ironically, history informs us that the debate over the merits of a technical versus nontechnical education for officers is not new. At the close of the nineteenth century, another service experienced great changes and con-

fronted the same issue that now stands before the military space force. In 1879, responding to the debate over officer education in the US Navy, Alfred Thayer Mahan (then a lieutenant commander but destined to become a rear admiral and the greatest sea-power theorist in memory) wrote an essay entitled "Naval Education" that is as relevant to our current dilemma as it was to the sea service over a century ago:

I confess to a feeling of mingled impatience and bitterness when I hear the noble duties and requirements of a naval officer's career ignored, and an attempt made to substitute them for the wholly different aims and faculties of the servant of science. The comparatively small scale on which those duties are now performed, the fancied impossibility of a great war, the pitiful condition of efficiency into which the material of the navy has been allowed to fall, have all helped to blind our eyes to the magnificence of the war seaman's career. . . . No wonder the line officers of the navy are themselves carried away by an amazed humility which dwarfs their own profession.³

Admiral Mahan's lamentation of the Navy's degraded status and the depressed state of naval morale at the end of the nineteenth century speaks also to the modern space officer. Much as Mahan's Navy ignored the naval officer, the new Air Force strategy ignores the noble duties and requirements of a space officer in favor of the skills and abilities of an engineer. Are not military space officers more than engineers in uniform? Are we not to lead others in service to the country—and perhaps into battle? Do we truly share more in common with Edison than Nelson, as the strategy suggests? Technical education instills in students the virtues of scientists or engineers. Is that what we want for *all* military space officers?

Indeed, a number of these officers cannot perceive the magnificence of a space warrior's career for many of the same reasons Mahan sensed in his Navy. A "fancied impossibility of a great war" in space permeates the thinking of the Air Force and Space Command, as exemplified in the common belief (oft denied but affirmed through inaction) that space serves merely a supporting role in military operations. Consequently, notions divorced en-

tirely from military experience that elevate nonviolent techniques (e.g., information and electronic warfare) to the totality of space warfare are accepted as gospel, to the detriment of space officers' connection with their fellow land, sea, and air warriors. Thus, the scope of the space officer's military duties becomes considerably less than that of other officers. Unsurprisingly, some are "carried away by an amazed humility which falsely dwarfs their own profession" and attempt to emulate the traits of the closest honorable profession they can relate to—the space engineer. Mahan notes that

it is necessary, then, to look forward to the end and consider really what you should require a sea officer of the Navy to be. We have actually gotten in the Navy, by constantly adding here a little, there a little, to a pass in which we think that each military sea officer, or to use the technical term, each line officer, should present in his own person a compendium of mathematics including its highest branches, its applications to numerous recondite physical problems, considerable knowledge of the physical and mechanical sciences, and an intimate acquaintance with the arts of the manufacturer; all in addition to a command of his own profession proper. Failing this, so many say, he must descend from the high position occupied by him and his predecessors for these centuries past and become the simple drudge of others whose minds have received a more rigorous and deeper, though often narrower, culture.⁴

Here he describes a belief, commonly held then as well as today, that the officer must be a mathematician, scientist, and engineer as well as a military leader to succeed in his or her duties. That belief lies dangerously close to becoming policy for the military space force.

Did the writers of the new strategy devote sufficient thought to what ideal space officers should be before deciding to make them acquirers (program managers, scientists, or engineers)? Restricting the educational options for these officers seems especially dangerous because we have no clear understanding of the skills they will need in the future. Currently, military space is limited to support operations for terrestrial war fighting. That it will

remain so 20 years from now no one knows. Today, the common space-operations officer runs a space or missile system from a computer on a climate-controlled operations floor at a stateside base—and strongly resembles an acquisitions officer. Tomorrow, however, space operators may field true combat weapons systems and actively engage in a fight, perhaps finding themselves in harm's way like their fellow land, sea, and air officers. At this time, we cannot be certain.

It is disconcerting to derive the requirements of the space-operations career field (Air Force Specialty Code [AFSC] 13S), in which the majority of the space cadre resides (as well as a correspondingly large portion of the future leaders of military space), by the entry-level requirements of the acquisitions career field (AFSCs 61, 62, and 63), an important but minority non-war-fighting subset of the cadre. By definition, acquirers obtain new weapons systems and equipment. They require management and engineering skills—the space-relevant skills as determined by the Space Professional Council. Acquiring systems does not equate with operationally exploiting space. We have no indication whatsoever that the "[narrow] . . . culture" of the engineer or manager will prove sufficient for leadership of the military space effort, nor do we have any clear justification for thinking that the acquisitions culture is better for a space officer than any other.

Unfortunately, the space-professional strategy seems to imply that current operations officers without an acquisitions background will ultimately descend from their high position and "become the simple drudge[s]" of those with acquisitions skills, whose expertise we currently deem more important than any other in space. Certainly, acquisition experts will be absolutely essential to the future military space force, and many will become fine commanders. However, the skills of the acquirer, both manager and technical specialist, do not encompass the myriad skills necessary for military effectiveness. Space—even military space—amounts to more than just equations and dollars. Mahan notes that military leadership often fails to grasp this fact:

Recognizing and dazzled by the stupendous nature of the changes made, and the wonderful things accomplished by the labors of science, those who have had direction of our naval education, or who have exerted influence upon that direction, seem to run away with the idea that every naval officer, having to use these engines of offense or defense which the student or mechanic has put into his hands, should be able to follow out the long train of laborious thought, be familiar with all the practical processes, by which each of these mighty engines has been conceived or produced.⁵

The space-professional strategy undoubtedly has “run away with the idea” that every space officer “should be able to follow out the long train of laborious thought” by which our systems are conceived. It is quite another issue whether or not the writers of the strategy understand the laboriousness of earning a technical master’s degree. For instance, the master of engineering degree in space operations (a strategy-approved area of study) from the University of Colorado at Colorado Springs requires classes in astrodynamics, mechanical-systems analysis, spacecraft dynamics, launch-vehicle analysis, systems engineering, and trajectory optimization, among other subjects.⁶ Each class requires extensive use of higher mathematics such as differential equations and matrix and linear algebra, as well as advanced principles of mechanics, thermodynamics, and other scientific disciplines. How many current colonels and generals (even in space billets) cringed at beginning calculus or panicked at the sight of their first free-body diagram? Must all space officers become masters of technical concepts rarely encountered in military operations—even in space? Attempting to earn a technical master’s degree, especially in light of an active officer’s limited time and resources, would almost assuredly require a technical bachelor’s degree. Certainly, not every military officer has either the ability or inclination to earn even a technical bachelor’s degree. Should this fact make these technically disinclined officers *persona non grata* in the military space forces?

Interestingly, with such a bachelor’s degree, one could begin a career and progress quite far as a spacecraft designer. A senior design

engineer often earns a technical master’s degree as a terminal degree. Therefore, Space Command wants each officer to become not only a “compendium of mathematics” but also someone qualified to build and design space systems from the ground up. But the mission of the space officer is to exploit space, not build spacecraft. So what kind of education does Mahan think successful officers need?

The knowledge that is necessary to a naval line officer is simply and solely that which enables him to discharge his many duties intelligently and thoroughly. Any information that goes beyond this point is after all simply culture, which, however desirable in itself, must not be confounded with essentials. This is true although the special culture may be of a kind very closely akin to his profession. For instance the manufacture of ordnance, the intricate questions connected with explosives, have a very close connection with the military part of his business. Yet to say that an exhaustive and exact knowledge of the various processes by which the finished gun and the proved powder are furnished to his hand and of the rapid though gradual advance made in each is necessary, is to occupy ground that is not tenable.⁷

Understanding the universal truth of the first sentence of that quotation is both important to comprehending Mahan’s goals for military education and essential to designing a correct scheme of education for military space officers. Oftentimes officers discharge their duties, which include defending their country, by effectively operating their systems, be they rifles, warships, or satellites. Throughout history, military officers have performed their duties admirably without complete understanding of the science behind war machinery. A pilot does not need to know about computational fluid dynamics to understand that pulling back on the stick will cause the aircraft to gain altitude. A soldier does not need skill in advanced chemistry to realize that pulling the trigger on a rifle will fire a projectile. Similarly, a space officer does not need to master the mathematical intricacies of perturbation theory to account for its effects on satellite operations. The scientific principles behind each

operational action are not essential to conducting an operation.

Space operations, however, share much of the culture of space engineering—so much so that Air Force space operations until recently were the express domain of engineering officers under the now-deactivated Systems Command. Mahan warns us that despite the similarity between military operations and engineering cultures, believing that the successful operator must have the same skill set as the successful engineer still confuses culture with essentials. He insists that one need not understand all the scientific underpinnings of modern astronautics to operate a system built on these principles. So how much is truly necessary?

For the portion of the requisite knowledge, how great an amount of scientific power is required? . . . Some acquaintance with the mechanical powers and the modes of their applications, but scarcely enough to dignify by the name of science. That the knowledge sufficient to run and care for marine steam engines can be acquired by men of very little education is a matter of daily experience.⁸

For example, the operations floor of the 2d Space Operations Squadron proves Mahan's point every day. Although the global positioning system (GPS), a constellation of almost 30 satellites, is undoubtedly one of the most complicated military systems ever produced, very few certified military-operations personnel have earned technical degrees. Satellite vehicle operators, responsible for maintaining the health of spacecraft subsystems and responding to potentially hazardous satellite anomalies, arguably occupy the most highly technical position on the operations crew. But we do not require that they hold technical degrees, and the majority of them do not have engineering or hard-science bachelor's degrees. More tellingly, satellite systems operators—the only crew position in the 2d Space Operations Squadron authorized to generate and transmit commands to a satellite—are young Airmen, often only a few months out of basic training and possessing only high school diplomas. Regardless, the GPS constellation remains one of the most reliable military systems

ever fielded, and the satellite vehicle and satellite systems operators consistently demonstrate their competence as crew members.

Even though GPS crews must understand basic principles of orbital mechanics, space dynamics, satellite design, and computer science, they do not need technical degrees to perform their jobs successfully. Skills developed in technical training such as Space 100 (formerly Officer or Enlisted Space Prerequisite Training) and Unit Qualification Training seem to produce fine operators who have no trouble keeping the GPS operational. However, the depth of knowledge obtained in these courses can “scarcely [be dignified] by the name of science.” Every other operations unit in Space Command can attest to that fact: “that the knowledge sufficient to run and care for [space systems] can be acquired by men of very little [technical] education is a matter of daily experience.” If so, what does Mahan believe the officer should study?

If I be asked, in my own words, how the English studies or the acquirements of Foreign Languages help a man to handle and fight his ship, I will reply that a taste for these pursuits tends to give breadth of thought and loftiness of spirit. . . . The ennobling effect of such pursuits upon the sentiment and intellect of the seaman helps, I think, to develop a generous pride, a devotion to lofty ideals, which cannot fail to have a beneficial effect upon a profession which possesses, and in its past history has illustrated in a high degree, many of the elements of heroism and grandeur. The necessarily materialistic character of mechanical science tends rather to narrowness and low ideals.⁹

In the final analysis, “breadth of thought and loftiness of spirit” are not qualities essential to an engineer, manager, or operator. An engineer needs mathematic and scientific insight, a manager needs economic and group-dynamic understanding, and an operator needs only a firm understanding of the technical order. However, breadth of thought and loftiness of spirit are essential traits of a military leader—the true definition of an officer.

As an officer with a technical background, when I read astrodynamics texts I feel like an engineer—a functionary. But when I read

Thucydides, Xenophon, and Mahan, I realize what it means to be an officer—a professional student of the art of war. Admittedly, the duties of junior officers are quite functionary, and technical backgrounds may very well make them better operators although we have no indication of this at present. However, officers do not remain mere functionaries for long. When military leadership and an understanding of warfare begin to increase in importance, the “[narrow] . . . ideals” of mechanical science may prove more a hindrance than a help to the officer.

At the level of senior leadership, including positions in the military space field, command decisions become much more than mere equations. Indeed, most of the pressing problems in Space Command today are not technical issues. Such matters as developing effective military space doctrine, applying the art of war to the space medium, and overcoming objections concerning the ethics of military space (including the sickening belief that disabling space systems by killing people on the ground is somehow more “moral” than destroying inanimate spacecraft in orbit) do not require skills of the engineer but those of the philosopher, historian, and military theorist.

The space-professional strategy wrongly emphasizes the functionary over the officer. It is much easier to give officers the technical skill to become successful functionaries in technical schools than to instill a “generous pride” and “a devotion to lofty ideals” essential for great military leaders during a few scant months in professional military education programs. Allowing officers to choose their higher education as they see fit will ensure a healthy balance of all skills necessary for the space officer corps. To deny the importance of the liberal arts to the officer is to undermine the very reasons for the existence of an officer corps. What can we do to secure a healthy balance of skills in Air Force officers yet maintain needed technical proficiency?

I am persuaded that in our theory of education we have failed in this country to recognize that the progress of the mechanical sciences, and the vast change thereby made in naval vessels and their armaments, as well as in other means of

warfare, have made necessary the organization of a corps of specialists.¹⁰

The space field undeniably needs officers skilled in science, engineering, and program management. Instead of vainly trying to make the space officer an operator, engineer, and manager all in one, the Air Force should focus on developing the best possible individual operators, engineers, and managers.

Air Force-coded scientists and engineers often lament that they very rarely use their degrees. A common notion exists among the science and engineering fields (AFSCs 61 and 62) that Air Force technical specialists do not really “do” science and engineering. Often, the officer technical specialist oversees the real technical work done by civilians and contractors. If our service wishes to ensure that the space cadre has the best technical specialists possible, perhaps it should focus on developing the current AFSC 61 and 62 space officers instead of requiring hard-science master’s degrees of all space officers.

Offering technical-specialist space officers the chance to become real engineers and scientists is essential. The Air Force should allow officers especially skilled at research and development to be engineers and scientists in uniform—not simple overseers. Only through hands-on research-and-development opportunities will space technical experts retain and enhance their technical skills. Forcing engineers to take tours as operators or vice versa will do nothing but undermine the specialties of technical experts.

Only by retaining specialties in the space forces can technical experts focus on science and engineering. The promotion schedule for specialties should permit equal advancement opportunities for officers who choose to concentrate entirely on engineering or science as well as specialists who also choose to take operational tours. If the space cadre allows research-minded technical specialists to focus their careers on research without promotion penalty, the military space force will benefit from a stronger technical officer corps. In order to do so, the Air Force must give AFSC 61 and 62 officers the freedom to follow

their interests in service to the military and work alongside civilian researchers rather than remain mere spectators. Filling the entire space cadre with technical specialists will only decrease the depth of knowledge that officer scientists or engineers can achieve since they would incessantly have to leave the lab to serve as operators or managers or attend to any other number of nontechnical details that will monopolize their careers. Instead of magnifying and expanding the roles and opportunities for existing officer scientists and engineers, Space Command has chosen to ask all space officers to fit its mold.

The space-professional strategy's endorsement of technical degrees for all officers springs directly from a passage in the report of the Space Commission:

Other career fields, such as the Navy's nuclear submarine program, place strong emphasis on career-long technical education. This approach produces officers with a depth of understanding of the functions and underlying technologies of their systems that enables them to use the systems more efficiently in combat. The military's space force should follow this model. In addition, career field entry criteria should emphasize the need for technically oriented personnel, whether they be new lieutenants or personnel from related career fields. In-depth space-related science, engineering, application, theory, and doctrine curricula should be developed and its study required for all military and government civilian space personnel, as is done in the Naval Nuclear Propulsion Program.¹¹

This passage makes clear the roots of the Air Force strategy's technical desires; however, it takes on new meaning when put into the context of the report's other findings. Throughout that document, the Space Commission insists that "space is a medium much the same as air, land, and sea" and that the "Department of Defense is not yet on the course to develop the space cadre the nation needs."¹² The commission never states exactly what form the mature space cadre should take, but one can reasonably conclude that the envisioned cadre would not consist of a narrow set of technical specialists but would encompass masters in all aspects—technical and nontechnical—

who can exploit the space environment for national-security purposes: "Military space professionals will have to master highly complex technology; develop new doctrine and concepts of operations for space launch, offensive and defensive space operations, power projections in, from, and through space and other military uses of space."¹³

One finds further proof that the commission intends the space cadre to embrace all aspects of military space in its opinions on an independent Space Department: "Near- and mid-term organizational adjustments should be fashioned so as to not preclude the eventual evolution toward a Space Department if that proves desirable."¹⁴ Indeed, the commission made a major recommendation, later adopted, that would lay the foundation for such a department.¹⁵ Therefore, one can reasonably assume that the commission wanted the space cadre to serve as the basis of a separate space service, entrusted with all aspects of the military exploitation of space, much as the Army, Navy, and Air Force are entrusted with exploiting the land, sea, and air mediums.

Thus, one should not conclude from the Space Commission's mention of the Navy Nuclear Propulsion Program that the space cadre *as a whole* should follow this model. Whereas the cadre would exploit the space environment, the Nuclear Propulsion Program is not responsible for exploiting the sea environment—a task entrusted to the Navy. The propulsion program trains only a small subgroup of technical specialists for the larger Navy, most of whom are confined to a warship's engine room, not the bridge. Therefore, to insist that the space cadre follow the propulsion program model is to fatally constrain the development of a robust team of dedicated space professionals. Certainly, none of the established military services has declared that only a person with a technical or business degree is eligible to earn a commission. Leaders know that restricting the officer corps' academic breadth of knowledge to the merely technical would rob the services of many essential skills. Similarly, restricting the space cadre would constitute a deplorable error. What does Mahan advise?

Do I then undervalue science? Do I ignore the great changes it has made in the appliances and system of naval warfare, or deny the necessity of the service of men thoroughly imbued with its spirits and acquainted with its truths? Not at all, I simply say that while the processes, by which the results of scientific research are obtained, are laborious and difficult, the results themselves, for naval purposes, are instruments easy of comprehension and intelligent use; while the practical use of them, under the varied and often exciting conditions of sea and battle service, calls for other and very different qualities and experience than those of the student or mechanic. Consequently, devotion to science and the productions of the instruments of warfare, from the ship itself downward, should be the portion of a certain, relatively small, class of specialists.¹⁶

Mahan's conclusion is as relevant to today's military space force as it was to the military sea force of his day. He did not undervalue science or the need for officers skilled in science and engineering—and neither should we. A military organization must have multiple, varied skills in its officer corps. Traditionally, the naval line officer and the operators of the Army and Air Force have provided the “generalists” of the officer corps. Military training courses prepare them to become sailors, pilots, and infantrymen who fight battles with the skills they have learned. After tours of field duty, they then become their service's strategists, theorists, planners, instructors, and leaders. Their academic background often determines the position they fill after operations tours. An in-

fantry officer with an English degree is uniquely suited to become an English instructor at a service academy. The military-historian submariner is academically equipped to become a strategist. Not all military positions are well served by technical degrees.

The military space force is no different than forces in the other services. A history degree may have far more relevance to planning the reorganization of military space than one in astronautics. Education in political science may prove far more necessary than business management for space-power theorists. To accomplish the varied tasks of military space, we need space officers with varied backgrounds. Officers with both a technical and liberal education must form a heterogeneous mix of experts dedicated to American space power. To make all space officers acquirers will deprive the military space force's officer corps of skills essential to the foundation of any military organization. At the end of the nineteenth century, Mahan warned against letting the skills of the engineer overshadow those of the warrior in the officer corps. Rather, he advised strengthening and enhancing specialists while leaving line officers free to study other fields necessary for military officership. At the beginning of the twenty-first century, Space Command has come dangerously close to following the path Mahan fought to avoid. It could gain much by heeding the advice of one of America's greatest military geniuses. □

Notes

1. Briefing slides, Peterson AFB, CO, subject: Space Professional Development Road Show, 15 July 2004, <https://halfway.peterson.af.mil/spacepro>.

2. “Certification Process,” Space Professional Development, <https://halfway.peterson.af.mil/spacepro/measurable.htm>.

3. Lt Cdr A. T. Mahan, “Naval Education,” United States Naval Institute *Proceedings* 5 (1879): 349.

4. *Ibid.*, 347.

5. *Ibid.*, 346.

6. “Master of Engineering, Space Operations,” College of Engineering and Applied Science, University of Colorado—Colorado Springs, http://mae.uccs.edu/rroppold/moe_space_operations.htm.

7. Mahan, “Naval Education,” 348.

8. *Ibid.*, 350.

9. *Ibid.*, 352.

10. *Ibid.*, 346.

11. *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington, DC: The Commission, 2001), 45, <http://www.defenselink.mil/pubs/space20010111.html>.

12. *Ibid.*, 13, 42.

13. *Ibid.*

14. *Ibid.*, 80.

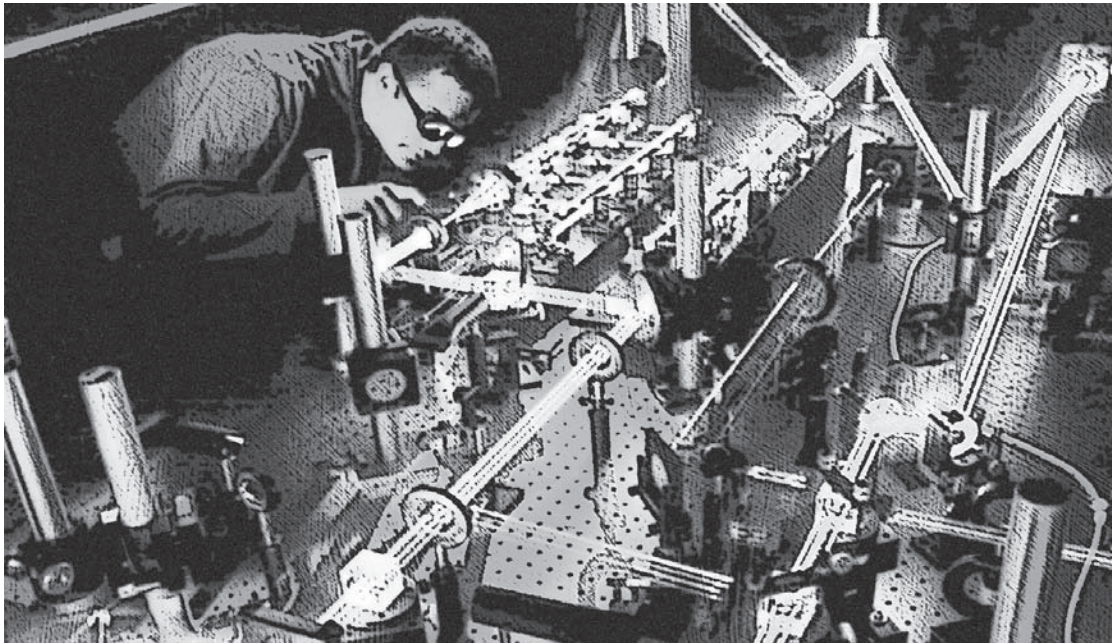
15. “U.S. interest in space may well ultimately call for the creation of a Space Corps or a Space Department to organize, train, and equip forces for sustained operations in space. For that reason, assignment of Title 10 responsibility to the Air Force by the Congress and its designation as Executive Agent for Space within the Department of Defense is recommended to lay the foundation for such future steps.” *Ibid.*, 93.

16. Mahan, “Naval Education,” 352.

The War Fighter's Need for Science and Technology

DR. J. DOUGLAS BEASON, COLONEL, USAF, RETIRED*
DR. MARK LEWIS

Editorial Abstract: For over five decades, science and technology have given the US Air Force the winning edge in conducting warfare, but without an aggressive, constant reinvestment and the ongoing pursuit of ever-improving technologies, we could someday lose that edge.



SINCE THE BEGINNING of World War II, we have seen the introduction of radar, precision-guided weapons, atomic bombs, ballistic missiles, transistors, semiconductors, computers, jet aircraft, stealth technology, satellites, cell phones, lasers, the global positioning system (GPS), and so forth. The list of scientific and technical applications

in warfare is staggering. Each of these technologies has had a profound impact on the way we fight and, equally importantly, on the way we keep our war fighters out of harm's way. Furthermore, the pace of inserting winning technology is increasing. In the millennia since humankind has kept records, estimates indicate that the world has seen a doubling—a

*Portions of this article come from Dr. Beason's book *DOD Science and Technology: Strategy for the Post-Cold War Era* (Washington, DC: National Defense University Press, 1997).

100 percent growth—in knowledge from the dawn of time until the 1950s. That knowledge, which has doubled several times since then, has spilled over to the war fighter. In many cases, it has actually been driven by his or her needs.

Because today's warrior fights with more technologically sophisticated weapons than in the past, fewer of them have to fight on the battlefield. Moreover, the increased precision of war fighting has ushered in a profound change in the very nature of national conflicts: rulers of nations can no longer wage war with the lives of their people without putting their own personal safety at risk. But technological advances in warfare have become a double-edged sword. That is, although the number density of combatants (the number per square kilometer) may have decreased throughout the years (fig. 1), their firepower has increased, made possible by the introduction of state-of-the-art weapons. One may understand the increase in firepower by considering the way technology has enabled fewer war fighters to levy more damage at a longer distance: the range of a spear was extended by the bow and arrow, whose range was extended by the bullet, whose range was extended by the artillery shell, whose range was extended even farther by missile technology. New technologies such as hypersonic missiles, which can cover hundreds of miles in a matter of minutes, or directed-

energy weapons, which can engage the enemy at the speed of light, allow us to extend a weapon's range beyond national borders or even around the world, reducing manpower density on the battlefield even further.

The Increase in Military Effectiveness due to Science and Technology

In 1945 J. F. C. Fuller enumerated range of action, striking power, accuracy of aim, volume of fire, and portability as qualitative parameters characterizing the power of a weapon, giving range of action the highest priority.¹ Brig Gen Simon P. Worden, USAF, retired, expanded on this concept by deriving military effectiveness as a basic measure of a weapon's military power.² One may define effectiveness in terms of the *brightness* (a term frequently used by laser engineers to measure the capability of a laser) per unit time, or the measure of a weapon's range, accuracy, and power per unit time, all rolled into a single number (table 1).

Note the presentation of military effectiveness in compact form as an exponential number—meaning, of course, that bullets have a military effectiveness of 10^2 or 100 times greater than arrows (10^8 divided by 10^6), and that inter-

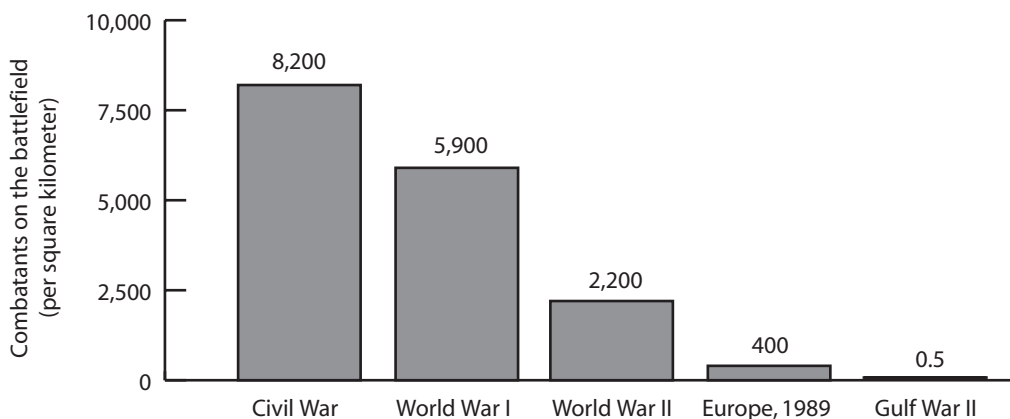


Figure 1. Manpower density on the battlefield. (From data in Kenneth L. Adelman and Norman R. Augustine, *The Defense Revolution: Intelligent Downsizing of America's Military* [San Francisco: Institute for Contemporary Studies Press, 1990], 55; and from Cable News Network.)

Table 1. Weapon effectiveness

Era (Year AD)	Weapon	Time ^a	Brightness (joule/steradian)	Firing Rate (per sec)	Effectiveness ^b (joule/steradian/sec)
1000	arrow	6 months	10 ⁸	10 ⁻²	10 ⁶
1500	bullet	3 months	10 ⁹	10 ⁻¹	10 ⁸
1800	artillery	1 month	10 ¹²	10 ⁻¹	10 ¹¹
1900	artillery	1 week	10 ¹⁴	10	10 ¹⁴
1930	aircraft	1 day	10 ¹⁹	10 ⁻¹	10 ¹⁸
1950	aircraft	1 day	10 ²³	10 ⁻²	10 ²¹
1970	ICBM	1 hour	10 ²³	10 ⁻¹	10 ²²
2015	SBKKV ^c	1 hour	10 ²³	10	10 ²³
2020	laser	5 minutes	10 ²²	10 ²	10 ²⁴

Source: Reprinted from Simon P. Worden, *SDI and the Alternatives* (Washington, DC: National Defense University Press, 1991), 14.

^a Time = both the time period of battle and the time it takes to get into position to engage the weapons

^b Effectiveness = brightness x firing rate

^c SBKKV = space based kinetic kill vehicle

continental ballistic missiles (ICBM) are 10⁸ or 100 million times more effective than artillery in 1900 (10²² divided by 10¹⁴). Here, Worden presents lasers as 10 billion times more effective than artillery. Although military tactics and strategy have played a role in increasing the effectiveness of these weapons, advances in military effectiveness stem chiefly from the exploitation of science and technology (S&T) (fig. 2). One sees the dramatic increase in such effectiveness on a logarithmic scale; that

is, the vertical axis of the figure shows exponential powers of 10, so the maximum value of 25 is not a simple factor of five greater than 20 but 10⁵—100,000 times greater.

When will this increase in military effectiveness stop? At the present rate, it will not cease in the foreseeable future because technology present in the battlefield keeps increasing. For the war fighter, this means that weapons used to win tomorrow's war will differ as much from today's weapons as the latter differ from

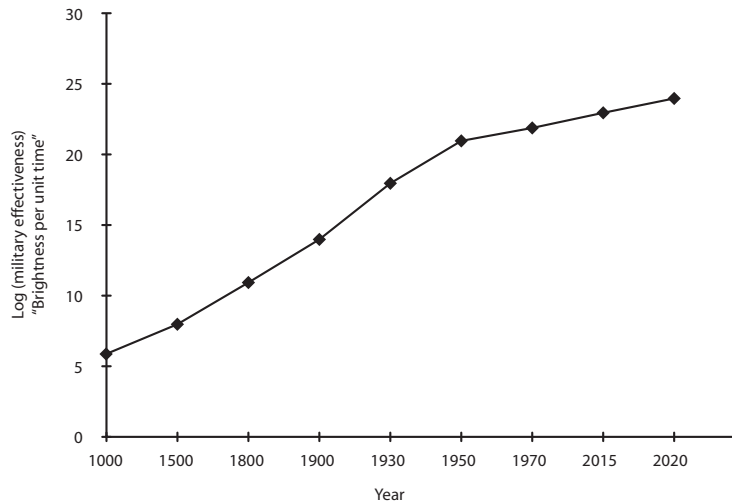


Figure 2. Military effectiveness through the years. (From data in Simon P. Worden, *SDI and the Alternatives* [Washington, DC: National Defense University Press, 1991].)

those used in World War II. But this will happen only if we keep investing in S&T because advances in that area have to come from somewhere—remember that today’s weapons are the result of yesterday’s investments. If we don’t invest, we’ll fight tomorrow’s war with today’s technology—but our adversaries may not. Or just as bad, the fact that we invent something doesn’t mean that we will exploit it first. The country that invented the airplane found itself using other nations’ airplanes in World War I. Aviation historian Richard Hallion has pointed out that a decade after the Wright brothers’ first flight, American military aircraft accounted for only 2.5 percent of the world’s total number of military airplanes then in service.³ Without a sustained S&T program, the brilliant ideas of our research scientists and engineers will languish or, worse, perhaps fall into the hands of future adversaries.

However, if we keep investing and exploiting advances in S&T, tomorrow’s battlefield will consist of global, interconnected networks keeping track of targets using distributed, sophisticated, smart, and reconfigurable sensors; microcombatants; stealthy air/land/sea/space platforms; and long-range, conventional (non-nuclear), high-precision, extremely accurate weapon systems (both manned and unmanned)—all linked with digital computers. History has shown that advances in S&T produce exponential increases in military effectiveness—not just increases of 10 percent or even a doubling of effectiveness but true factors of many thousands of times. So this is the precedent: advances in S&T will make their way to the battlefield and will change the very nature of warfare. For example, military authorities note that in World War II, aircraft had to drop approximately 5,000 bombs to destroy one target.⁴ In Vietnam the addition of laser-guided technology dropped that number to around 500; to about 15 in the Iraq war of 1991, thanks to advances in precision-aiming technology; and to 10 and then to five in Kosovo and Afghanistan. Even more precise weapons came into play during Gulf War II of 2003, with ratios approaching one target killed for every weapon dispensed.

An important human dimension accompanies such advances. Hallion further notes that hitting a 200,000-square-foot German factory in World War II with a 96 percent chance of success required a squadron of 108 B-17 bombers (carrying 1,080 aircrew members and 648 bombs) and approximately 100 single-seat escort fighters, bringing the total force to nearly 1,200 human lives. Typically, 15 of the bombers and their 150 men would not make it back home. Today we could perform the same mission either with a single F-117 stealth fighter dropping two precision-guided bombs or with one cruise missile.⁵ Furthermore, to date only one F-117 has ever been shot down in combat.

In the 45 years between World War II and the first Gulf War, the average miss distance of a bomb decreased from over half a mile to 10 feet.⁶ We’re also quickly approaching the ultimate limit of using one bomb to destroy one target since warriors will be constrained by the number of bombs they can carry. Of course, our intelligence gathering must ensure that the target we hit is the one we really want to destroy. Also, advances in S&T hold out the promise of nonkinetic weapons such as directed energy, whose near-infinite precision may allow warriors to kill many targets with one weapon, resulting in a “deep magazine.” Clearly, we are reaping the benefits of decades of investment in S&T. Weapon systems from the F-22 to the airborne laser owe their existence to years of aggressive, vigorous Air Force support of S&T investments.

The Air Force has a proud tradition of supporting S&T for long-term investments in future war-fighting technology. Originally established as a technology branch of the military, the Army Air Corps offered machines that fly in the air. The nation validated the need for that high-tech legacy by establishing the Air Force as a separate service in 1947. With the invention of the atomic bomb, global aircraft, and jet aircraft, Gen Henry H. Arnold realized the Air Force’s critical dependence on advances in S&T. Consequently, he and Dr. Theodor von Kármán established the Scientific Advisory Group (now the Scientific Advisory Board), giving the nation’s most-renowned



The airborne laser: a uniquely modified 747-400 freighter designed to shoot down ballistic missiles during their boost phase

scientists a vehicle for advising the service on S&T investments.

Today, the Air Force Research Laboratory (AFRL) is responsible for the Air Force's annual \$1.2 billion S&T program, including far-term basic research, exploratory development, applied research, and advanced development. The laboratory employs more than 6,300 military and civilian personnel who can proudly claim to have contributed to technological breakthroughs in all of today's modern aircraft, spacecraft, and weapon systems, as well as significant advancements in modern communications, electronics, manufacturing, and medical research and products. The AFRL also houses the Air Force Office of Scientific Research (AFOSR), which provides funding to over 1,000 researchers at universities, industries, and government agencies throughout the country and around the globe. One can say without exaggeration that the financial and intellectual support of the AFOSR influences the direction of basic research in nearly every technical field with military relevance. The commitment of the thousands of researchers and program managers at the AFRL demon-

strates recognition of the importance of basic S&T research to the Air Force mission.

But danger looms: unless we continue to nurture defense S&T, the advantages that the Air Force enjoys in military effectiveness could stagnate—perhaps even grind to a halt. As total funding in Air Force S&T decreases—both in terms of real dollars and constant fiscal-year funding as a percentage of the service's total obligation authority—so will the direct edge in military capability. S&T funding has to come from somewhere. A significant decrease in the level of industrial research and development and annual decreases in funds available for university research, coupled with the tightening of belts at the defense and national laboratories, will place tomorrow's advancements in military capability in jeopardy. Our war fighters do not want a fair fight; they want to so completely dominate an opponent that conflicts end quickly with minimal loss—or don't start at all. If the time comes when we no longer dominate the battle, our warriors will find themselves fighting with the same capability as their foes.

Technology Can Change Warfare Overnight

On many occasions, new technology introduced on the battlefield has changed the course of military affairs overnight. The Battle of Crécy in 1346 saw the unveiling of high-powered, highly accurate English longbows in continental Europe, resulting in ruinous defeat of the French and recognition that metal armor would never again offer impenetrable protection. The French, of course, responded, so that within 10 years their armies included highly skilled longbowmen, and military tactics changed forever. Additionally, nineteenth-century naval history shows us examples of military technical revolutions fueled by innovation, creative thinking, and hard work. During the American Civil War, the introduction of ironclad warships altered naval warfare, but another revolution had occurred over half a century earlier. At the end of the eighteenth century, the fledgling American Navy sought a design for a new class of warship. Unfettered by hundreds of years of warship-building legacy, American naval architects led by such out-of-the-box thinkers as Joshua Humphreys of Philadelphia designed sailing frigates that were larger, better armed, better built, and faster than their English counterparts.

These early ships, including the still-commissioned frigate USS *Constitution*, prevailed in all of their engagements during the early part of the War of 1812. Imagine the shock to the British when their 1,000-ship navy suffered defeat after defeat to a colonial upstart with superior technology. A number of factors proved key to this success: well-trained volunteer crews and newly developed, innovative designs, including hull structures diagonally braced to support heavier cannon; advanced material, including live oak from the Carolina swamps, superior to that of the British; and newly derived designs that allowed higher gun placement above the water and freer movement of ships' hulls through the water. The moral of this story is that innovation often comes from looking at an old problem from a new perspective—another edge that S&T gives us.

The Best Use Is Not Always the First Use

Most weapon systems experience the same jaw-dropping, unexpected use made of every new major technological device: once war fighters get their hands on an asset, they almost invariably come up with a new, perhaps even more important, application. History bears this out. For example, no one in his or her right mind wanted a device—such as a GPS receiver—that would indicate one's location accurate to centimeters, much less time of location accurate to microseconds. For years, people had gotten along fine with maps from the American Automobile Association (AAA), or if they needed more accuracy, standard navigation gear such as compasses.

To determine their location, pilots started using long-range aid to navigation (LORAN), which came in handy when they flew in fog or through clouds or, especially, over water.⁷ Even then, no one really had a need for more accurate navigation tools since pilots could always “eyeball” a landing once they flew in under the cloud layer. Nevertheless, more sophisticated navigational tracking devices appeared, such as star trackers and then the ultimate—the inertial navigation system (INS), based on the accurate reading of differences between gyroscopes. Later, the laser gyroscope further refined the INS. Why in the world would anyone want anything more accurate than that?

This is precisely the criticism that a few far-thinking Air Force scientists encountered when they first proposed the GPS. Undaunted, they argued that precise navigation would do away with the need for the sometimes-inaccurate LORAN (then used for the majority of air navigation) and could set a standard for everything from mapping to geolocation. Many scoffed at the idea: why spend billions on a navigation system instead of a new class of fighters? Luckily, Congress agreed with the visionaries and funded the project. When the GPS finally came online, however, it fizzled. Nobody used it, and at first nobody wanted it. After all, why would someone spend thousands

of dollars buying a GPS receiver to find his or her location within a few hundred meters (for security purposes, the Air Force masked the commercial GPS algorithm, making it 10 to 100 times less accurate than the military version)? Even the military couldn't see why it needed to spend the extra money to obtain a new, uncertain capability; INS worked just fine.

Then came the first Gulf War—the battle to liberate Kuwait. Suddenly, hundreds of thousands of soldiers and Airmen discovered that AAA maps didn't work in the desert. Even worse, the National Imaging and Mapping Agency (now the National Geospatial-Intelligence Agency) didn't have accurate maps of Iraq because no recognizable landmarks existed for thousands of square miles. Frustrated soldiers wrote home before the war started, and their moms rushed to sporting-goods stores, buying \$1,000 GPS units and shipping them to their sons and daughters so they could find their way in the desert—and it worked. Suddenly, everyone wanted these receivers. The military upgraded the civilian ability to use the GPS, and the number of uses exploded. Now engrained in society, the GPS has become indispensable for navigation in commercial industry.

The point is that no one knew exactly what benefits would arise from investing in the GPS, and we're only now realizing the potential of this critical investment. People initially skeptical of new technology can't get enough of it later. This mind-set is not unique. In 1921, when told of Billy Mitchell's claim that airplanes could sink battleships, Secretary of War Newton Baker growled, "That idea is so damned nonsensical and impossible that I'm willing to stand on the bridge of a battleship while that nitwit tries to hit it from the air." Similarly, in 1938 Maj Gen John K. Herr remarked, "We must not be misled to our own detriment to assume that the untried machine can displace the tried and proven horse." And in 1939, Rear Adm Clark Woodward sniffed, "As far as sinking a ship with a bomb is concerned, it just can't be done."⁸

More recently, some individuals even scoffed at precision-guided weapons: "Who would need to be so precise when a grease pencil mark on the cockpit window has worked for

years?" Others decried the Airborne Warning and Control System aircraft for controlling the air battlefield: "The Soviets did this and lost!" In the same way, many think the airborne laser will show the same resilience as these other new national systems and provide the United States with a capability that we can't even begin to imagine. After all, putting a highly capable national asset in the hands of a war fighter and placing him or her in a new, life-threatening situation will not cause that warrior to freeze up and not function. We teach our war fighters to think innovatively, on their feet. The products of new S&T will give us the edge that allows us to win.

Invention to Innovation

The time it takes for a weapon to be invented until someone finds a "killer application," a use that no one can live without, is known as the period from invention to innovation. For example, precision weapons introduced in the 1960s (laser designators in the Vietnam War) were not widely embraced until later, when the news media televised scenes of incredibly accurate air-to-ground missiles shooting through windows in the first Gulf War. There, the time from invention to innovation was roughly 30 years. Every discovery has this period—sometimes referred to as the S curve of technology development (fig. 3). This is especially true of advances in the basic sciences, such as physics, chemistry, biology, and ap-

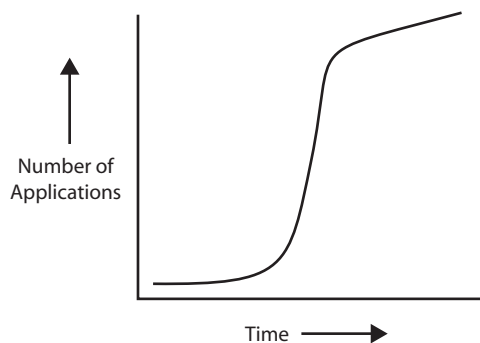


Figure 3. The S curve of technology

plied mathematics. Rarely does a discovery reveal what it will ultimately affect. In fact, today some critics still wait at all the worthlessness generated by researchers.

Consider our recent history with the basic sciences.⁹ Within a few years of 1875, discoveries made since the 1600s—an incubation process lasting nearly 270 years—started to feed into the West's industrial-technology base.¹⁰ Would anyone today have the patience to wait for the innovative use of something invented 270 years ago? Over that period, the basic sciences laid the groundwork for explaining the basis of the natural sciences, chemistry, and physics. These developments culminated in the foundation of rigorous engineering procedures responsible for the rapid evolution of technology. For example, the hundreds of significant breakthroughs in the basic sciences in the midnineteenth century include Rudolf Clausius's Second Law of Thermodynamics, Georg Friedrich Riemann's non-Euclidian geometry, and James Clerk Maxwell's Kinetic Theory of Gases in the 1850s; Dmitry Mendeleev's periodic table of the elements, Gustav Kirchoff's black-body radiation, and Maxwell's electromagnetic equations in the 1860s; and Louis Pasteur's work in food spoilage, Johannes Diderick van der Waals's gas laws, and J. W. Gibbs's chemical thermodynamics in the 1870s.¹¹

The innovative application of these discoveries was not immediately apparent; however, from Maxwell's equations sprang the basis for radio, television, electronics, and computers; Mendeleev's work on the periodic table established the basis of modern chemistry; and Pasteur's efforts in food spoilage resulted in the science of bacteriology and modern biology.

On the surface, a direct connection seems to exist between discovery and application. That is, by looking into the past, one can easily show a simple path from creative spark to world-changing technology. But the path from these scientific discoveries to the technology used by the war fighter is never direct but long and circuitous, rarely linear, and never straight-forward. One discovery begets another; a new application yields a wellspring of others. Rarely does the ultimate application leap directly

from the mind of the inventor; instead, it waits to be revealed by the user like an onion's inner core—peeled away, layer by layer.

The labors of research do not quickly bear fruit. Typically, the applications of basic research are measured in decades, not days. For example, the time between invention and innovation for the fluorescent lamp was 79 years; gyrocompass 56 years; cotton picker 53 years; zipper 27 years (!); jet engine 14 years; radar 13 years; safety razor nine years; and wireless telephone eight years.¹² Although this extensive timescale is a drawback of long-range research, its applications have proven that they can change the direction of society.

Similarly, revolutions in modern warfare such as stealth technology did not happen overnight. Stealth began with an investment in basic research in the 1950s, led in large part by fundamental efforts supported by the AFOSR and fueled by an American appreciation for some basic theories developed by the Russian physicist Pyotr Ufimtsev, the application of whose work was largely ignored in his own country. As another example, future hypersonic missiles will build on almost five decades of basic and applied research in high-speed flight. The engine that will most likely power a high-speed cruise missile—the supersonic combustion ramjet or “scramjet”—first underwent rigorous analysis by two engineers, Richard Weber and John McKay, working at the National Advisory Committee on Aeronautics, precursor of the National Aeronautics and Space Administration (NASA), in 1958. Forty-six years later, the flight of the X-43a experimental airplane validated Weber and McKay's concept by flying at seven times the speed of sound on 27 March 2004 and 10 times the speed of sound on 16 November 2004. These flights, with a combined total of 20 seconds of engine data, represent the culmination of literally hundreds of hours of wind-tunnel tests and thousands of hours of computer simulations—just the beginning of a long series of experiments to make high-speed missile engines practical.

The same holds true of the application of lasers and high-power microwaves as directed-energy weapons. Their world-changing appli-

cations will dwarf any initial expectations of what these technologies could eventually accomplish. Thus, although a specific purpose may drive the initial use of an invention, the real, innovative result of investments in S&T always awaits discovery. War fighters will do just that.

The Way Ahead

Current advances in S&T will find their way into the war fighter's arsenal on an ever-decreasing timescale. The scientific breakthrough of today will serve as the foundation for the weapons of tomorrow. In other words, the warrior's equivalent of industry's "time to market"—beating the competition by fielding a new, better product—means deploying new war-fighting capabilities before the enemy can respond. This ensures that the United States will avoid technological surprise as well as

keep an overwhelming, asymmetric advantage over its adversaries. It is impossible to list all the breakthroughs and myriad ways the military is trying to exploit them; the AFOSR or the Pentagon's Office of the Director of Defense Research and Engineering provides a broad window for individuals interested in examining our current, future investments.¹³ However, some exciting possibilities made possible by recent scientific breakthroughs bear mentioning.

Quantum Key Distribution

With his colleagues B. Podolsky and N. Rosen, Albert Einstein published a paper in 1935 now known as the EPR paradox, named after its authors.¹⁴ In an effort to refute quantum mechanics, Einstein attempted to prove the incompleteness of this new theory: the EPR paradox seemed to show that information



An F-16 suspended inside an anechoic chamber, which allows scientists to evaluate the aircraft's ability to guard against high-power microwaves

could travel faster than the speed of light. Instead, Einstein's paper led to a new branch of physics, currently used in passing secret codes, which has spawned a growing field known as quantum cryptography.¹⁵ Using quantum mechanics, scientists have demonstrated the possibility of creating a code with only two unique, uninterceptable keys. This breakthrough means that someday the military (or whoever else uses this technique, such as banks—or even terrorists) might generate an unbreakable code.¹⁶

Nonlethal "Force Fields"

Millimeter waves centered at 95 gigahertz (GHz) produce the active-denial effect. Funded by the Joint Non-Lethal Weapons Directorate, the Air Force's Active Denial Program, recently declassified, causes temporary, intense pain to individuals at distances greater than those characteristic of small-arms fire.¹⁷ The millimeter waves are nonionizing and thus noncarcinogenic, producing no long-term harmful effects. The waves quickly produce what researchers call the flee effect, giving warriors a nonlethal option other than shouting at or shooting someone. In a sense, this creates a "force field."

Secure Communication

Quickly absorbed by the atmosphere, terahertz waves (one terahertz = 1,000 GHz) do not propagate more than a few kilometers. We can use this drawback to our advantage by providing short-range, secure communication between nodes in a dynamic network of computers or even foot soldiers when we want to prevent the interception of radio "leakage" over long distances.¹⁸ Among other applications, this stops adversaries from detecting command-and-control centers.

Nanotechnology

Nanotechnology involves machines 1,000 times smaller than a micron—a billionth of a meter in length. In 1993 nanotech research was funded at levels over \$3 billion a year, and by the end of this decade, that investment will approach \$1 trillion a year.¹⁹ Recent advances in



A military vehicle modified to carry active-denial technology, which uses a millimeter wave beam of energy to create an intense heating sensation that causes targeted individuals to repel or retreat

nanotechnology suggest the possibility of coating projectiles with a layer one molecule thick, making them superslick and able to penetrate far deeper than today's typical bunker-buster bombs. Advances in the future may also someday allow Airmen to carry nanotech "medics" in their bloodstream that repair damage to internal organs in wartime. Today these advances remain in the realm of science fiction. We must remember, however, that a decade ago, scientists never dreamed of today's accomplishments in nanotechnology.

Conclusion

Advances in S&T are crucially important to giving the Air Force the winning edge. Today, we reap the benefits of decades of investment in S&T. History shows that such investments *always* pay benefits, but current pressure to solve our problems (such as paying fuel bills and war costs, and even increasing the quality of life) can threaten to give S&T short shrift.²⁰ After all, trying to solve today's important,

nagging problems makes it easy to put off the future.

We must also be mindful that with advanced technology and capabilities come increased vulnerabilities. For example, a military dependent upon the GPS for precision guidance is also particularly susceptible to an opponent who threatens that system. Consequently, *once we have invested in technology, we must continue investing to stay ahead of those who would seek to use those leads against us.*

It is also true that military technology, like all technology, undergoes revolutionizing

changes that can be fleeting. Someday our opponents' technical advances may negate the advantages stealth technology offers the Air Force. But if that day comes, we can be prepared with new technologies such as hypersonic flight—so fast that detection becomes irrelevant—and directed-energy weapons that strike almost instantaneously with near-infinite precision. To ensure our winning edge, the Air Force *must* continue to support S&T by aggressively investing in its programs and its talent, both military and civilian. □

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Diving the Digital Dumpster

The Impact of the Internet on Collecting Open-Source Intelligence

LT COL DAVID A. UMPHRESS, PHD, USAFR

Editorial Abstract: Initially a research project for networking computers, the Internet now enables a free flow of information and has woven itself into the very fabric of our culture. However, the Air Force should be judicious about the information it places on Web sites. In this article, Colonel Umphress argues that although the Internet is an information system we cannot avoid, the Air Force must use this resource responsibly to avoid falling prey to its vulnerabilities.

AIR FORCE ORGANIZATIONS commonly ponder the type of information they should post to Web sites. On the one hand, they could reasonably consider posting as much information as possible. Web sites so constructed might include an organization's functions; its list of personnel; details of its operations, policies,

major decisions, finances; and so forth, thus conveying a sense of openness and transparency. Visitors to the site could easily find whatever they are looking for. On the other hand, these organizations could argue in favor of posting very little information beyond perhaps their names and post-office-box addresses. Although such a policy would



not present a very friendly “Web presence,” it would certainly prevent someone from using information for nefarious purposes.

Common sense says that the answer lies somewhere between these two extremes. But where? Although the Internet makes possible the free flow of information, the Air Force should not necessarily make all information freely available through the Internet. Obviously, the service should not post classified or sensitive information, appropriate only for a restricted audience, without appropriate information-protection mechanisms. The less obvious question addresses how much unclassified information the Air Force should make publicly available, realizing the possibility of assembling compromising intelligence from seemingly innocent information.

We live in an information age, one requiring that we carefully consider possible threats to national security before we openly provide certain information. This article explores the issue of legal data collection in the context of the Internet by describing its susceptibility to exploitation for open-source intelligence (OSINT), current Air Force efforts to prevent OSINT collection, current practices that expose the Air Force to such collection, and possible countermeasures.¹

The Internet: An Information Delivery System We Cannot Avoid

Picture a world in which everyone has a printing press and potential access to everyone else’s documents. Because of today’s technology—specifically, the Internet—this image is not far removed from reality. Rising from the modest roots of 1960s technology, the Internet currently attracts an estimated 935 million users across more than 214 countries. At its current growth rate, usage could reach world saturation by 2010.²

The Internet first demonstrated its usefulness by providing the underlying computer-network infrastructure for transmitting data files from one computer to another, thereby

spawning electronic mail, news groups, chat boards, and other applications that support information transfer. Over the past decade, the World Wide Web (WWW) has given the Internet a user-friendly veneer by providing data-transfer protocols and addressing schemes needed to deliver text, pictures, sounds, and videos. It has put the Internet—hence information—directly into the hands of ordinary citizens. Indeed, the WWW has made it possible for anyone with access to a Web server—something supplied by all major Internet service providers—to publish information to the world.

The Internet’s potential has prompted technology pundits to declare it a major force of change because it offers information unfettered by physical, political, or cultural boundaries. With the Internet, for instance, a student can find information on how computer networks work; a civil engineer can locate an aerial photo of a road system; a child can send an instant message to a military mother deployed to a foreign country; a doctor can download a scholarly paper on diseases; a shopper can purchase electronic equipment from a geographically distant retailer; a tourist can read information about her native country in her native language; a blogger can append a description of daily observations to a Web log; and so forth.

This hunger for information is not likely to subside. Industry is increasingly turning to publishing information on Web pages in an effort to enable consumers to find answers to their questions. The US government has taken a similar path with the E-Government Act of 2002, which promotes “establishing a broad framework of measures that require using Internet-based information technology to enhance citizen access to Government information and services.”³ The Department of Defense (DOD) echoes this desire with a policy that states that “using the World Wide Web is strongly encouraged in that it provides the DoD with a powerful tool to convey information quickly and efficiently on a broad range of topics relating to its activities, objectives, policies and programs.”⁴ Each military service has a derivative policy conveying the same idea.⁵

The Internet as Open-Source Intelligence

We no longer question *whether* to use the Internet to convey information to the public—only *what* information. It is naïve to think of the Internet purely in terms of the 1960s fulfillment of a “global embrace” in which we use information for the betterment of all.⁶ Instead, we need to consider the Internet a vast pool of data from which we can draw information, recognizing that doing so might lead to unintended consequences.⁷

People commonly use the Internet, particularly the WWW, for open-source information—that is, “publicly available information (i.e., any member of the public could lawfully obtain the information by request or observation).”⁸ Because the Internet has such a popular following, it is a good candidate for OSINT, the discipline of acquiring open-source information for the purpose of answering a specific question. The student, civil engineer, doctor, and so forth, in the earlier hypothetical examples practiced OSINT in their use of the Internet. One could easily imagine more sinister real-life scenarios of Internet OSINT: using the Internet to locate information on how to build a bomb; to obtain high-resolution aerial photos of major US metropolitan areas, including many military installations; to learn the lethality level of various nerve agents; to download computer-hacking tools; and to learn how to conduct OSINT operations.⁹ Plainly put, the Internet can serve as a resource for helping schoolchildren with their homework as well as for helping terrorists plan attacks.

The Internet is not the only source of OSINT. Other forms include newspapers, phone books, scientific journals, textbooks, broadcasts, and the like. A combination of three features makes the Internet unique. First, it provides access to the largest body of public information in the world. One can envision the Internet as having both *surface* and *deep* content. The surface Internet refers to information accessible through search engines and public links. Traditional WWW pages alone contain, at a minimum, an estimated 170 tera-

bytes of information—a body of data roughly 17 times the size of the print holdings of the Library of Congress.¹⁰ The deep Internet describes publicly available information—but only to those who know how to access it. This includes information that software assembles on the fly; that resides in a database, transmitted in response to a specific query; or that simply does not have a publicly known address. Examples include the Berkeley Digital Library Project and Amazon.com.¹¹ Estimates put the volume of the deep Internet at over 400 times that of its surface counterpart.¹²

Second, as noted previously, since anyone can publish to the Internet, that information might be unregulated and unexpurgated, even within organizations that have strict constraints on electronic publishing. Web pages that abet audience comments—such as public chat rooms, communities of interest, and newsgroups—frequently convey information that a public affairs office would not approve for publication. Blogs and discussion forums frequently offer a unique mixture of raw information and emotion, providing an interested observer not only with content but also with a sense of how it is perceived. A sponsoring organization may monitor such Web pages, in which case it will remove damaging information—but oftentimes not before its wide dissemination.

Third, the information appears in a format that computers can process. Unlike open sources such as print media and broadcasts, which require humans to identify and isolate every piece of information, the Internet has facilities that search for specific information based on certain characteristics (e.g., keywords, location, organization, etc.). As one commentator on the intelligence community puts it,

Collecting intelligence these days is at times less a matter of stealing through dark alleys in a foreign land to meet some secret agent than one of surfing the Internet under the fluorescent lights of an office cubicle to find some open source. The world is changing with the advance of commerce and technology. Mouse clicks and online dictionaries today often prove more useful than stylish cloaks and shiny daggers in gathering in-

telligence required to help analysts and officials understand the world.¹³

This is not to say that finding useful intelligence on the Internet is easy. Quite the contrary: the superabundance of information means that specific searches often yield an intractable number of results, the majority of which are irrelevant. Primitive search capabilities based on an exact keyword match have such a narrow focus that they may miss useful intelligence.

OSINT Technology Fronts on the Internet

Managing information on the scale available through the Internet has become an active research area for today's computer scientists—an area in which major strides occur almost continuously. Technology fronts of particular interest to Internet OSINT include search engines and data mining.

Search Engines

A search engine is a software system that allows users to locate an Internet resource—a Web page, news-group entry, or other public file—based on some search characteristic. Popular Internet search engines include Google, Alta Vista, Excite, Yahoo, and MSN Search.¹⁴ Currently the leader in the highly competitive search-engine market, Google well illustrates the information-location capabilities available today. With a searchable database consisting of over 8 billion Web pages, Google seeks “to organize the world's information and make it universally accessible and useful.”¹⁵ To that end, it offers a wide selection of searching capabilities, including searches constrained to a particular segment of the Internet, such as scholarly journals, news groups, military Web sites, geographic locations, and so forth. Google not only locates information based on textual keywords and phrases but also provides limited capabilities for locating images based on the name of the file containing the image.

Google's searchable database uses two approaches common to other search engines. First, it draws most of its information from “crawling” Web pages. That is, Google downloads the content of a Web page; indexes that information into a database, based on a number of parameters; and then downloads the content of pages linked to the Web page under examination.¹⁶ In this fashion, it visits page upon page by following links. Second, it has the user community submit addresses of Web pages, thus forming a human-edited directory. Categorizing the submissions into a directory that resembles the yellow pages of a phone book allows incorporation of information into the search database that might not have links on pages on the path of the Web crawler. These submissions, presumably, then become candidates for crawling by the automated Web-crawling mechanism.

The company recently added an “alert” feature, which sends e-mail to users who have registered search criteria, notifying them that the search engine has found what they are looking for. Google points out that they can use alerts for “monitoring a developing news story[,] keeping current on a competitor or industry[,] getting the latest on a celebrity or event[,] and] keeping tabs on your favorite sports teams.”¹⁷ Because this feature uses the same search techniques as the traditional Google services, it might yield irrelevant results; however, it ups the OSINT ante by allowing the user to wait passively for information.

For the technologically sophisticated audience, Google makes many of its services accessible programmatically through “application program interfaces.”¹⁸ In other words, a user can write software that draws upon Google's search features rather than having to use its Web interface. Thus, a user can have a highly specialized program for finding information based on an in-depth analysis of the results of Google searches, possibly combining Google results with those from other sources.

Data Mining

Also known as knowledge discovery, data mining attempts to extract meaning from large

amounts of data. “Soft” data mining identifies already-existing patterns of knowledge within a body of data; “hard” data mining discovers heretofore unknown knowledge from a body of data. The former is analogous to an analyst recognizing specific bits of intelligence from a mass of raw data; the latter to a scientist originating new facts by extending concepts gleaned from raw data. Both are relevant to OSINT operations for different reasons; however, both require extensive human intervention because they demand understanding the semantics of information—something very difficult to automate.

Common search engines give a glimpse into the world of data mining at the most fundamental level. All engines present search results in some type of rank ordering. Some rank results based on the number of times keywords appear in the content. Google, for example, utilizes a more complex approach by presenting search results based on a “fitness” measurement that takes into account the content of the page, number of links pointing to the page, arrangement of information on the page, and other factors.¹⁹

Google’s search results typically have three links: one pointing to the address of the Web page where the search result was initially found, one pointing to the copy of the Web page at the time the search result was found, and one pointing to pages “similar to” the page pointed to by the search result. The company has not revealed how it determines its similar-to links. They appear to be based on major keywords on the target page, perhaps employing synonyms as well. Regardless of the underlying mechanism, the similar-to links seem to represent the accepted state-of-the-practice of generalized Internet data mining.

Air Force Efforts to Prevent OSINT

The World War II maxim “loose lips sink ships” well illustrates the concern with public disclosure of information relating to military operations. In a sense, the Internet is an extremely large collection of loose lips. The Air

Force attempts to prevent these lips from sinking its metaphorical ships through three primary means: policies, technological practices, and training.

Policies

As addressed earlier, policies show that the DOD recognizes the worth of using the Web to promote public awareness of the military services. It also recognizes the danger that accompanies public disclosure:

The considerable mission benefits gained by using the Web must be carefully balanced through the application of comprehensive risk management procedures against the potential risk to DoD interests, such as national security, the conduct of federal programs, the safety and security of personnel or assets, or individual privacy created by having electronically aggregated DoD information more readily accessible to a worldwide audience.²⁰

This balance is codified in a chain of policies that begin with DOD Directive (DODD) 5230.9, *Clearance of DOD Information for Public Release*, which states that “information shall be reviewed for clearance by appropriate security review and public affairs offices prior to release.”²¹ Attendant DOD Instruction (DODI) 5230.29, *Security and Policy Review of DOD Information for Public Release*, assigns the director of the Washington Headquarters Services the responsibility of monitoring compliance of public disclosure and directs each DOD component to “issue any guidance necessary for the internal administration” of information released to the public.²²

With DODD 5230.9 and DODI 5230.29 primarily setting the stage for information released to the public, the DOD’s *Web Site Administration Policies and Procedures* specifically addresses the face that the DOD places on the Web.²³ It issues instructions on the process a Web site administrator goes through in posting information to the Web, noting in particular a number of reviews that information should undergo before release.²⁴ Importantly, it also contains a “guide for identifying information inappropriate for posting to a publicly accessible DOD web site.”²⁵ Although termed a

guide, the categories of information deemed incompatible with public release are quite extensive and detailed. They address areas of military operations and exercises, personnel information, proprietary information, test-and-evaluation information, scientific and technological information, intelligence information, and miscellaneous confidential information. As a whole, the categories preclude the publishing of maps, detailed organization charts, notices of exercises, and so forth.²⁶

Air Force-specific policy mirrors DOD policy. For example, Air Force Instruction (AFI) 35-101, *Public Affairs Policies and Procedures*, places Web information under the purview of the public affairs function and echoes the content guidelines of the DOD-level *Web Site Administration Policies and Procedures*.²⁷ AFI 33-129, *Web Management and Internet Use*, gives individual commands the authority to establish Web sites, subject to approval by higher headquarters, assigning them responsibility for assuring the “content and security” of information posted to the Web.²⁸ Importantly, it also directs that all Web sites be evaluated using a checklist that includes open-source vulnerability criteria.²⁹ AFI 10-1101, *Operations Security (OPSEC)*, also provides indicators of information vulnerabilities, albeit in a more general sense than does AFI 33-129.³⁰

Technological Practices

AFI 33-129 explicitly segments the Air Force’s public Web information into two parts: pages accessible to the general public and pages intended for a restricted audience, namely .mil and .gov users.³¹ Public pages contain information released through Air Force public-affairs channels, accessible by any Web browser. A limited number of users can access private pages, based on the network address of their browsing computer, password, and possibly other information-assurance certifications. AFI 33-129 further outlines the security mechanisms (e.g., password and type of encryption) appropriate for placement on Web site information.³²

Training

Personnel authorized to place information on Air Force Web pages must undergo training in topics relating to OPSEC, Privacy Act information, information designated “for official use only,” and Web administration.³³ The Web Administration course (the primary training source), offered through the Air Force’s computer-based training program, distills much of AFI 33-129 into practices required specifically of people working at the operational level.³⁴ Although the course addresses the protection of Web information, it emphasizes network security and only alludes to OPSEC and information vulnerability, which it treats perfunctorily.

Typically, the base or wing prescribes supplemental training. Maxwell AFB, Alabama, for example, requires Web masters to pass a locally constructed course that covers AFI 33-129 in depth. Additionally, the base Webmaster holds quarterly meetings of Web-page maintainers, during which personnel learn about the latest changes in Internet policies. Training related to information protection utilizes the same means as does the line Air Force: computer-based courses and briefings on information-assurance awareness, network-user license awareness, Privacy Act information, and operational risk management.

OSINT Vulnerabilities on the Internet

Assuming adherence to all of its policies and practices, the Air Force appears to have in place the mechanisms needed to minimize exposure to traditional OSINT collection. What vulnerabilities remain? The answer lies along two fronts.

First, information available on sites outside the scope of Air Force control represents a much deadlier threat than the OSINT-collection possibilities on Air Force-owned systems because the service has no control of the data (nor does the US government, in the case of information protected by the First Amendment or of Internet portals hosted by foreign entities). Too, the sheer volume of data rela-

tive to that available on Air Force systems increases the probability that useful intelligence information actually exists and can be found.

The second, more tractable, threat involves systems under Air Force control. The current process to reduce the risk of OSINT collection focuses almost exclusively on information content, but the Internet delivers more than content over open sources, including metadata, meaning, and information about content. For example, when a Web browser requests a Web page, the Web server transmitting the page may also transmit the date of the Web page's creation and modification as well as the name of the server software transmitting the page. The former two items yield insight into the currency of information on the Web page; the latter item keys an assailant to documented software flaws susceptible to network attacks. Similarly, because the uniform resource locator (URL)—the addressing scheme used by the WWW—contains a wealth of information, it can be unintentionally compromising. The Air Force's Internet policies and practices mitigate risk from visible information—not from unseen information used to transmit content.

Deterrents and Countermeasures

The Internet presents the Air Force with an inexpensive and pervasive mechanism for transmitting information. It can improve communication with the public and within the Air Force community. However, any information that the Air Force releases to the public could also potentially reveal a military vulnerability. The following recommendations address the need to decrease the Air Force's exposure to vulnerabilities.

Long-Term Recommendations

The Air Force should present itself as a player in crafting national and international policy for open-source information. At present, such policy is in the formative stage; immediate and aggressive support could put the Air Force in

a role to substantially influence the management of information on the Internet. Some institutions have already offered suggestions regarding such policy. For example, a recent University of Maryland report proposes developing a definition of sensitive information that is unclassified but controlled; identifying mechanisms for controlling such information within the public, private, and academic/scientific sectors; encouraging a process of reviewing research findings for possible open-source vulnerabilities; and launching an education campaign to make all sectors of the information community aware of such vulnerabilities.³⁵

Currently, we have no principal defender of cyberspace in the same sense that we have principal defenders of land, sea, and air. Since the Air Force includes information superiority as one of its distinctive capabilities—as demonstrated by its capabilities in information warfare and network security—the service is in a position to assume that role.³⁶ Adopting positions advocated by the University of Maryland's policy researchers, particularly the ones outlined above, will move the service in that direction.

Short-Term Recommendations

The Air Force could take a number of actions within its own bounds, thereby eliminating the need for cooperation from multiple information communities.

1. Work with the research community to help it understand its ethical obligation to control the distribution of sensitive work (a recommendation of the University of Maryland's report). The authors of the report clearly understand the culture of biological and nuclear scientists, an audience that has traditionally appreciated the need to use research results responsibly. However, this optimism may become misplaced when it comes to engendering a culture of introspection and cooperation among the computer-hacker community, which historically has flaunted conventional ethical standards by posting online tools and techniques for breaking into computers,

launching denial-of-service attacks, constructing viruses, and so forth.

These actions have isolated the hacker community into a subculture all its own. Few legitimate organizations are willing to understand the hacker community, much less work with it. As information plays an increasingly important role in maintaining the country's infrastructure, it becomes necessary to persuade those who could damage that infrastructure to adopt mainstream ethical behavior. The Air Force can and should assume this role by becoming actively involved in working with the computer-hacker community by attending hackers' conferences and showing a desire to rechannel their creative work into more productive endeavors. A successful effort would reduce the amount of computer hacking of open-source information available to the public and would facilitate understanding and prevention of possible attacks.

2. Reevaluate Web-site policy. Web sites should periodically review their presentation of information in light of advancing search-engine capabilities. Organizations should be encouraged to determine how they want their Web information accessed. Search engines' default position of directing searchers to any page within a Web site allows visitors to access pages deep in a semantic hierarchy of Web pages without first visiting so-called entry pages, which provide context and meaning. Air Force organizations wishing to enforce entry pages should take appropriate action to remove access to deep pages by search-engine crawlers.
3. Identify an information-removal policy. Air Force policy that calls for the removal of sensitive information discovered on its Web sites is only a starting point. It should follow up with an assessment of who may have gotten that information, creation of worst-case and probable-case scenarios should someone use the information, actions to take if the user copies

information to a server beyond Air Force control, and so forth.

4. Establish an active OSINT-collection initiative within the Air Force that would attempt to track down useful intelligence data for the purpose of identifying how the information came to be posted on the Internet. If the information originated with people under Air Force jurisdiction (e.g., military personnel, employees, or contractors), then the service could take remedial action.
5. Assemble a team to examine the meta-data exposure of Air Force Web sites and develop recommendations for minimizing such vulnerabilities. Make recommendations for improving Web administrators' awareness of these technical OSINT possibilities.
6. Conduct red-team attacks regularly on each organization's Web presence, looking specifically for OSINT candidates and examining the content of each Web page as well as browser tags that describe the rendering of information. These tags can reveal information not visible to the browser but useful in determining software capabilities of the page builder.
7. Enable or disable Web pages for searches. Use the "no follow" tag to prevent legitimate search-engine Web crawlers from indexing Web pages. Use links that require the user to enter the text displayed in computer-generated pictures to thwart crawlers that ignore such tags, such as illicit crawlers that surreptitiously examine the Web. Analyze Web traffic to detect traces of automated Web crawlers.

Conclusions

Not a passing trend, Internet technology has woven itself into the very fabric of our culture. Although it began as a research project for networking computers, it has evolved into a societal project for networking people. That the Internet is an inherently public medium

makes it attractive to individuals—both friendly and unfriendly—who seek information over open sources.

Air Force policies and practices put into place mechanisms for minimizing the risk of exposing sensitive content on its public Web sites. However, two vulnerabilities remain: OSINT collection from Web sites not under Air Force control and intelligence collection

from metadata delivered collaterally with content. Generally intractable, the first vulnerability requires defensive measures to detect the intelligence and then take action necessary to protect the target of the intelligence. The second vulnerability, which lies within the scope of Air Force control, requires offensive measures to change the way of posting information to public Web sites. □

Notes

1. This article uses *Internet* as an umbrella term for describing any information service available to globally networked computer users. Although such usage is technically inaccurate, it reflects the colloquial trend of referring to e-mail, Internet messaging, the World Wide Web, and so forth, by the generic network that carries them.

Strictly speaking, the Internet is a worldwide system of connected computers that exchange information using a common protocol. Information sent over the Internet is broken into small segments, each one transmitted along computers in the Internet network until it reaches its destination computer, at which point the segments are reassembled into the original format. The Internet proper remains unaware of the content of the information transmitted. It simply provides a mechanism for transporting data, regardless of whether that data represents text, static images, voice, video, or sound.

Software running on computers connected to the Internet uses the Internet to provide useful services. Built on top of the basic Internet transmission protocol, these services, in effect, give meaning to the information routed through the network. Typical Internet services include sending and receiving electronic mail (SMTP protocol), logging in to a remote computer (telnet protocol), text conferencing (IRC protocol), transferring files (FTP protocol), posting and reading user-generated news (NNTP protocol), and retrieving and displaying a Web page (HTTP protocol).

2. "Worldwide Internet Users Will Top 1 Billion in 2005," *Computer Industry Almanac, Inc.*, 3 September 2004, <http://www.c-i-a.com/pr0904.htm>; "Rank Order—Internet Users," *The World Factbook*, 17 May 2005, <http://www.odci.gov/cia/publications/factbook/rankorder/2153rank.html>; and "Global Internet Trends," *Nielsen/NetRatings*, <http://www.nielsen-netratings.com>.

3. "The E-Government Act of 2002," H.R. 2458/S. 803, 17 December 2002, *E-Gov*, <http://www.whitehouse.gov/omb/egov/g-4-act.html>.

4. *Web Site Administration Policies and Procedures* (Washington, DC: Department of Defense, Office of the Assistant Secretary of Defense, 25 November 1998), http://www.defenselink.mil/webmasters/policy/dod_web_policy_12071998_with_amendments_and_corrections.html.

5. Army Regulation (AR) 25-1, *Army Knowledge Management and Information Technology*, 15 July 2005, http://www.usapa.army.mil/pdffiles/r25_1.pdf; Secretary of the

Navy Instruction (SECNAVINST) 5720.47A, *Department of the Navy Policy for Content of Publicly Accessible World Wide Web Sites*, 24 October 2003, <http://www.chinfo.navy.mil/navpalib/internet/secnav5720-47a.pdf>; Marine Corps Order (MCO) 5720.76, *Standardization of Publicly Accessible Web Pages*, 14 September 2001, [http://www.usmc.mil/directiv.nsf/bf7ed869c4398a1685256517005818da/afa583efe72bda7685256af10060c9d7/\\$FILE/MCO%205720.76.pdf](http://www.usmc.mil/directiv.nsf/bf7ed869c4398a1685256517005818da/afa583efe72bda7685256af10060c9d7/$FILE/MCO%205720.76.pdf); and Air Force Instruction (AFI) 33-129, *Web Management and Internet Use*, 3 February 2005, <http://www.e-publishing.af.mil/pubfiles/af/33/afi33-129/afi33-129.pdf>.

6. Marshall McLuhan, *Understanding Media* (1964; repr., Cambridge, MA: MIT Press, 1995), n.p.

7. Here we make a distinction among *data*, *information*, and *intelligence*. Data is raw content; information is data that has meaning and context; intelligence is the application of information for a particular purpose. Note that we make no assertion as to the accuracy of the information on the Internet.

8. Director of Central Intelligence Directive (DCID) 2/12, *Community Open Source Program*, 1 March 1994, <http://www.fas.org/irp/offdocs/dcid212.htm>.

9. *Report on the Availability of Bombmaking Information* (Washington, DC: Department of Justice, April 1997), <http://www.usdoj.gov/criminal/cybercrime/bombmakinginfo.html>; "Will I Be Able to See My House?" *Keyhole*, <http://www.keyhole.com>; "Medical Management Guidelines (MMGs) for Nerve Agents: Tabun (GA), Sarin (GB), Soman (GD), and VX," *Agency for Toxic Substances and Disease Registry*, 2004, <http://www.atsdr.cdc.gov/MHMI/mmg166.html>; "Tools," *Hacking Exposed*, <http://www.hackingexposed.com/tools/tools.html>; and *NATO Open Source Intelligence Handbook*, November 2001, http://www.oss.net/dynamaster/file_archive/030201/ca5fb66734f540fb4f8f6ef759b258c/NATO%20OSINT%20Handbook%20v1.2%20-%20Jan%202002.pdf.

10. *How Much Information?* (Berkeley: University of California, School of Information Management and Systems, 2003), <http://www.sims.berkeley.edu/research/projects/how-much-info-2003/execsum.htm>.

11. Digital Library Project, University of California—Berkeley, <http://elib.cs.berkeley.edu>; and *Amazon.com*, <http://www.amazon.com>.

12. Michael K. Bergman, "The Deep Web: Surfacing Hidden Value," White Paper, *BrightPlanet*, 2005, <http://www.brightplanet.com/technology/DeepWeb.asp>.
13. Stephen C. Mercado, "Sailing the Sea of OSINT in the Information Age," *Studies in Intelligence* 48, no. 3 (2004), <http://www.odci.gov/csi/studies/vol48no3/article05.html>.
14. Note that a number of engines search a specific collection of electronic information. LexisNexis (www.lexisnexis.com), for example, yields results from a search of its proprietary library of legal, regulatory, and business documents. See also www.google.com; www.altavista.com; www.excite.com; www.yahoo.com; and search.msn.com.
15. "Press Center: Google Inc. Fact Sheet," *Google*, 2005, <http://www.google.com/press/facts.html>; and "Corporate Information: Company Overview," *Google*, 2005, <http://www.google.com/intl/en/corporate/index.html>.
16. "Corporate Information: Technology Overview," *Google*, 2004, <http://www.google.com/corporate/tech.html>.
17. "Google Alerts," *Google*, 2005, <http://www.google.com/alerts>.
18. "Google Code: Google APIs," *Google*, 2005, <http://code.google.com/apis.html>.
19. "Corporate Information: Technology Overview."
20. *Web Site Administration Policies and Procedures*, pt. 1, sec. 4.2.
21. DODD 5230.9, *Clearance of DOD Information for Public Release*, 9 April 1996, par. D.2, https://sites.defenselink.mil/dd5230_9.html.
22. DODI 5230.29, *Security and Policy Review of DoD Information for Public Release*, 6 August 1999, par. 5, http://www.dtic.mil/whs/directives/corres/pdf/i523029_080699/i523029p.pdf.
23. *Web Site Administration Policies and Procedures*.
24. *Ibid.*, pt. 2, sec. 3.
25. *Ibid.*, pt. 4, sec. 2.
26. Ironically, by explicitly naming what should not be posted to public Web pages, the military makes known what constitutes sensitive data. Web searches tuned to these areas would presumably yield useful intelligence.
27. AFI 35-101, *Public Affairs Policies and Procedures*, 26 July 2001, chap. 18, <http://152.229.169.35/pubfiles/af/35/afi35-101/afi35-101.pdf>.
28. AFI 33-129, *Web Management and Internet Use*, sec. 3.
29. "Checklist," *Air Force Public Web Site Review*, <https://www.webreview.hq.af.mil>; and AFI 33-129, *Web Management and Internet Use*, sec. 3 and table 1.
30. AFI 10-1101, *Operations Security (OPSEC)*, 31 May 2001, attachment 3, <http://www.e-publishing.af.mil/pubfiles/af/10/afi10-1101/afi10-1101.pdf>.
31. AFI 33-129, *Web Management and Internet Use*, sec. 1.
32. *Ibid.*, table 1.
33. *Ibid.*, sec. 3.10.4.
34. Web Administration, Course YAF04SE, *Air Force ITE-Learning*, <https://usaf.skillport.com>.
35. Jacques S. Gansler and William Lucyshyn, *The Unintended Audience: Balancing Openness and Secrecy: Crafting an Information Policy for the 21st Century* (College Park: University of Maryland, Center for Public Policy and Private Enterprise, School of Public Policy, September 2004), http://www.cpppe.umd.edu/Bookstore/Documents/UnintendedAudience_3.05.pdf.
36. Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, 17 November 2003, 78.

Science is in the saddle. Science is the dictator, whether we like it or not. Science runs ahead of both politics and military affairs. Science evolves new conditions to which institutions must be adapted. Let us keep our science dry.

—Gen Carl A. Spaatz



Emergent Capability

Influence Operations and the Strategic Airman

LT COL SHAUN COPELIN, USAF

LT COL ANDRE PROVONCHA, USAF, RETIRED

IN JUST OVER 30 days, the US armed forces swiftly and skillfully defeated a proven threat to the Middle East and US national interests.¹ Operation Iraqi Freedom validated the doctrine and methods of conventional modern warfare. Yet, senior military officers observe that although the campaign showcased brilliant technological capabilities, crisis-action planning did not adequately address the need to engage the people of Iraq in the postconflict phase. Additionally, campaign planners failed to draw upon unconventional doctrine and methods in support of US interests.² Deliberate planning also fell short of fulfilling the national military strategy of fostering an environment for long-term stability in the region. Recent official reports and media stories from the field comment on the severe lack of resourcing for planning efforts aimed at postcombat activities, most of which included information operations, civil affairs, cultural awareness, and intelligence. These reports suggest that establishing cultural relevancy at the strategic through tactical levels of planning and applying it across the spectrum of conflict are key to engaging and advancing objectives within a given targeted group. Current operations, however, might have little effect on realizing long-term objectives because of the lack of trained, experienced, culturally relevant planners. Challenges facing the Air Force in building its future force include acquiring a wider understanding of influence operations, learning the nature of these operations, placing Air-

men at the center of successful operations, and providing the tools of war necessary for victory.

Understanding Air Force Influence Operations

The largely democratic and capitalistic systems that emerged in Europe following World War II do not owe their existence to the defeat of Germany alone. Instead, they benefited greatly from the Marshall Plan, a noble and ambitious program invested heavily in engaging local, national, and international entities—all influenced by American leadership. Military forces exerted much of that influence. Does the Air Force have the capabilities to produce the same effect today?

Current Air Force information-operations doctrine captures the influence-operations capabilities needed to meet the challenge of cultural aspects in warfare.³ Both joint and service doctrine define and codify information operations, which complement air, land, sea, and space power. Although these operations address a range of activities, influence operations, for the Air Force, constitute a principal subset of battlespace effects in the cognitive domain. Influence operations employ capabilities that affect behaviors, force the adversary to misallocate forces, protect operations, communicate the commander's intent, and project accurate information to achieve desired effects across the battlespace. Furthermore,

they involve the integrated planning, employment, and assessment of psychological operations, military deception, counterintelligence, counterpropaganda, public affairs, and operations security to gain superiority over the adversary's decision process and disrupt his control of his forces. After developing target sets that affect key decision makers, influence planners then pair Air Force capabilities with those sets to change the behavior of the intended receiver. Photos of bomb craters and destroyed targets do not represent victory—capitulation of the adversary does. In the lexicon of influence operations, a change in observed behavior defines victory—not well-crafted messages or delivered information.

The Nature of Influence Operations

When the US military engages in force-on-force operations, combat victory is a virtual certainty. Nevertheless, wars are not won solely by placing bombs on target but by achieving national and strategic objectives during all phases of the campaign. Many military members believe that combat operations end with a cessation of hostilities. However, the lion's share of achieving national objectives involves operations by agencies other than the Department of Defense (DOD). Few would dispute the military's critical role in creating an environment for successful postcombat operations, and the DOD does indeed remain a vital participant following hostilities. Yet, the focus at this time must shift to civil affairs. Although the restoration of infrastructure plays an important role in fulfilling campaign objectives, investment in engaging cultures provides long-term stability and growth. It is culture that binds victor to vanquished. People whose political and economic systems have undergone forcible alteration require guidance, dedicated support, and outside resources. The victors have an obligation to supply culturally relevant guidance, dedicated support, and resources. Less certain, however, is the extent to which the military contributes to precombat operations designed to shape an environment conducive to achiev-

ing national goals. Traditionally, it has focused on operations during and following combat.

One finds the best example of the application of influence operations in a report entitled *Towards a Free and Democratic Iraq*, which recommends methods of achieving a growing economy and democratic political system in that country. Citing the lack of trained and experienced personnel to apply relevant capabilities, the report notes that “[DOD] influence operations . . . have not succeeded in convincing the Iraqi people of the true purpose and character of American efforts . . . in [Iraqi Freedom].”⁴ By contrast, insurgents have had a significant influence on US audiences, as noted during a hearing before the Subcommittee on the Middle East and South Asia in April 2002.⁵ Jihadists have learned that culturally relevant propaganda can erode US public support for operations in Iraq.

The stark contrast between the effects of combat operations and those of influence operations became evident during the Abu Ghraib prison debacle in Iraq. That scandal, as well as the growing number of noncombatant deaths recorded by the media worldwide, causes both the “Arab Street” and some US citizens to believe there is little distinction between coalition policy and criminal acts committed by rogue military members. How could trained and experienced influence-operations planners and practitioners anticipate—even preempt—certain audiences' misperceptions of events as related to intended effects or objectives?

Strategic Airmen

What is the link between pursuing national objectives and influencing a targeted group? Moreover, what is the nature of the relationship between US military personnel and strategic impact? We may find the answer in the concept of the “strategic Airman.” All Air Force members should understand that the messages they communicate and the actions they take lead to strategic, operational, and tactical effects. Even actions by relatively junior military personnel can have a long-term, significant impact. As Gen Matthew B. Ridgway,

US Army, stated during the Korean War, "The soldier is the statesman's junior partner."⁶ Actions taken by operators at the tactical level of war represent the entire American military and are extensions of US foreign policy. Ultimately, however, the influence-operations planner, working for the combatant commander, is responsible for building and executing a culturally relevant plan that enhances and contributes to the achievement of national objectives in any given theater. Ideally, well-crafted and well-coordinated efforts of Airmen at all levels and during all phases of operations should contribute to the achievement of national objectives. The more realistic approach would require the Air Force to employ deliberate and crisis-action planners as well as tactical-execution units that engage in culturally relevant operations. Operational planners who engage all target sets must have a clear understanding of the cultural terrain, just as tactical units must understand the linkage among objectives, operations, and cultural effects. Consistent and accurate cultural training is essential in the modern influence-operations battlespace.

Tools of War

The DOD needs to invest in operational planners and intelligence analysts who have in-depth training in the cultures in which operations occur. The Air Force must build a force capable of planning for and conducting culturally relevant activities at all levels and during all phases of theater operations. Currently the Air Force conducts influence operations geared toward such relevance. Yet, the information-warfare flights that include these planners are neither fully trained for nor actively engaged in their assigned cultures. Furthermore, the Air Force, as well as the other services and joint staff, does not have adequate resources to build and sustain an influence-operations force. Services lack a single, consistent, accurate, and responsive cultural-awareness training program that would assure successful influence operations. Although several joint and service courses exist, the training reaches only a small segment of

the total force and emphasizes predeployment scenarios. Does the Air Force have a stated need for such training? The vetted information-operations requirements for cultural-awareness training found in the prioritized-needs summary of the Air Force's Information Operations Capabilities Plan for fiscal year 2008 include the following: integrating training in information-operations awareness into initial accession training at all levels; developing research in human vulnerabilities to support Air Force operations; producing culturally relevant communication and interaction tools to research the public-information environment as well as cultures in the joint-operation area to best support public-affairs operations; and creating an expert cadre of agents to support assessments of human vulnerability.

Successful prosecution of the global war on terrorism demands that we maintain a culturally aware fighting force. The Air Force, therefore, faces a fundamental challenge in successfully conducting the combatant commander's influence operations in a particular theater because it must provide trained experts who understand and continuously apply the social and cultural norms that define the target audience's mind-set. Creating the proper mind-set for the strategic Airman, then, depends upon linking requirements with a rigorous, dynamic training program that includes cultural scholars, experienced interagency officials, and officers from sister services who have experience in-theater.

Even though criticism from academics and others may lead to an understanding of the complexity of the modern combat environment, we should remember Pres. Theodore Roosevelt's comment that "credit goes to the man in the arena."⁷ People with experience in the combat arena believe that winning wars requires an understanding of cultural relevancy. The responsibility for applying that relevancy to any conflict rests with well-trained and experienced influence operators. Thus, an influence-operations force composed of strategic Airmen must become an essential element of future joint operations, and creating those Airmen will make influence operations a reality for the United States Air Force. □

Notes

1. Major combat in Operation Iraqi Freedom began on 20 March 2003 when coalition forces invaded Iraq and concluded on 1 May 2003 with an announcement from Pres. George W. Bush on the deck of the USS *Abraham Lincoln*. Pres. George W. Bush, "President Bush Announces Combat Operations in Iraq Have Ended" (Washington, DC: US Department of State, Bureau of Public Affairs, 1 May 2003), <http://www.state.gov/p/nea/rls/rm/20203.htm>.

2. Maj Gen Robert H. Scales Jr., US Army, retired, "Culture-Centric Warfare," US Naval Institute *Proceedings*, October 2004, n.p.

3. See Air Force Doctrine Document 2-5, *Information Operations*, 11 January 2005.

4. *Towards a Free and Democratic Iraq: Organizing, Training and Equipping to Optimize Influence Operations in the Iraq Theater of Operations*, White Paper (Langley AFB, VA: Headquarters Air Combat Command, July 2004), 3–6.

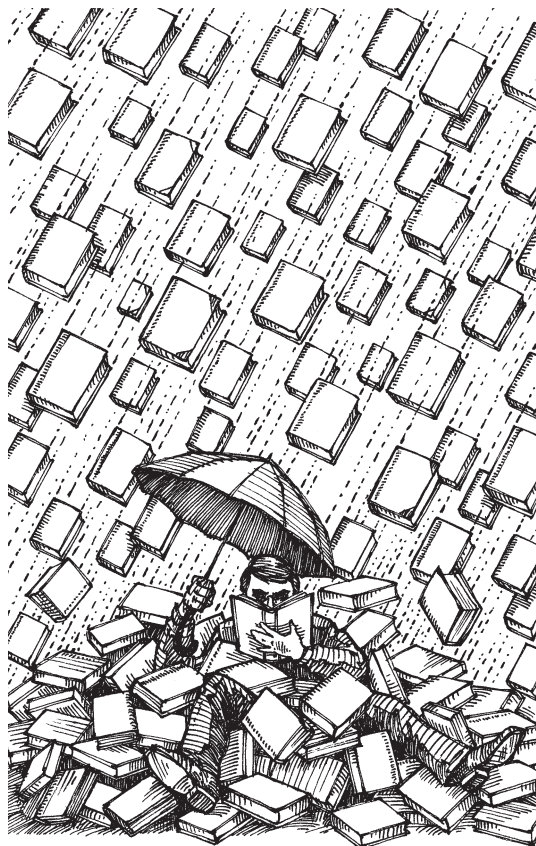
5. *Words Have Consequences: The Impact of Incitement and Anti-American and Anti-Semitic Propaganda on American Interests in the Middle East. A Hearing before the House Subcommittee on the Middle East and South Asia of the Committee on International Relations*, 107th Cong., 2nd sess., 18 April 2002.

6. Newsletter, West Point Society of Southern Arizona, 2nd quarter 2002, <http://home.earthlink.net/~web71/second02.html>.

7. Pres. Theodore Roosevelt, "Citizenship in a Republic" (speech, the Sorbonne, Paris, 23 April 1910).

strategic level of war. *The level of war at which a nation, often as a member of a group of nations, determines national or multinational (alliance or coalition) security objectives and guidance, and develops and uses national resources to accomplish these objectives.*

—Air Force Doctrine Document 1, *Air Force Basic Doctrine*, 17 November 2003



Wolfpack Warriors: The Story of World War II's Most Successful Fighter Outfit by Roger Freeman. Casemate Publishers and Book Distributors, LLC (<http://www.casematepublishing.com>), 2114 Darby Road, Havertown, Pennsylvania 19083, 2004, 256 pages, \$37.95 (hardcover).

In the war-torn skies over Europe, America's 56th Fighter Group entered an almost daily struggle against Hermann Goering's Luftwaffe in a race to achieve air superiority before the planned Allied invasion of the continent. "Zemke's Wolfpack," as it became known, was an integral part in dominating the fighter pilots of Nazi Germany. Flying the less glamorous P-47 Thunderbolt, these American pilots fought the Luftwaffe from the beginning of the

air offensive against Germany until the last days of the war. Their story, told in yet another wonderful book by author Roger Freeman, the author of more than 50 books on World War II, is certain to make a significant contribution to the study of the Allied air campaign over Europe. *Wolfpack Warriors* is one of his most interesting books.

The author consulted over 150 veterans during the research for this book and spent 14 years compiling the history of the 56th Fighter Group. In bringing the book alive, he freely quotes men from the unit to give the reader a much better perspective of life within the group. He quotes not only pilots but also crew chiefs, maintenance officers, service personnel, and unit commanders. These first-person accounts—more than any other feature of the book—bring to life the fears, concerns, victories, and defeats of these men. Freeman gives the reader a feeling of being in the cockpit with one of the pilots or in the barracks relaxing during some down time. Quotes from German pilots who engaged the 56th may have made this aspect of the book even more appealing but, unfortunately, were not included.

Fortunately for us, *Wolfpack Warriors* is much more than just a shoot-'em-up history of this one fighter group. More importantly, the author takes the time to discuss the unit from its peacetime conception and formulation, to its deployment overseas, through its years of combat, and finally its disbanding after the war. He also discusses in great detail many of the teething problems the unit faced with its P-47 Thunderbolts, the use of drop tanks in an attempt to increase the aircraft's range, and the harrowing experiences of ground-attack missions. Once the reader finishes the book, there is some actual identification with the men of the unit.

Although reading about World War II is enjoyable, I have never enjoyed reading about force-on-force combat. Simply knowing that Battalion X engaged Battalion Y has always held little interest. I find it more fascinating to read about the personalities behind the events. The men who made decisions, fought the battles, or engaged other pilots have always been intriguing. In *Wolfpack Warriors*, the reader is not let down in this area. Some of the biggest names in American aviation emerged from this one unit. Men like Hub Zemke, Dave Schilling, Francis "Gabby" Gabreski, Walker "Bud" Mahurin, and Robert Johnson, just to name a few, will always be

connected with excellence in air combat. Gabreski and Johnson, for example, led the way for American aces in Europe with 28 aerial victories apiece.

Several activities were also pointed out in the book that many readers will likely find interesting. In the race to destroy enemy aircraft, Freeman discusses the practice of giving pilots credit for ground victories as well as aerial victories and the problems this led to later in the war in determining actual credit for individual pilots. The Germans in North Africa were poor in aircraft recognition, and the Americans did little better. On one mission in particular, one 56th pilot in a hurry to achieve the group's first kill came home only to find, through examination of his gun-camera film, he had accidentally shot down a British Spitfire.

In all, *Wolfpack Warriors* is a fascinating book that boasts 32 pages of excellent photographs. When reading a unit history that spends so much time discussing the men that made it great, the reader should be able to see the people who are written about. Unfortunately, the final product doesn't have maps, charts, or appendices detailing the most important aspects of the 56th Fighter Group or its relationship to other fighter units of the Eighth Air Force. Perhaps if the author reprints this book in a couple of years, he will add these to the revised edition.

If I had only one complaint about the book, it would be the title. A more accurate title would be *Wolfpack Warriors: The Story of World War II's Most Successful American Fighter Outfit*. During the course of the war, the 56th Fighter Group destroyed 664 German aircraft. In North Africa alone, German Fighter Group JG 27 destroyed 776 Allied aircraft between April 1941 and December 1942. Likewise, JG 26 on the Western Front destroyed some 2,700 aircraft, and it is estimated that JG 52 on the Russian Front destroyed nearly 10,000 enemy aircraft. The top six pilots within JG 52 destroyed a combined 1,580 aircraft. Some British, Russian, or even Japanese units may also have been more successful than the 56th. Although Zemke's Wolfpack was arguably the best American fighter unit, if the measure of a fighter unit's success is aerial victories, as alluded to by the author, then the 56th was certainly not the best during the entire conflict.

Notwithstanding these facts, this book is highly recommended. Roger Freeman has done a superb job of bringing the history of one of America's most recognized and decorated fighter units to us. Well written, this book easily keeps the reader's attention. Although Donald Caldwell's incredible book *JG 26: Top Guns of the Luftwaffe* is the standard for aviation combat units and although *Wolfpack Warriors* falls short of this, the reader will still not be

the least bit disappointed in Freeman's work. Readers interested in the European air war and the contributions made by a truly "elite unit" will want to add *Wolfpack Warriors* to their personal libraries.

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Into the Mouth of the Cat: The Story of Lance Sijan, Hero of Vietnam by Malcolm McConnell. W. W. Norton and Company (<http://www.wwnorton.com>), 500 Fifth Avenue, New York, New York 10110, 1985, 253 pages, \$13.95 (softcover).

Lance Sijan is currently the only graduate of the US Air Force Academy to win the Medal of Honor. Unfortunately for him, like the majority of recipients of this award, he received the decoration posthumously.

During a mission over Laos in 1967, a faulty fuse caused a bomb to detonate just after release, downing his plane. Rescue attempts failed, and Sijan spent six weeks crawling through the jungle with a compound fracture before the North Vietnamese army captured him, passed out in the middle of a dirt road. Despite a number of serious injuries, made worse by malnutrition, he escaped before being captured a second time. He died a few weeks later in captivity. Before he died, he told other prisoners of war what he had done, and North Vietnamese guards would later independently confirm his story.

The author of this book, journalist Malcolm McConnell, was a high school classmate of Sijan's, but he had very little to work with—both in the sense of story and of source material. Sijan was only 25 years old when he died, and there was no direct witness to his escape and evasion efforts. Instead of trying to produce a traditional biography, McConnell instead focuses on the events of 1967 and 1968 that made Sijan a legend, and at various points along the way incorporates the story.

The source material for this book would seem at first blush to be quite weak. McConnell conducted a series of interviews with Sijan's friends, family, and fellow prisoners of war. The story of Sijan's struggle is based entirely on secondhand accounts, which usually have clear limits to their utility and reliability. Memory, though, is a tricky thing. Sijan reported his experience with his fellow prisoners, and people with little to do can focus on and incorporate into their long-term memory an amazing amount of important items. McConnell pushes his

sources to their limits, but they stand up after close investigation.

The result is an impressively good read. There is no denying the heroic nature of Sijan's behavior after his plane was downed. The story is quite powerful on its own and sells itself. In short, any member of the US Air Force going near combat should read this book. It is sobering but also inspiring.

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The Threat of Ballistic Missiles in the Middle East:

Active Defense and Counter-Measures edited by Arieh Stav. Sussex Academic Press (<http://www.sussex-academic.co.uk/index.htm>), 920 NE 58th Avenue, Suite 300, Portland, Oregon 97213-3644, 2004, 312 pages, \$67.50 (hardcover).

I am not an expert on the threat of ballistic missiles. However, I have read enough to know that this is an issue that may well have serious consequences for our national security in both the mid-term and long term. While the overall ballistic missile threat appears to be declining, signs remain on the horizon that development and proliferation issues still need serious attention. A quick *Google* search or cursory glance at any major newspaper will bring reminders about the nature and growing complexity of the problem. Therefore, it is fortuitous that Dr. Stav chose to republish this anthology.

Despite original publication in 1999, this compilation of 16 articles by Israeli, American, and British authors is a timely reminder of the scope of the ballistic missile threat, of the complex technological challenge of addressing this threat (as evidenced by the work of our own Missile Defense Agency), and of how quickly events can change in this area. Within this one book, Dr. Stav has brought together a number of contributors of varied backgrounds and provided a primer on the technical issues associated with the intercept problem. This anthology also offers a highly readable discussion of the strategic and operational thinking associated with the development and deployment of systems designed to address this threat. While some of the technical discussion is redundant (Dr. Stav acknowledges this in his introduction), on the whole the book provides a comprehensive review of the issues. Notably, one of the contributors presents a strategic-level discussion of the relative merits of missile defense against the historical Israeli position of preemptive strike to deal with threats facing the nation. As we

assess our own missile-defense program, some of the discussions presented here may help illuminate our thinking on these substantive issues at both the national and theater levels.

The technical discussions presented cover all the relevant aspects associated with all three phases—boost, midcourse, and terminal—of the missile-intercept problem in a clear and understandable fashion. The discussions on the limitations of terminal defense and the difficulties of boost-phase intercept are particularly relevant. While we hear discussions about the airborne-laser program in our country, it is interesting to be exposed to other discussions about how to solve the boost-phase intercept problem, most notably using conventional forces or unmanned aerial vehicles. Although the technical discussion is comprehensive, the discussion of the role of missile defense in the formulation of national-security policy is equally interesting and provides an alternative perspective for consideration.

The missile-defense problem, as a strategic issue, is not new to Israel. They have faced some level of threat since the introduction of Scud missiles in the 1970s when Egypt, Syria, Iraq, Yemen, and Libya acquired these systems from the Soviet Union. However, what has subsequently evolved in Israeli thinking is the marriage of unconventional warheads, primarily chemical and biological, with newer and cheaper weapon systems and the proliferation of those systems across the Middle East. Whereas we measure our strategic depth in terms of thousands of miles and hundreds of targets, the Israelis measure theirs in terms of tens of miles and a handful of targets. Recent developments—for example, the coalition invasion of Iraq—changed a portion of the landscape, but for the Israelis these events are offset by other developments such as the continuing Iranian development program. But why should we care about a discussion of missile proliferation in the Middle East?

First, while the demise of the Soviet Union greatly reduced the nuclear threat and fundamentally changed the geostrategic equation between our two nations, the continuing proliferation of missile technology to a number of regimes hostile to the United States and our allies has created a different set of problems. Though debate on the scope and level of the threat will continue, as it should, the seriousness with which the current administration perceives the threat was clearly illustrated by the US withdrawal from the Antiballistic Missile (ABM) Treaty, our subsequent deployment of a limited ABM capability, and our continuing efforts on a system of layered defense not only to protect the homeland but also to address theater-level

threats. As mentioned above, the Israeli strategic equation is fundamentally different than ours. Yet, in reviewing the varied positions presented on the Israeli strategic problem and its possible solutions, there is much that is relevant. *The Threat of Ballistic Missiles in the Middle East* indeed provides a different perspective for our own theater-level concerns, especially as we look at the midcourse and terminal-phase intercept problems and other options of addressing the threat.

Therefore, with the one qualification on the amount of redundant technical information provided, I recommend this book. Its technical discussion is excellent and comprehensive. The primarily foreign perspectives on strategic development and deployment issues are illuminating, and the discussion of the operational issues associated with missile defense will certainly reawaken interest in this threat area.

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Storm over Iraq: Airpower and the Gulf War by

Richard P. Hallion. Smithsonian Institution Press (<http://www.si.edu/sipress>), 750 Ninth Street NW, Suite 4300, Washington, D.C. 20560-0950, 1992, 383 pages, \$19.95 (softcover).

The title of Richard Hallion's book on the air campaign during the United States' first war against Iraq is a little misleading. In a volume that runs to 268 pages (not counting appendices or index), only the last 148 have anything to do with the Gulf War. This should not trouble the reader, however, for although just under half the book is about something other than what one might expect, it is all relevant. Hallion's thesis is that the air war against Saddam Hussein's forces in the winter of 1991 culminated an almost century-long struggle by airpower advocates to demonstrate what they had always known: that airpower alone could win a war.

As a preeminent airpower historian, Hallion is well qualified to weave the story of the development of airpower—and he does so well, touching on everything from the days of Billy Mitchell and Giulio Douhet to the revitalization of the Air Force in the wake of Vietnam. All of this leads, of course, to the air component of Operation Desert Storm. Despite the fact that Hallion appears to provide a balanced treatment of airpower's historical development, one suspects from his enthusiasm that the author is a believer in strategic bombing, even if he

falls short of saying so. His lack of perfect objectivity notwithstanding, Hallion does a fair job of discussing the evolution of land-based air forces and their missions, laying the context for his interpretation of the Gulf War air campaign.

Hallion's consideration of the rebuilding of the Air Force following the war in Vietnam is particularly interesting. Not only were morale and public confidence low, but also the emerging leaders of the service did not believe that the Air Force had the tools it needed to fulfill its missions. The response entailed building those tools—most notably the F-15, F-16, and F-117. For Hallion, Desert Storm served as their proving ground.

Although the overall treatment of the air campaign itself is informative, one notices a number of omissions. First, it is clear that Hallion is not only an airpower devotee, but also a US Air Force devotee. The book is not about "airpower" in the Gulf War, but about the US Air Force in that conflict. He all but ignores the Navy, Marine Corps, and coalition air forces, except to point out how few sorties they contributed relative to Air Force assets. Indeed, he seems relatively immune even to the political value of joint and coalition operations, which Gen Charles A. Horner, the joint force air component commander, had mastered (see, for example, Tom Clancy and Horner's *Every Man a Tiger* [1999]).

Second, by failing to notice the contribution of other nations or services, Hallion ignores the major interoperability issues that occurred, especially between Air Force and Navy systems—as Edward J. Marolda and Robert J. Schneller Jr. point out in *Shield and Sword* (2001), their history of naval operations in the Gulf. This would seem to constitute a major point, since a failure to raise such issues leads to sluggishness in their resolution.

Finally, the author appears reluctant to air out the Air Force's dirty laundry. Specifically, he does not mention the friction between John Warden and Chuck Horner at all and gives the impression that the two worked together on the plan for the air campaign. Horner himself has suggested that he sent Warden packing as soon as the latter finished his briefing; Horner then started planning from scratch, albeit with the help of some of Warden's junior planners. Furthermore, Hallion fails to provide an analysis of Warden's plan compared to the one eventually used to win the war. In fact, Warden's plan proved optimistic in its estimation of the importance of "strategic" targets; it also failed to appreciate the significance of striking troop formations in the field. In the end, the damage inflicted on Iraqi tanks and infantry by coalition air forces

stands as one of the biggest contributions they made to eventual victory.

Storm over Iraq is not a perfect book, mostly due to the author's parochial views regarding airpower and the US Air Force. Nevertheless, it is an engaging, well-written book that remains one of the most accessible treatments of both the rebuilding of the Air Force after Vietnam and its critical role in Operation Desert Storm. As such, one should read it—but should do so with caution.

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The Battle for Hearts and Minds: Using Soft Power to Undermine Terrorist Networks edited by Alexander T. J. Lennon. Massachusetts Institute of Technology Press (<http://www.mitpress.mit.edu>), Five Cambridge Center, Cambridge, Massachusetts 02142-1493, 2003, 392 pages, \$25.00 (softcover).

Battle for Hearts and Minds is a wide-ranging and readable collection of articles previously published in the *Washington Quarterly*. Focusing on nonmilitary responses to terror, Lennon arranges the articles into five broad sections: the role and limits of military power; questions of state failure and nation building; strategies of postconflict reconstruction; the challenge of public diplomacy; and the future of foreign assistance. If these categories sound familiar, they are—they span the topics in the news today, especially as the rehabilitation of Iraq continues.

The articles differ from typical media coverage in two ways. First, they were all written before Operation Iraqi Freedom (OIF) and are therefore often outdated in their facts and outlook. Far from being a failing, this is the collection's most interesting point—we can compare these pre-OIF predictions to the reality of the current world situation. For instance, as Karin von Hippel notes in her contribution, "The inability to cope with each of these four factors—refugees, the media, sanctions, and defiance by errant rules—produced the 'Do Something' effect and entrapped the U.S. government into choosing the most extreme option of force" (p. 113). She writes here about Somalia and Haiti, but we can now see how this applies to the war in Iraq.

The second difference is the depth of treatment. In the news media (and indeed in most public political discourse), the treatment of the topics of nation building, public diplomacy, and foreign assistance is fleeting and shallow. The ideas are presented

but often with partisan bias and without concrete specifics or depth. *Battle for Hearts and Minds* digs deeply into each area, as experts parse and analyze the real options available to policy makers.

For instance, the terms *nation building* and *failed state* are tossed lazily around in public debate, without much effort to define what they entail. Here they are carefully dissected, beginning with Robert Rotberg's analysis of what precisely defines a failed state. Without a common understanding on this point, strategies to deal with such states cannot be planned. Other articles seek to demonstrate empirically the link between failed or failing states and terrorist networks. This link is not so straightforward as one might think. Ray Takeyh points out that it is not so much a failed state that provides a home for terror, but "a weak state that cannot impede a group's freedom of action but has the veneer of state sovereignty that prevents other, strong states from taking effective countermeasures" (p. 95).

The book's strongest point is its detailed treatment of a wide range of topics and policy options that are less familiar to the lay reader. Articles propose detailed Peace Corps reform, debate the role of conflict diamonds, imagine an international peacekeeping force (either inside or outside of United Nations control), ponder the future of the Voice of America network, list the countries that would be included in the Millennium Challenge Account, illuminate the debate over private military corporations, and document the bonds that are forming between some US states and various foreign governments. These proposals and recommendations are specific and often unique to narrowly defined problems. But they are the real policy options that our elected leaders must consider—the nuts and bolts of how we proceed as a nation to undermine the forces of terror.

For the general reader, however, this level of detail may be entirely too extensive. Unless one is already versed in the language and methods of expert debate on these subjects, the fine detail of corporate governance or the disposition of rebel forces in Sierra Leone is a bit much to absorb. Indeed, at \$25.00 for a paper copy, the book is geared for the same policy wonks that filled its pages in the first place. However, the topics it details are some of the most important ones that we face today. For readers who want to go deeper than the typical analysis and find pathways and options to explore, *Battle for Hearts and Minds* is an admirable guide.

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Messerschmitt Roulette: The Western Desert, 1941–42 by Wing Cdr Geoffrey Morley-Mower, DFC, AFC. AirLife Publishing Ltd., United Kingdom, distributed by Stackpole Books (<http://www.stackpolebooks.com>), 5067 Ritter Road, Mechanicsburg, Pennsylvania 17055-6921, 2003, 232 pages, \$16.95 (softcover).

Memoirs are truly like a box of chocolates—one never knows what one is going to get. Although generally fascinating reading, memoirs can sometimes be preachy, boring, enlightening, eye-opening, or anything in between. As time passes, the deaths or clouded memories of the men and women who experienced this great conflict will result in the loss of great personal histories; therefore, the importance of *Messerschmitt Roulette* is readily evident.

Commander Morley-Mower served 31 years as an officer pilot in the Royal Air Force before retiring as a wing commander in 1968. His decorations include the Distinguished Flying Cross and the Air Force Cross. He provides one of the most insightful memoirs concerning life in the North African desert during World War II. At the time a flight lieutenant, he was a tactical reconnaissance Hurricane pilot assigned to 451 Squadron, Royal Australian Air Force (RAAF).

The way the author modestly tells his story of life in the squadron makes this book very captivating. The continuing struggle of an Englishman assigned to an RAAF squadron, trying to make it run efficiently with British, Australian, and South African pilots, was fascinating and interesting. Through these trials, he and the members of his squadron went about their daily business of flying deep into enemy territory gathering information for the army. Unsurprisingly, flying behind enemy lines, either alone or with one man covering for them, several of their pilots became victims to the prowling German Me-109s. Morley-Mower himself had several encounters where he was able to successfully stay out of the crosshairs of young German pilots.

His time in the desert is the saga of one man doing his job daily as part of a team—no glory, few accolades, but most importantly, successfully fulfilling the army's requirements and living to tell about it. Whether it was time spent in Tobruk, the November Handicap, fighting for acceptance from his Australian and South African counterparts, the inevitable losses of squadron pilots, or simply the mundane day-to-day life of an airman in the desert, the author more than successfully brings the reader into "his" world.

Loaded with black-and-white photographs, several appendices, and a map of the North African area of responsibility, this book is an excellent read and is highly recommended to anyone interested in the war in the desert. As a reconnaissance pilot, the author gives a whole new perspective of that particular conflict. There are several other good memoirs of fighter and bomber pilots that flew in North Africa, but this perspective is truly unique and a worthwhile read.

Lt Col Robert Tate, USAFR

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Disaster at D-Day: The Germans Defeat the Allies, June 1944 by Peter Tsouras. Greenhill Books/Lionel Leventhal Ltd., distributed in the United States by Stackpole Books (<http://www.stackpolebooks.com>), 5067 Ritter Road, Mechanicsburg, Pennsylvania 17055-6921, 2004 (reprint of 1994 edition), 256 pages, \$19.95 (softcover).

Obviously, this is nonsense. We all know that the Allies landed on 6 June 1944 and swept inevitably and irreversibly through Europe, pushing German forces all the way to Berlin. Well, not exactly Berlin—there was a political decision that stopped the Americans short of the German capital—but the Allies won. Didn't they?

Of course they did. But not inevitably. That's the point of Peter Tsouras's interestingly presented alternative history. The narrowest of margins separated success from failure on Omaha Beach, and as Omaha went, so went the landings. A stroke of luck here, an error of judgment there, and suddenly the Allies were revisiting Dunkirk or Gallipoli rather than slogging inexorably through France and on to Germany.

What if the German high command had let Rommel have his requested extra Panzers on Omaha to back up the extra infantry that really *were* there and missed by Allied planners? What if Rommel were there at that critical point of the battle instead of back in Germany? Both events could have happened had decisions not gone otherwise. They are legitimate what-ifs, not just idle speculation.

Incorporating these and other choices rejected at the time, Tsouras develops his detailed account of D-day. Small initial changes trickle down, generate more change, moving the war in significantly different directions from what history records.

The story is full of heroism, blood, and gore. It's nasty business all around. It's war. It's D-day. Tsouras hasn't sacrificed any of the historical bloodiness, tragedy, and farce for his intellectual exercise, his lesson about war. Moreover, Tsouras keeps the excitement of an oft-told story, almost as a sleight-of-hand maneuver to divert attention from his tinkering with history.

For those interested in the construction of the alternate history, Tsouras itemizes the pivot points that take D-day from history to his story. He even adds fictitious footnotes and historical photos with nonhistorical captions to lend authenticity.

This work succeeds on a couple of levels. As alternate history, it's well put together, with the proper blend of fact and fiction and a good, logical consistency. One can read it as an interesting and sophisticated what-if exercise or as an exciting and dramatically presented fiction. Either way, the book is fine. The important level is the second, the lessons learned. Without hammering a message into his reader's head, Tsouras makes clear the iffiness of war, the criticality of chance, in this most serious of human endeavors. All who engage in humanity's most perilous enterprise, war, should keep in mind how narrow are the differences between success and failure—and how costly even success can be.

John H. Barnhill
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Modern Bombers: Aircraft, Weapons, and Their Battlefield Might by Anil R. Pustam. Stackpole Books (<http://www.stackpolebooks.com>), 5067 Ritter Road, Mechanicsburg, Pennsylvania 17055-6921, 2004, 72 pages, \$14.95 (softcover).

Anil Pustam's *Modern Bombers* presents a pictorial history of America's bomber force in action. The third volume of Stackpole Books' US Air Power series, which examines aircraft and crews of the different military services over the last decade, it offers a brief chronological account of the B-52, B-1, and B-2, including information about planned upgrades. Brilliant photos (both black and white and color) acquired from numerous sources depict the bombers' contributions to recent US operations in Kosovo and Afghanistan. Brief narratives that accompany each picture provide additional information on the aircraft and their weapons. Not only do the photos show the bombers releasing their mighty payloads, but also they capture the numerous sup-

port functions required to put these aircraft over target. In short, *Modern Bombers* gives us an effective snapshot of the world's most formidable bomber force.

Lt Col Melvin G. Deaile, USAF
Chapel Hill, North Carolina

Seven Stars: The Okinawa Battle Diaries of Simon Bolivar Buckner, Jr., and Joseph Stilwell edited by Nicholas Evan Sarantakes. Texas A&M University Press (<http://www.tamu.edu/upress>), John H. Lindsey Building, Lewis Street, 4354 TAMU, College Station, Texas 77843-4354, 2004, 224 pages, \$29.95 (hardcover).

Sociometrics—the science of using the personality of individuals to analyze how organizations work and to assess the effectiveness and efficiency of organization and function—appears, on the surface, to represent the exact opposite of what military science is supposed to be. As war fighting becomes more complex, military historians have come to look at operational art as a series of interrelated but essentially independent acts. Logistics, strategy, tactics, the principles of war, and so forth are means of understanding complex situations. This review certainly does not intend to call into question the effectiveness of such tools or their applicability to the operational art. They work very well for planners and analysts, contributing mightily to the military historian's task; indeed, no effective military historian can do work without those tools in his or her intellectual toolbox. For these historians, however, the problem is somewhat different. Too often one measures the success or failure of generals by how they act in accordance with pre-conceived understandings and operational models, minimizing the human element or, worse, ignoring it altogether. Considering the role of a commander's personality in formulating battlefield decisions, even for historians inclined to consider such intangibles as "charisma," is too frequently seen as a throwback to an earlier day—a kind of archaic hero worship that has become obsolete in modern history.

Enter now Nicholas Evan Sarantakes, who has edited the battlefield diaries of Simon Bolivar Buckner Jr. and Joseph Stilwell. Each of these men in turn commanded Tenth Army during the invasion of Okinawa, the last and costliest of the island-hopping campaigns in World War II. Buckner was killed in June 1945, and Stilwell became Tenth Army commander. From the beginning of the Okinawa cam-

paign, the Japanese resisted furiously, and throughout the early summer of 1945, the Imperial High Command mustered every resource possible to dislodge the Americans. Between April and June, for example, the Japanese hurled no less than 11 major kamikaze operations, involving 1,465 planes, at the American invasion force. By July, after the island was declared secure, Stilwell began planning for the invasion of Japan itself. The dropping of the atomic bombs in August and the official surrender of the Japanese on 2 September did not end Tenth Army's operations. On 7 September 1945, Stilwell and Tenth Army accepted the surrender of the last fighting units of the Imperial Army.

In addition to diary entries, Sarantakes has included personal letters, memos, orders, speeches, excerpts from interviews, and press releases. Together, these give a remarkable view from the ground, not merely of combat but of strategic problems besetting the Americans in the final months of the war. Both Buckner and Stilwell write with the candor that comes from not expecting publication of one's letters about the impending invasion of Japan and the problem of peace. By itself, this would make *Seven Stars* indispensable to students of the Okinawa campaign, the Pacific war, postwar Japan, generalship, and staff operations. Such effectively collected and edited primary sources are rare enough. But relegating this work to the position of a mere sourcebook does a disservice to its editor.

The editor's vision and crafting of this collection make it truly valuable. Rather than reducing each general to a common denominator, Sarantakes, a talented and accomplished historian, looks for and emphasizes their differences, using these sources to explain command decisions. He even painstakingly describes the way each general writes and provides clues to how each one thinks. Stilwell made his entries on a flip-top notebook or whatever was at hand, including indecipherable kanji and abbreviations that in some cases are indecipherable; Buckner's entries, however, are more formal and organized. Sarantakes edits out the personal parts of the entries, leaving us the views of two vastly different men responding to the same problem of combat leadership. One finds no hero worship here; rather, the editor brilliantly shows the human face of command.

Sarantakes's introductory comments in the text and the chronology allow readers with a cursory understanding of the campaign to use *Seven Stars*. For more advanced students, his epilogue (called "Taps" in the book) both finishes the story and addresses some of the tactical and historiographical problems associated with the campaign. Sarantakes addresses and evaluates the controversy over Buckner's

fitness for command, high casualties, and his use of what some people describe as World War I-style tactics. He offers us both Buckner's and Stilwell's views on the operation as a means of understanding the situation and the tactical response of the commanders.

"The end of the war in the Pacific was far more complex, dangerous, and uncertain than many have allowed" (p. 135). As a collection of primary documents, *Seven Stars* certainly demonstrates the difficult, intricate nature of military operations in Okinawa and the way operational complexity drove tactical responses. Sarantakes's assessment of Buckner's initial operations is compelling. However, his fusion of sociometrics and military science creates a new dimension in the study of modern command. One also sees the role of personality as a driving force in operations, but the real strength of the work lies in Sarantakes's ability to show the role that personality plays in operational development. This study is both a history of the Okinawa campaign and a personal history of the generals involved. What makes the book effective—and unique—is its ability to show how understanding one leads to understanding the other. *Seven Stars* makes an important contribution to our understanding of leadership, generalship, and the end of the war in the Pacific.

Dr. Everett Dague
Benedictine College

21st Century U.S. Air Power by Nicholas A. Veronico and Jim Dunn. MBI Publishing Company (<http://www.motorbooks.com>), Galtier Plaza, Suite 200, 380 Jackson Street, Saint Paul, Minnesota 55101, 2004, 176 pages, \$29.95 (hardcover).

What is airpower? According to *50 Questions Every Airman Can Answer*, a 1999 US Air Force pamphlet, "airpower is the fundamental ability to use aircraft to create military and political effects. . . . It is military power that maneuvers through the air while performing its mission." Although slightly dated, that basic definition still applies. Fortunately for airpower enthusiasts, many books focus on military aviation. Veronico and Dunn's *21st Century U.S. Air Power* appeared in the aftermath of the terrorist attacks of 9/11 and the need for improved homeland security in the air and elsewhere. The authors profile the various technologically advanced aircraft that protect US skies.

The book's main sections deal with the air forces of the Air Force, Navy/Marine Corps, Army, and Coast Guard. For good measure, it also throws in military demonstration teams. Three appendices cover bomb types, missiles, and aerial victory credits from 1981 to the present. Even though the last appendix goes back almost two decades into the twentieth century, it helps support the case that US airpower remains the dominant force around.

Veronico and Dunn effectively describe the wide variety of military aircraft types by providing short histories, significant capabilities, and sidebar highlights (similar to what appears in the annual almanac issue of *Air Force Magazine*). They also list active, Guard, and Reserve units to which the aircraft are assigned and detail unit nicknames, tail numbers, and locations. Over 200 color photographs, some of them of exceptional quality, accompany the text.

In its attempt to cover the military gamut, the book makes a few notable errors and omits some information. For example, the authors state that the US Navy operates eight aircraft carriers and is constructing two more—all nuclear. However, they fail to mention the two conventionally powered carriers in the inventory. Furthermore, they mention that the new V-22 Osprey tilt-rotor aircraft will soon replace most rotary-wing helicopters but do not include even one photograph of the “future of assault warfare” destined for the Navy, Marines, and special operations forces.

Overall, *21st Century Airpower* contains interesting facts and quality photos. For readers who can never get quite enough of military airpower, it complements a number of other works.

Dr. Frank P. Donnini
Newport News, Virginia

If Britain Had Fallen by Norman Longmate. Greenhill Books (<http://www.greenhillbooks.com>), Park House, 1 Russell Gardens, London NW11 9NN, 2004, 304 pages, \$19.95 (softcover).

What if the Luftwaffe had defeated the Royal Air Force (RAF) and won the Battle of Britain in the summer and early fall of 1940? In *If Britain Had Fallen*, Norman Longmate provides an in-depth look at what might have happened if this “counterfactual” event had occurred: the Germans would have successfully launched Operation Sea Lion in September 1940 and occupied Britain. As a result, the British Isles would not have become the “unsinkable aircraft carrier” from which the Allies could

launch their own invasion of Festung Europa, and the history of both World War II and the world would have been drastically different.

Although other authors have written about a successful invasion and occupation of Britain (Erskine Childers, *The Riddle of the Sands* [1903]; H. H. Munro, *When William Came* [1913]; and C. S. Forester, *If Hitler Had Invaded England* [1967]), these works cover only one phase—the preparations, landing, or subsequent campaign. Longmate covers them all—and in a highly believable manner. The first four chapters describe preinvasion activities on both sides, and the last 13 cover the German occupation of Britain. Only three are fictional.

First published in 1972, *If Britain Had Fallen* draws on documents collected by the British Broadcasting Company (BBC), which produced a television film of the same name. Additionally, the author studied the actual German occupation of Europe—specifically, that of the Channel Islands, the only part of Britain so occupied during World War II. In the process, Longmate succeeds in creating a fictional account that reads like nonfiction.

The key to this alternate history is Göring's (and Hitler's) decision during the Battle of Britain to continue attacking Fighter Command and British radar stations until German forces defeat the RAF, rendering it unable to stop a cross-channel invasion. The Nazi leaders realized they needed air superiority over the English Channel for a successful invasion. As we know, however, they in fact ordered the Luftwaffe to bomb cities, especially London, in early September 1940—a critical decision that gave the RAF breathing room to recoup its losses and prevent the Luftwaffe from establishing air superiority. As a result, the Germans postponed Sea Lion several times, finally canceling the operation. Hitler went on to invade the Soviet Union in June 1941—and we know the rest of the story.

I have only two minor criticisms of an otherwise excellent work of alternate history. With the German army advancing through London, Longmate depicts Prime Minister Winston Churchill as the last defender in a last-ditch stand on Downing Street. There he is shot and killed by a German soldier before a superior can stop him. I am not so sure that the prime minister would have placed himself in such a situation. Additionally, although the author discusses his references in a bibliographical essay for each chapter, he provides no notes to identify the sources of specific passages.

Lt Col Robert B. Kane, USAF, Retired
Eglin AFB, Florida

American Soldier by Gen Tommy Franks with Malcolm McConnell. ReganBooks/HarperCollins Publishers (<http://www.harpercollins.com>), 10 East 53d Street, New York, New York 10022, 2004, 608 pages, \$27.95 (hardcover).

As the combatant commander in charge of US military operations during one of the most turbulent times in one of the most turbulent parts of the world, Gen Tommy Franks's autobiography is a fascinating read and an important addition to the collection of military biographies. He commanded US Central Command (USCENTCOM) during Operation Enduring Freedom (OEF) in Afghanistan and Operation Iraqi Freedom (OIF) in Iraq. Anyone interested in command and control at the highest strategic and operational levels, the art of planning and executing large-scale military operations, and the relationships between military and political leaders at various levels will appreciate this book.

American Soldier begins in the early 1950s with Tommy Franks growing up in a middle-class family trying to capture "the American dream"—descriptions that captivated this European reviewer. He was commissioned through the Army's Artillery Officer Candidate School in February 1967 and soon sent to Vietnam where, although wounded, he finished his tour and gained valuable experience. This was the first of four wars he would participate in during his career, which made me realize how much closer war is to the average American than for most West Europeans. It might also explain why the US military is so much more respected at home when compared to the Europeans' respect for their forces and perhaps why we seldom see books written by European generals.

Franks's next Cold War assignment took him to Bavaria, Germany, where he commanded troops defending Europe from the Soviet threat and faced issues of low morale, alcohol and drug abuse, inadequate training, and poor equipment maintenance. I was unaware—and to be honest, now find it somewhat scary—that these problems were as serious as Franks describes. Nevertheless, he dealt with them, learning the value of motivated noncommissioned-officer leadership. When a Chinook helicopter accident killed several of General Franks's artillery-battery officers, it drove home his sense of responsibility for the people in his command. This accountability trait complemented his "people-person" approach to commanding troops.

Brig Gen Tommy Franks entered Desert Storm as an assistant division commander for operations and maneuver—an assignment that required him to interact with the press and juggle political and

military responsibilities. Although he freely admits mistakes, the reader will also note his ability to learn from experience and seldom make the same mistake twice. Speed, Franks believed, has the same effect as mass, and combining the two reveals the importance of time. That personal perspective helps clarify some of his strategic choices and gives extra attention to *information*—a factor that might be of even greater importance than time. This is good stuff for those interested in joint-warfare development and details the lessons to be applied when another war occurs.

Franks was appointed commander of USCENTCOM in the summer of 2000. He begins the second part of his book by explaining his area of responsibility (AOR), which he refers to as "a dangerous neighborhood." The development of the OEF strategy is particularly interesting, and, although he has the Northern Alliance to fight alongside his own forces, there is no guarantee of finding and defeating a hidden enemy in the world's most primitive battlefield. Victory, he says, has everything to do with effects: effects enabled by the military forces and national and international political leaders. The reviewer doubts that there are any courses to teach senior leaders how to negotiate the challenges at this level, but Franks proved himself very capable.

Franks relates discussions he held to solidify his command—discussions with his subordinate commanders, service chiefs, and Secretary of Defense Donald Rumsfeld. He told the service chiefs to either trust or replace their three-star component commanders in the AOR. He made clear to his colleagues in Washington that he was in command and that he would not allow his operations to be frustrated by their defense-budget-spawned concerns. He overcame those parochial interests and got the political trust and military jointness he needed. It is remarkable how much the parochial interests in Europe resemble those US problems and impede effective combined operations.

OIF was quite different from OEF, complicated by contingency plans to keep Iraq from setting fire to its oil wells and Turkey's refusal to be used as a base from which to attack. Franks's description of the coalition's high-tech forces during the sandstorm of 22–27 March 2003 revealed airpower capabilities that were missed by the embedded press, which saw only a veil of sand that seemed to bring the war to a halt. The coalition's B-1s, B-52s, and many of its fighters used weapons guided by the global positioning system to effectively attack the Republican Guard in one of the fiercest air-to-ground attacks in airpower history.

Franks also discusses his strategic-level relationships with and between senior military and political leaders, showing that for military leaders to be effective in reaching political objectives, they must also have political sensitivities and diplomatic skills. I had the pleasure to witness those skills when I heard the general speak at the airpower symposium celebrating the 50th birthday of the Royal Netherlands Air Force (RNLAf). In the Hall of Knights—the very heart of Dutch democracy—Franks gave a 45-minute speech on the transformation of warfare. He captivated his audience without using notes or PowerPoint slides. He was impressive not only for his powerful personality but also for the warm respect he showed those around him.

Lt Col W. M. Klumper, PhD, RNLAf
The Hague, Netherlands

An Officer and a Lady: The World War II Letters of Lt. Col. Betty Bandel, Women's Army Corps edited by Sylvia J. Bugbee. University Press of New England (<http://www.upne.com>), 1 Court Street, Suite 250, Lebanon, New Hampshire 03766, 2004, 304 pages, \$19.95 (softcover).

World War II accelerated and even implemented numerous forms of social and institutional change. Just one among these many transformations was the broader utilization of women's talents and intellects within the armed forces. *An Officer and a Lady* highlights the experience of a leading personnel officer within the Women's Army Auxiliary Corps (WAAC) who served as the aide to its director, Col Oveta Hobby, and eventually supervised the demobilization of thousands of female officers and enlisted troops within the Army Air Forces. Although the book is a collection of letters, it tells a personal story. One can see Colonel Bandel mature from a wide-eyed recruit ("You would cringe at this place—all 440 women have given up nail polish—it takes too long to put on" [p. 12]) to a woman at the center of personnel policy making ("They seem to view me as the final authority on WAAC, and when I say something they all accept it in a way that scares me to death" [p. 107]).

Bandel's civilian career as a newspaper reporter is both an advantage and a drawback to the content of the letters. She wrote competently, and—true to her ethos—she reported what she saw. Her letters therefore function as a window into her wartime world. She seldom, however, follows up her observations with much reflection or analysis. In her de-

fense, she was busy. Not confined to an office, she logged tens of thousands of miles traveling across the United States, Britain, and North Africa. A greater editorial effort within the text to connect the contents of the letters to what was happening in the war at the time, along with footnotes instead of endnotes, would have helped provide the nonspecialist with context necessary to glean the full import of the letters. For instance, a letter of June 1943 noted that the Army was using women trained as radio operators "as file clerks, librarians, shoe fitters and the like" (p. 108). Was this a consequence of sexism, or were these legitimate needs that the Army had to fill? *An Officer and a Lady* will be of greatest interest to readers who are familiar with the story of women within the WAAC and who seek anecdotal sketches of life in that important organization.

Dr. Michael E. Weaver
Maxwell AFB, Alabama

Choosing Your Battles: American Civil-Military Relations and the Use of Force by Peter D. Feaver and Christopher Gelpi. Princeton University Press (<http://www.pupress.princeton.edu>), 41 William Street, Princeton, New Jersey 08540-5237, 2004, 236 pages, \$37.50 (hardcover).

Whenever American leaders decide to use military force, there is usually a great debate within elite leadership circles over *how* to use that force. One school of thought prefers liberal engagement of the military through a wide range of civil/military operations and with varying degrees of restrictions on the use of that force. Another school reserves the use of force for truly realpolitik uses, then engaging with overwhelming force (the Powell Doctrine). This gap concerning the use of force has affected and will continue to affect military effectiveness and civil-military cooperation.

Woven throughout this debate is a perception in both schools that the American public will not tolerate American casualties resulting from *any* American military operation. Our political and military leadership as well as our potential foes views this "casualty phobia" as an Achilles' heel.

Through 214 pages of text, tables, and graphs, Feaver and Gelpi's *Choosing Your Battles* gives a solid analysis of 21 different studies—as well as additional research studies and surveys—at the Triangle Institute for Security Studies (TISS). Their analysis thoroughly explores civil-military operations within elite leadership circles to determine answers to the questions of when and how America will use force.

In what is certainly the book's cornerstone, they convincingly argue that the casualty-phobia perception is a myth.

A vast majority of the raw data for this book came from a series of TISS surveys that went to three broad categories of the population: civilian elite (prominent Americans across a breadth of categories); military elite (academy students, intermediate and senior-service-school students, and students from Capstone and the National Defense University); and the general public. The surveys provided several levels of granularity between military-elite and civilian-elite decision makers—including Reserve-component officers, civilians who have attended professional military education, and veterans who presently serve as civilian elite.

The authors plunge into a mind-numbing statistical analysis of the TISS data that would make budding data analysts enthusiastic. It makes for good bedtime reading for the statistically uninitiated. But it's the revealing results of this analysis that civilian and military planners and decision makers at all levels will be interested in.

Perhaps the most important aspect of this book is that Feaver and Gelpi work hard to dispel the casualty-phobia myth. They succeed not only by looking at their own TISS data but also by exploring public-opinion surveys dating back to the Korean War. In so doing, they break down the American population into four distinct groups: those who would press forward at any human cost; those who weigh human cost against benefits of the military operation (weighed against US security, a "big" war will entail more casualties, whereas an intervention to stabilize a government should see relatively few casualties); those who will support casualties so long as the military is making progress toward a defined end state; and, finally, those who are truly casualty-phobic and will not tolerate casualties resulting from any military operation.

The authors find that, generally, the American public is defeat-phobic, not casualty-phobic. They will continue to accept US casualties as long as the civilian and military leadership can show progress toward a defined end state and feel that the military mission is in the interest of their security. Public support will erode when the mission bogs down, leaders express a lack of confidence in the mission and/or reaching the end state, or even if the public perceives no progress toward an end despite US payment in blood. Feaver and Gelpi support this conclusion with several compelling case studies, including the first six months of Korea, Vietnam prior to the Tet offensive, and Somalia before and after the Ranger raid of 3 October 1993.

The implications for civilian and military leaders and planners are staggering. Many know the phrase "Do not plan to fail." However, in embracing the casualty-phobia myth, the authors argue that military and civilian planners and leaders are doing just that. To counter this tendency, planners and leaders at all levels must do the following:

- Clearly communicate to the American public how the impending use of US military power supports or enhances US security. Certain types of operations will entail casualties. Even operations to shore up a faltering democracy will result in some US deaths, even if not due to enemy fire. The United States cannot provide global security without risking military casualties. It is a mistake to believe that the American public is unwilling to take risks when its leaders are persuasive that the risks are appropriate (p. 210).
- Unmistakably state what the desired end state of the operation is and at what point US military forces will be withdrawn from the operation. Once communicated, stick to the phase points, and bring the troops home as advertised.
- Continually inform the public about the progress of the operation and how it relates to the already stated end state and US security objectives. Feaver and Gelpi clearly show that the majority of Americans will buy into some level of casualties commensurate with the type of operation.
- Resist losing faith in the operation. If something bad happens, be honest. But, if at all possible, capitalize on the bad event and use it as a rallying point for public support. Feaver and Gelpi point out that Clinton had a fantastic opportunity to turn the tragic US deaths in October 1993 into a rallying point. US support for the Somalia operation had dwindled from 74 percent in December 2002 to 42 percent in mid-September 2003—dropping to 36 percent *after* the October 1993 deaths. They argue that Clinton, his closest advisors, and members of Congress embraced casualty phobia. "They all lost whatever political will they had remaining for the Somalia mission after the Ranger raid and made no attempt to frame the casualties as the necessary price for victory and thereby tap into the reservoir of public support that might otherwise have been available" (p. 135).

Feaver and Gelpi concede that there remains much more work to be done regarding casualty sensitivity and US decision and policy making. They point to opportunities for future research and/or validation of their own work. On its own, the robust TISS data provides many insights to a large cross section of America. *Choosing Your Battles* just begins to scratch the surface but simultaneously blazes a bold trail.

This book should be on the “must read” list for every top government official, military planner and strategist, and field-grade and flag-grade commander. Feaver and Gelpi are thorough in their analysis. *Choosing Your Battles* is enlightening, timely, and strongly recommended.

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Maxwell AFB, Alabama

The Gathering Biological Warfare Storm edited by Jim A. Davis and Barry R. Schneider. Praeger Publishers (<http://www.praeger.com>), 88 Post Road West, Westport, Connecticut 06881-5007, 2004, 272 pages, \$39.95 (hardcover).

This collection of essays focuses on aspects of biological warfare that have acquired new importance since the terrorist attacks of 11 September 2001 and the mailings of letters containing anthrax. The authors discuss not only well-known threats, such as the anthrax scare, but also less publicized topics such as foot-and-mouth disease, which can quickly destroy entire livestock populations. The latter form of terrorism would have the dual effect of destroying portions of the food supply and the wealth of the US farming industry. As the essay on this disease points out, this type of warfare—waged as recently as World War I in the United States—constitutes a real threat.

Another piece, which addresses the ability of the public-health sector to respond to a bacterium, virus, or toxin, should serve as a wake-up call to the entire medical profession. Drawing on internal hospital studies, the editors conclude that most doctors cannot spot symptoms of a biological at-

tack since they assume that they are dealing with patients who need treatment for disease rather than with victims of a deliberate attack. The anthrax threat also helps to explain the urgency of vaccinating military personnel. Undoubtedly, the debate over the safety of the vaccine will interest the Air Force reader. Smallpox, another biological-warfare agent that could unleash terror and paralysis in a modern Western society, merits its own chapter.

Other chapters, all of which are well written and easy for the layman to understand, provide an overview of biological-warfare agents carried by land-attack cruise missiles and other possibilities for biological warfare in the Middle East. Far more worrisome is the chapter on the next generation of biological-warfare weaponry. The ability to manipulate genes and splice other material into a biological-warfare agent at the cellular level makes current and known countermeasures ineffective or impossible to design; thus, biological warfare would become the scourge of civilization. The discussion of Soviet activities until 1990 will certainly raise some concerns. If Russian scientists and experts move to countries working on offensive biological-warfare programs, the results could be catastrophic. The development of designer genes, designer diseases, and stealth viruses is the next level of offensive biological warfare, for which defensive measures will be elusive without extensive intelligence gathering. The book's final chapter waylays some existing myths about biological warfare and then describes several scenarios whereby the United States could be attacked with biological agents and the associated likely outcomes. After 9/11 we can no longer afford to discount these scenarios.

The selection of topics in Colonel Davis and Dr. Schneider's timely and engaging book will help all levels of the Air Force understand biological warfare and the potential threats it poses. I highly recommend *The Gathering Biological Warfare Storm* as a major addition to biological-warfare texts that contain current information rather than abstract theoretical pieces.

Capt Gilles Van Nederveen, USAF, Retired
Fairfax, Virginia



Mission Debrief

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The Editor

OUR CONTRIBUTORS



Chief Master Sergeant of the Air Force Gerald R. Murray (AAS, Community College of the Air Force; AA, Saint Leo College) is the 14th chief master sergeant appointed to the Air Force's highest noncommissioned officer position. He serves as the personal adviser to the chief of staff and the secretary of the Air Force on all issues regarding the welfare, readiness, morale, and proper utilization and progress of the enlisted force. With a background in aircraft maintenance, he has served as a command chief master sergeant at the wing, numbered air force, and major command levels. The chief also deployed in support of Operations Desert Storm and Southern Watch. Before assuming his current position, he served as command chief master sergeant, Pacific Air Forces, Hickam AFB, Hawaii.



Lt Col Ed "Mel" Tomme (USAF; MA, University of Texas at Austin; DPhil, Oxford University, UK) is deputy director of Air Force Tactical Exploitation of National Capabilities (TENCAP) in the Space Warfare Center at Schriever AFB, Colorado. A 1985 distinguished graduate of the United States Air Force Academy, he has flown and instructed in the T-37 Tweet, F-4G Wild Weasel, T-3 Firefly, and TG-7 Motorglider. After earning his doctorate in plasma physics, he taught physics at the US Air Force Academy, where he became the only officer ever recognized as both the outstanding academy educator by the dean and the outstanding associate air officer commanding by the commandant. Championed by the commander of Air Force Space Command and the chief of staff of the Air Force, Colonel Tomme has briefed his concept for utilizing the near-space regime for military purposes to over 200 flag officers since April 2004.



Col Sigfred J. "Ziggy" Dahl (BA, University of Washington; MA, Webster University) is the director of Air Force Tactical Exploitation of National Capabilities (TENCAP), Space Warfare Center, Schriever AFB, Colorado. He has more than 2,000 operational fighter hours in the F-4D/E/F and the F-15E. His space experience began in 1994 in the Space Warfare Center, where he was instrumental in developing real-time information into/out of cockpit technologies, GPS enhancements, and increasing GPS-guided-weapons accuracy. He was selected to lead stand-up of the USAF Weapons Instructor Course Space Division. Colonel Dahl draws on experiences from several assignments with the US Army. He commanded the 5th Air Support Operations Squadron; served as the 1st Air Support Operations Group's deputy commander for transformation at Fort Lewis, Washington; and served as air/fighter liaison officer and terminal air controller supporting conventional, Stryker, Ranger, and special forces operations. Most recently, he served in combat with Coalition Joint Task Force-7 and Coalition Provisional Authority, Baghdad, Iraq, as the first Iraq Air Component Coordination Element director in 2003.



1st Lt Brent D. Ziarnick (USAF) is a spacecraft systems analyst with the 2d Space Operations Squadron (GPS), Schriever AFB, Colorado. Earlier, he underwent Officer Space Prerequisite Training and Initial Qualification Training at Vandenberg AFB, California. Previously, Lieutenant Ziarnick has published in *Air and Space Power Journal*.



Dr. J. Douglas Beason, Colonel, USAF, retired (USAF; MS, PhD, University of New Mexico; MS, National Defense University), is the associate director (threat reduction) of Los Alamos National Laboratory, Los Alamos, New Mexico. A member of numerous national review boards, including the Air Force Scientific Advisory Board and a vice-presidential commission on space exploration, he previously served on the White House staff, working for the president's science adviser under both the Bush and Clinton administrations. His last assignment after 24 years of active duty was commander of the Phillips Research Site, Kirtland AFB, New Mexico. The author of 14 books and a Fellow of the American Physical Society, Colonel Beason is a graduate of Squadron Officer School, Air Command and Staff College, Air War College, and Industrial College of the Armed Forces. His latest book, *The E-Bomb*, was published in September 2005.



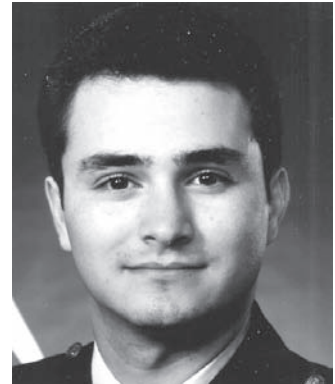
Lt Col David A. Umphress, USAFR (BS, Angelo State University; MCS, PhD, Texas A&M University), is an associate professor of computer science and software engineering at Auburn University and a researcher at the College of Aerospace Doctrine, Research and Education, Maxwell AFB, Alabama. He has served on the faculty at Seattle University; as lead software engineer, US Strategic Command; as assistant professor at the Air Force Institute of Technology; as communications-computer officer at Texas A&M University; and as lead systems programmer for the 1020th Computer Services Squadron. A Certified Software Development Professional, Colonel Umphress led an Air Force-Navy venture to modernize a software organization of over 900 people and led a project to develop the Air Force's first workstation application in the Ada software language.



Lt Col Raymond W. Staats (BA, Syracuse University; MS, Air Force Institute of Technology; PhD, Virginia Polytechnic Institute and State University) is an assistant professor and chief of the Operations Research Division within the Department of Operational Sciences at the Air Force Institute of Technology. He has served as a Defense Satellite Communications System III crew commander and instructor with the 3d Satellite Operations Squadron, as well as executive officer for the 50th Operations Group, Schriever AFB, Colorado; Delta II launch-crew commander with the 1st Space Launch Squadron and chief of the Delta II Standardization and Evaluation Section, 45th Operations Group, Cape Canaveral Air Force Station, Florida; and ICBM test operations officer with the 576th Flight Test Squadron and chief of plans and programs at the 381st Training Group, Vandenberg AFB, California. Colonel Staats is a graduate of Squadron Officer School and Air Command and Staff College.



Dr. Mark Lewis (BS, BS, MS, DSc, Massachusetts Institute of Technology) is chief scientist of the US Air Force, serving as chief scientific adviser to the chief of staff and secretary of the Air Force. He is currently on leave from his position as professor of aerospace engineering at the University of Maryland and as director of the Space Vehicles Technology Institute, College Park, Maryland. His research has contributed directly to several NASA and Department of Defense programs in high-speed-vehicle and spacecraft design. The author of more than 220 technical publications, Dr. Lewis has served on the Air Force Scientific Advisory Board and has chaired a number of science and technology reviews of the Air Force Research Laboratory.



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