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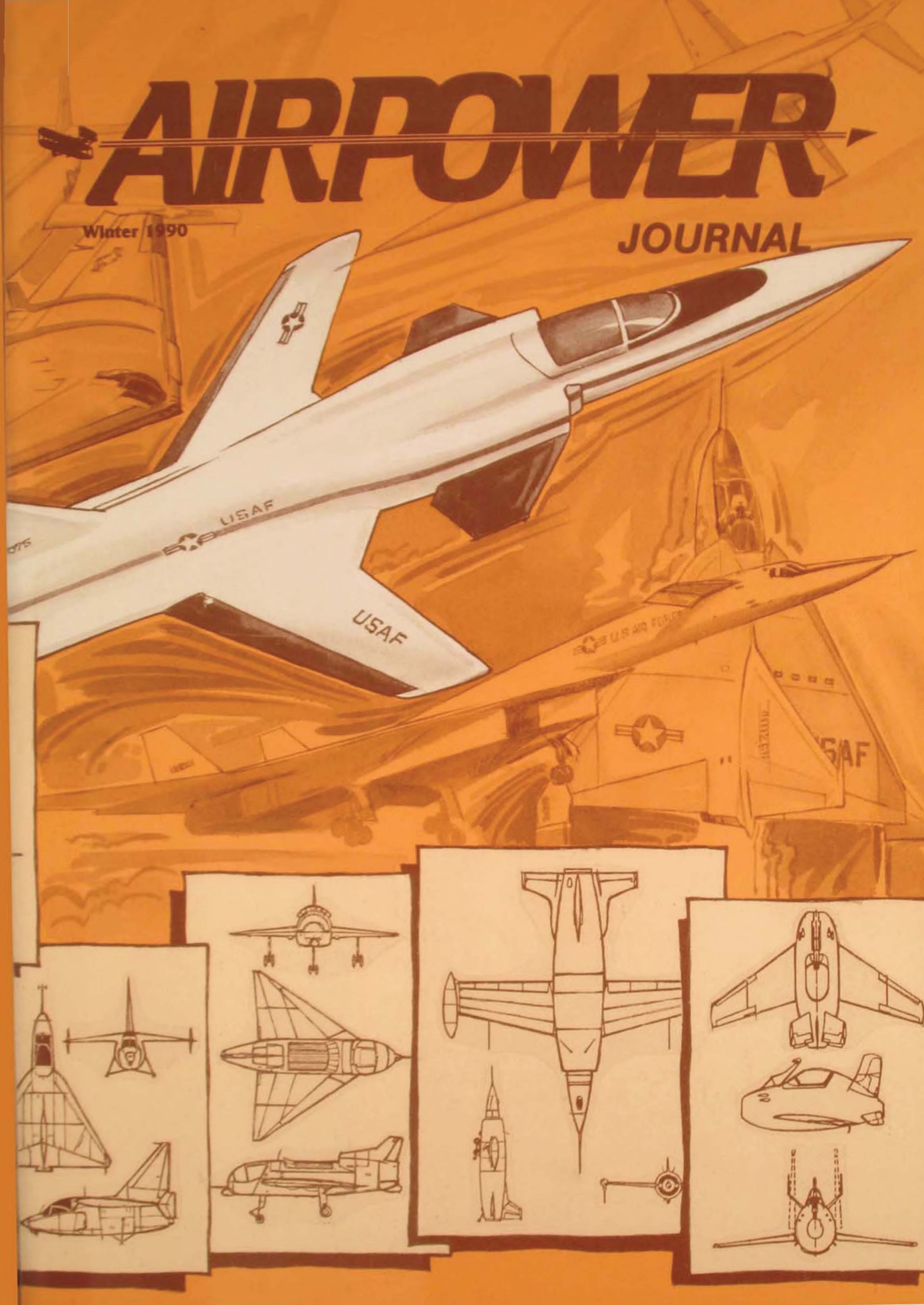

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AIRPOWER JOURNAL

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EDITORIAL

"We Never Dreamed ..."

HARSH reality begins to illuminate the truth of the situation more relentlessly than a brilliant desert sun. The Situation: Operation Desert Shield. The harsh Reality: potential combat, destruction, suffering, and death. The Truth: this is not abstract; it's real, and it's personal. If combat comes, there are only two ways to go: suffer and win, or suffer and lose. In either case you fight, and in either case you suffer. That's war's reality, the down-and-dirty meaning of "gone for a soldier."

A reporter for a domestic regional newspaper interviews the hometown troops deployed to Saudi Arabia for the Great Adventure. One 27-year-old with 10 years' service tells him. "We were just riding the clock before, but you've got to pay your dues here. We joined and we know that, but we never dreamed this would happen. We never dreamed we might have to go to war."

Where was this man for those 10 years? Did he evade all the mission orientations, ignore the bull sessions, tune out the war stories of the old heads? Perhaps, perhaps not. He's simply a young man coming to grips with a reality that for one reason or another never sufficiently surfaced in the lull of peacetime routine, a reality that those old combat vets did not make—or were restrained from making—sufficiently clear to him.

How easy it is to lose sight of a military force's raison d'être: it exists, ultimately, to fight. We can cloak our purpose in slogans such as Learn a Trade, Save for College, Be All That You Can Be, or Aim High—Go Air Force. Nice, but incidental. We debate grand concepts of deterrence theory, argue about structure, and develop competitive strategies. Important activities—perhaps very important—but still only preparatory ones. We underwrite marvellous technological advances, we promote good citizenship, and we are an instrument in achieving social change and social equality. Positive accomplishments, those, but peripheral fallout. None of them are the Real Reason for us. All of us are here to fight.

It is all too possible to put in time at the supply depot, laboratory, maintenance shop, staff desk, or even flight line, yet lose sight of what it's all about. It's been almost 20 years since the US military, as a whole, centered its daily attention on fighting and what it means—almost 20 years since most of those people in uniform wondered if the next posting, or even the next TDY, would take them to meet the Beast. That's time enough for the focus on fighting to diffuse, time enough for memories to be locked away, time enough for new troops to come on board without the focus at all.

"We never dreamed...." Lives are disrupted, routines are in turmoil, plans are on hold, and troops are learning—once again—about deprivation and discomfort. But combat's reality has yet to become fully manifest. Perhaps it won't this time, but somewhere, sometime, it will blast itself into crystal clarity in an awful moment of realization. Ultimately, militaries and their people exist to fight.

"We never dreamed...." But shouldn't we have? KWG

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Letters to the editor are encouraged. All correspondence should be addressed to the Editor, Airpower Journal, Walker Hall, Bldg. 1400, Maxwell AFB AL 36112-5532. We reserve the right to edit the material for overall length.

MORE COMMENT ON PROMOTIONS

As an Air Force officer who is concerned about the development, character, and values of our future Air Force officers, I was both disappointed and offended by the editor's decision to print such an outdated, bigoted, narrow-minded, and damaging essay under the title of "How to Get Promoted" (Spring 1990). Colonel Geiger's decision to print this poorly written and inane essay in the *Airpower Journal* is inexcusable.

Anonymous
USAF Academy, Colorado

Editor's Note: Contrary to our usual policy, we have printed our only anonymous letter for two reasons. First, we want your comments on Airpower Journal's content—but only if you feel confident enough to identify yourself. Second, the letter points up many of the issues which we hope have been the subject of discussion among you:

- *Is the promotion essay outdated, or are there current, substitute social conventions to be observed?*
- *Is the essay bigoted, or is it unsettling?*
- *Is the essay narrow-minded, or has it pursued a specific theme within a broad spectrum?*
- *Have the essay and the subsequent comments enabled us to learn something?*

WAR GAMING

I was interested in Lt Col David B. Lee's article "War Gaming: Thinking for the Future" (Summer 1990). Commercial board war games go back further than computer games. Their history in the US dates to the late 1950s when the Avalon-Hill Company came out with a game called "Tactics." That company's products spawned a hobby that grew slowly during the 1960s. It exploded in the 1970s as other companies entered the field.

As Colonel Lee noted, the early 1980s marked the beginning of commercial computer war games. They have evolved rapidly, and those that appeared even a couple of years ago cannot match today's standards for graphics and sophistication.

Commercially produced war games are an easy way for anyone to begin thinking about the uses and misuses of the genre. If you have a personal computer (PC), it's also an exciting way as well. The advent of compact disk read-only memory (CD ROM) for PCs is promising another major change for computer war games.

Maj Gregory G. Wilmoth
Tucson, Arizona

Lt Col David Lee's article on war gaming was quite interesting. However, regarding the example of war games and the Japanese attack on Pearl Harbor, I wonder why the Japanese didn't attempt to sink the US vessels in deep ocean waters where ships could not easily be refloated and repaired? The Japanese decision to sink American ships in shallow harbor waters made salvage operations possible and allowed the US Navy to quickly rebuild its ships.

Michael J. Miller
Wright-Patterson AFB, Ohio

GNAT GNOTES

If we had only listened to our instincts and not our worries, the Vietnam War would have ended much earlier and with a different outcome. "Using a Sledgehammer to Kill a Gnat" (Summer 1990) vividly points that out. My hat is off to the author for presenting the facts so well. Thanks!

MSgt Russell K. Choate, USAF
Abilene, Texas

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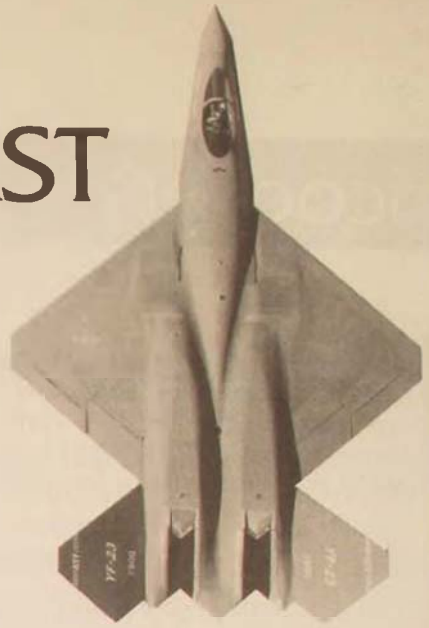
A TROUBLING PAST

Air Force Fighter Acquisition since 1945*

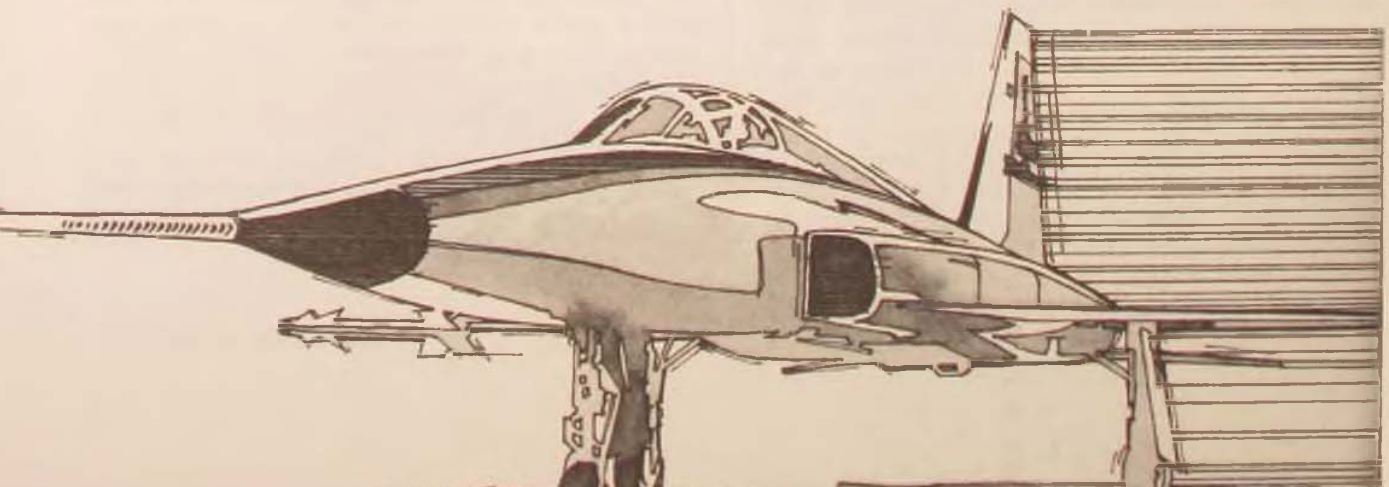
DR RICHARD P. HALLION



SINCE 1945 the United States Air Force has acquired nearly 27,000 fighter aircraft, while the Soviet Union has procured over 50,000. As a general rule, American fighters have proven superior to their Soviet counterparts in a variety of wars and incidents, but American defense planners and fighter designers should examine fighter acquisition in the broader context of Air Force planning and missions from 1945 to the present. There are aspects of American fighter development that raise some disturbing questions regarding the planning and forecasting process by which aircraft were conceptualized, acquired, and placed in service. In fact, one can argue that it was not until the harsh demands and experience of the Vietnam War that Air Force decision makers developed a realistic appreciation for the kind of future fighters that the service required.

Aircraft acquisition is inextricably caught up in the interplay and tension between doctrine and operational thought (the requirements pull) on one hand and technology (the technology push) on the other. Both are inherently dynamic processes responsive to external influences and pressures. If they do not proceed in roughly consistent and synchronous part-

*This paper is based on a lecture presented by the author at the Triangle Universities' Security Seminar on Changing Technologies and New Weapons Systems, Quail Roost Conference Center, Durham, N.C., 2–3 February 1990. I wish to thank professors I. B. Holley, Jr., and Alex Roland for soliciting my participation. Also, I wish to acknowledge with appreciation the assistance and comments of Chris Bowie of the Secretary of the Air Force's Action Group; Lt Col Price Bingham, Air University Center for Aerospace Doctrine, Research, and Education (AUCADRE); Lt Col Donald Baucom, Strategic Defense Initiative Organization; Maj Brian Hoey, AFSC Commander's Action Group; Michael Gorn, AFSC History Office; Jack Neufeld, Air Staff History Office; and William Heimdahl and Sheldon Goldberg of the Office of Air Force History.



nership, the dominance or decline of one is necessarily injurious to the other. Two great and related technological transformations occurred within aeronautics at mid-century: the turbojet revolution and the transonic and supersonic breakthroughs. Between 1939 and 1945 the speed of fighter aircraft rose from 350 to 550 miles per hour (mph). Slightly over a decade later, the speed of fighter aircraft had almost tripled, from 550 mph to nearly 1,500 mph. Indeed, by the end of 1958 the basic speed and operating altitude of today's modern fighter had been mapped out. Approximately a quarter century after the turbojet revolution and high-speed breakthrough occurred, two other roughly synchronous transformations arose to profoundly affect future aircraft development: a materials revolution that resulted in the introduction of synthetic composite structural materials, and an avionics and computer technology revolution that affected aircraft all the way from their conceptualization through design and on to performance and operations.[1]

Arguably, there have been six generations of fighter aircraft since 1939, the "birth date" of the first jet airplane. Likewise, there have been six generations of turbine fighter engines in this time span.*

*These have been (1) early centrifugal-flow and axial-flow demonstrator and production engines, such as the Derwent and Jumo 004; (2) mature subsonic centrifugal and axial-flow production engines, such as the Nene and J47, sometimes with afterburning; (3) transonic axial-flow engines, such as the J57 and Avon; (4) supersonic axial-flow engines, such as the J79 and J58; (5) afterburning turbofans, such as the TF30; and (6) high thrust-to-weight ratio afterburning turbofans, such as the F100.

Following is a list of the generations, typical aircraft in each generation, and some of the defining characteristics of these aircraft.

1. *High subsonic* (1943–50): Me 262, Meteor, P-80, Vampire, Yak-15, MiG-9, Saab J-21, F-84 straightwing, F9F straightwing, Ouragan, Venom. Little aerodynamic difference from the last generation of propeller-driven fighters. First- and second-generation turbojets; wood, fabric, and all-metal construction; optical gunsights; straight wing and straight tail. Mechanical control systems. Primitive ejection seats. Mach 0.75-0.85.

2. *Transonic* (1947–55): F-86, F-84 sweptwing, F9F sweptwing, MiG-15/17, Hunter, Mystère IV. Second-generation turbojets; radar gunsights; swept wings; generally have adjustable horizontal stabilizers. Early hydromechanical flight control systems. Mach 0.90-1.05.

3. *Early supersonic* (1953–60): MiG-19, F-100, F-8. Swept wings, all-moving tails, radar gunsights, introduction of air-to-air missile armament. Third-generation turbojet engines. Early stability augmentation technology. Generally adaptable for both air-to-air and air-to-ground missions. Mach 1.3.

4. *Supersonic (limited purpose)* (1955–70): F-104, early model MiG-21, EE (BAC) Lightning, early model Mirage III. Supersonic aerodynamics, especially area ruling; fourth-generation turbojets; radar for search and fire control. Overreliance on air-to-air missiles based on unrealistic expectations. Mach 2.0.

5. *Supersonic (multirole)* (1958–80): F-105, F-4, late-model MiG-21, late-model Mirage III, F-5, F-111, Mirage V, Su-24, MiG-23/27, Jaguar, Mirage F1, Kfir. Refined supersonic aerodynamic design, including canards and variable geometry wings; fourth- and fifth-generation engines; stability augmentation; mixed-gun air-to-air missile (AAM) armament; terrain-following radar for low-level high-speed flight; radar search and fire control; infrared sensors; heads up displays (HUD); laser ranging and targeting; wide range of air-to-surface missiles, bombs, and rockets, including precision-guided munitions. Mach 1.4-2.5.

6. *Supersonic multirole, high efficiency* (1974–present): F-14, F-15, F-16, F-18, Mirage 2000, Tornado, MiG-29, Su-27. Combined the characteristics of the fifth-generation fighters with advances in propulsion, radar (multiple target track-while-scan, look-down/shoot-down), sensor, and electronic flight control technology to generate highly maneuverable, highly agile aircraft that can be swing-roled for air-to-air and air-to-ground missions. Fifth- or sixth-generation gas-turbine engines; engine thrust-to-weight ratios in excess of one; ability to attain supersonic speeds without afterburning; sustained high-G flight, and controllability below 70 knots at angles of attack exceeding 70 degrees. High degree of energy efficiency. Mix of cannon and missile armament, coupled with diverse air-to-ground weaponry. Mach 1.8-2.5.

One measure that can be used in evaluating the change in fighter aircraft technology over time is component cost as a percentage of aircraft cost. Since 1945 airframe costs have decreased from roughly 66 to 47 percent. Avionics costs have increased from 6 percent to over 20 percent. Engine costs have held steady, at approximately 25 percent. As might be expected, the "long pole in the tent" of modern aircraft acquisition is avionics. Modern fighters have daunting avionics needs; the F-15A has 60,000 lines of software code; the avionics-intensive F-15E has 2.4 million. Difficulties in avionics development and testing have replaced unanticipated aerodynamic and propulsion difficulties as the leading causes of delay, cost excursions, and frustration in flight-test programs.[2]

The Postwar Years

From 1945 to mid-1950 both the Air Force and the Navy were forces in transition—from wartime expansion to peacetime contraction, from the era of the propeller-driven airplane to the era of the jet, from the era of conventional war to a perceived era of atomic warfare. There was precious little evidence in fighter acquisition programs of any interest in the kind of swing-role air-to-air and air-to-ground tactical fighter-bomber missions that had proven so valuable—and so necessary—in the Second World War, a mere half decade or so in the past. Indeed, the period 1945–50 witnessed the disestablishment of American tactical air power in both the Navy and the Air Force, which displeased some of the veteran tactical air commanders of the Second World War. Lt Gen Elwood R. Quesada, the Air Force's consummate master of tactical air support, left the service in part because of what he considered the tacit breaking of a 1945 Army Air Forces (AAF) promise to Gen Dwight D. Eisenhower that the Army would always be able to call upon strong tactical air support assets even if the AAF were made a separate air force.[3]

The de facto basing of the post-World War II Air Force on science and technology, rather than on a realistic appreciation of what the nature of future war, dates back to the moment that Theodore von Kármán's handpicked scientific advisory panel issued—at Gen Henry H. ("Hap") Arnold's specific request—the *Toward New Horizons* report of 1945. From the executive summary onward, this report emphasized speed. It stated that enemy defenses would be so well protected by surface-to-air missiles that "only aircraft or missiles moving at extreme speeds will

be able to penetrate enemy territory protected by such defenses."[4] It was not the last time that the effectiveness of speed or missiles would be exaggerated, nor was the Air Force alone in such misperceptions. As prescient in many ways as the von Kármán study was, it must be recognized for what it was: a scientific and technological think piece remarkably and regretfully detached from realistic doctrinal underpinnings. In this regard, it may be fair to ask whether it accomplished more harm than good in its influence on "planning."

The crucible of Korean and Vietnam combat drastically altered the subsequent development of American fighter aircraft, first for the Navy and subsequently for the Air Force. When prosecuting air strikes deep into North Korean territory, the Navy had to rely on the Air Force's F-86 for protection. Korea gave the Navy a much greater appreciation of the fighter and attack aircraft that it needed to do its job. Indeed, one is struck by how pragmatic Navy fighter- and attack-acquisition became. Out of the Korean experience came what were arguably the two finest American fighter aircraft developed in midcentury: the Vought F8U-1 (F-8) Crusader and the McDonnell F4H-1 (F-4) Phantom II. Both were designed to address shortfalls that were revealed in Korea. In a way, the F-8 and F-4 represented two sides of a doctrinal divide opening up in the fighter world—the perceived "old" era of close-in maneuvering dogfighting and the forecasted "new" era of beyond visual range (BVR) missile shots against relatively benign targets. In fact, of course, this latter view was seriously flawed, as Vietnam would subsequently indicate.[5]

If the Korean conflict had given the Navy a better vision of its future, such was

The YF-22 is the Lockheed-Boeing-General Dynamics representative to the advanced tactical fighter program. The ongoing debate over the nature of future fighters, the changing international environment, and domestic budgetary pressures will all play critical roles in determining whether either the YF-22 or the Northrop-McDonnell Douglas YF-23 actually enters service.

Avionics costs for the modern fighter, such as this F-15E, have continued to escalate since the end of World War II.

not really the case with the Air Force. Like the Navy, the Air Force's missions in Korea had been primarily "air to mud." Sixty-four percent of Air Force missions had been for interdiction or close air support, with only 20 percent going toward air superiority—chiefly the much-heralded Sabre-versus-MiG war over the Yalu River. Air Force pilots, too, marveled at the fast-climbing MiG-15, sometimes too much. The necessity for newer fighter-bombers to replace the obsolete F-51 Mustang and the aging F-80 Shooting Star drove development of the F-84 and F-86 series. It ensured that the service's first supersonic fighter, the F-100, would be a swing-role air-to-air and air-to-ground airplane in the tradition of the fighters of the Second World War. The encounters with the MiG-15 in Korea caused a strong outcry among Air Force fighter pilots for a cheap, lightweight, maneuverable, high-performance fighter to confront future Soviet fighters. The effort to develop such a fighter got seriously off track, for the result was the F-104. Instead of fulfilling the realistic spectrum of air combat, the Mach 2+ F-104 overemphasized rate of climb and brute speed. Both were values consistent with the Mach 2+ supersonic future that the Air Force saw for itself, with the prevailing doctrinal belief that speed would obviate any need for classic dogfighting. While these were good attributes for an interceptor, they were not enough for a satisfactory air superiority fighter.[6]

The Century Series: From MiG Alley to Blind Alley

Today the survivors of the century series are—for the most part—in museums, display parks, or mounted as "gate guardians" at various Air Force bases; the rest were scrapped or, too often, planted themselves in smoking holes. If the F-104 represented a questionable response to the Korean War experience, the other Air Force fighters of the 1950s could be considered questionable products of the interplay of existing military thought, air power assumptions, and the innate high-speed animus of the post-World War II years. Air Force planners generally considered the Korean War an exception that was not typical of the future. Despite the occasional sharp clashes between Strategic Air Command (SAC) and Tactical Air Command (TAC) over control of the future direction of the Air Force—clashes that SAC clearly won—there was general unanimity that the future threat was primarily intercontinental atomic warfare, despite what was happening in Indochina, Malaya, Algeria, and elsewhere.[7]

In this "new" world, the fighter was envisioned as primarily an interceptor, much as it had been in the 1930s. At that time, the apocalyptic vision of the strategic bomber encouraged intensive interceptor development. Sedate "pursuit-curve" tactics by tightly controlled interceptor formations would be required to confront marauding bombers. (This thinking cost a

The "fly by wire" F-16 is capable of fulfilling both air-to-air and air-to-ground missions—a versatility that proved immensely popular with air forces throughout the world.

number of Royal Air Force fighter pilots their lives when they tried it in 1940.) Yet, in the war that followed, virtually all of these interceptors—the Spitfire, Hurricane, Bf 109, P-38, and P-47, for example—were called upon to function as swing-role air-to-air and air-to-ground fighters. After Korea, the threat of the hydrogen-bomb-armed bomber triggered Air Force interest in developing pursuit-curve-flying interceptors with sophisticated fire control systems data-linked to ground tracking, command, and control facilities. The miniaturization of the atomic bomb and its incorporation into weapons that could be easily carried by a fighter-class airplane worked its own unhealthy magic. Now the fighter could itself serve as an atomic-delivery system. This was by no means undesirable or indefensible; in fact, it made good sense. But what did not make sense was the next stage: developing aircraft called "fighters" but narrowly conceptualizing them as primarily nuclear-strike airplanes and constraining their design accordingly. (The F-105 is the classic example.) Thus, by the end of the Eisenhower era, the Air Force's peacetime conceptualization of the fighter's future role was completely out of sync with its previous wartime record in every air war since the fighter had first appeared in 1915. With the exception of the F-100s, which owed enough to the swing-role F-86 in origin that they avoided either of the two following extremes, the Air Force's century-series fighters were either *interceptors* (F-101B, F-102, F-104A, F-106) or, on the other hand, *nuclear-strike aircraft* (F-101A/C, F-104C, F-105). Not surprisingly, then, top-end speed—preferably as close to Mach 2 as possible—continued to predominate as the primary performance design consideration.[8]

The value of the century-series aircraft to American defense in the 1950s and early 1960s is open to serious question. The Air Force acquired a total of 5,525 century-series "fighters." In reality, the number of fighter aircraft actually available for what could be considered traditional air-to-air and air-to-ground missions

(for example, air superiority dogfighting and battlefield air support) was considerably smaller than the above total implies. In fact, only 2,839 of the above could be even remotely considered "classic" fighters in the World War I, the World War II, or the present-day sense. Of this number, 201 were the tactical fighter versions of the F-101 and F-104, and 685 were the F-105, overtly intended for deep nuclear strike, and were not really suitable (except in a defensive emergency) for air-to-air combat. Thus, at any point up to the Air Force's procurement of the Navy's F4H-1 Phantom II, which was imposed by the Department of Defense (DOD), one can state that the only meaningful, genuine swing-role fighter capability that the Air Force possessed was in its many squadrons of F-100s. And of this total of 1,953 aircraft, it fell to the 1,274 F-100Ds—fully mature fighter-bombers "designed from the ground up" for TAC—to really serve as the Air Force's tactical fighter cutting edge pending acquisition of the Phantom in the mid-1960s. These 1,274 aircraft represented but 23 percent of the century-series aircraft the Air Force procured as fighters from 1952 through 1964. The economic implications of the century-series aircraft for tactical forces are interesting. If, for example, the Air Force had procured only the F-102 and F-106 as interceptors, the money otherwise saved would have gone a long way. For just the flyaway price—$1.3 billion—of the 650 F-101B and F-104A aircraft (not including their substantial research, development, test, and evaluation—RDT&E—costs), the Air Force could have more than doubled F-100D production. The service could have procured over 1,622 additional F-100Ds or had a substantial funding base with which to develop a meaningful multimission successor—one not so single-mission compromised as the F-105, which was the "official" F-100 fighter-bomber replacement until the Kennedy administration forced the F-4 on the service at the expense of further F-105 production.

There are several other issues worth noting regarding the development of fighter aircraft in the period between Korea and Vietnam. Of particular interest is the failure of the Air Force to devote any great amount of interest in practical vertical and/or short takeoff and landing (VSTOL) fighter aircraft. Aside from a few far-fetched, speed-dominated studies in the late 1950s and early 1960s, this subject has traditionally languished. Another area open to criticism is the service's laggard approach to munitions development—particularly that of air-to-air missiles, despite an interest in such weapons that predated Korea. In Vietnam the Air Force depended on the Navy-developed Sidewinder and Sparrow, both of which—despite their own problems—significantly outperformed the Air Force's own Falcon. Getting the Air Force to consider Sidewinder at all, in fact, had required the personal intervention of Assistant Secretary of the Air Force Trevor Gardner to obtain a comparative flight-test evaluation; Sidewinder-firing F-86s subsequently made a spectacular debut in the 1958 Taiwan Strait crisis. Beyond the scope of this essay but worthy of comment are the number of other munitions that were Navy-derived and Air Force-employed in Southeast Asia: Shrike, Standard antiradiation missile (ARM), Bullpup, Walleye, and the Mk 82 Snakeye drag-retarded bomb, to mention a few.[9]

The McNamara Era

Secretary of Defense Robert S. McNamara has come under a great deal of criticism for his stewardship of the Department of Defense during the administrations of John F. Kennedy and Lyndon B. Johnson. Unfortunately, there is much to criticize, but there is much, too, that deserves a closer look, particularly his policies affecting subsequent American fighter aircraft. McNamara greatly strengthened the Office of the Secretary of Defense (consequently diminishing the role of the service secretaries and the mili-

The A-10, whatever its merits, was not the 1970s–80s equivalent of the fearsome P-47 Thunderbolt of World War II.

Secretary of Defense Robert S. McNamara's enforcement of interservice commonality of aircraft worked in the case of the F-4 but not in the case of the F-111.

tary chiefs of staff). High on his agenda was improving coordination and cooperation between the services, in part by deleting or combining duplicative programs and development efforts. He directed the acquisition of the F-4 and A-7 by the Air Force and the development of a tactical fighter experimental (TFX), which became the F-111. McNamara has been justly criticized for the latter decision, but the former—supplying the Air Force with variants of the F-4 and A-7—is worthy of

To furnish an inexpensive multipurpose fighter for America's allies, the Department of Defense authorized extensive foreign sales of the swing-role F-5 lightweight fighter, still one of the most prolific and important warplanes in international service.

much more praise than it has received. Indeed, his initiatives restructured Air Force fighter forces to meet the kind of real-world needs that the United States faced in the late 1960s and early 1970s.

To understand McNamara's commonality approach, one must make a distinction between usage by a service of an aircraft *initially developed for another service* and the *joint simultaneous development of a single aircraft type for dual-service use*. The F-4 and A-7 are examples of the former, while the TFX/F-111 is an example of the latter. As a rule, the former category—taking an existing aircraft and modifying it for the needs of another service—has a much greater success

To its shock, the Air Force found itself in the early 1960s without a frontline fighter of its own to replace the aging F-100. The result was the acquisition of Navy-developed F-4 Phantom IIs (here shown en route to a target in Vietnam in 1966, one without benefit of camouflage).

Although losing the Air Force fly-off competition to the YF-16, a modified version of the YF-17 would find new life as the Navy's F/A-18.

rate than the latter. Further, there is a corollary that one can add concerning joint-service use: it is possible to take an aircraft intended for shipboard service and modify it successfully for operation from land. *However, it is extremely difficult to take a land-based aircraft and modify it for operation from a ship without undertaking extensive revision and redesign of the airplane.* Failure to heed this dictum was one of the most serious errors that prevented the attainment of McNamara's commonality goal with the TFX/F-111.

Justified on the grounds of saving approximately $1 billion, the TFX/F-111 program eventually generated a loss of about the same amount. Though much has been written of the civilian-versus-military nature of decision making on the program, the critical point too often ignored in discussions of the TFX/F-111 experience was *the basic incompatibility of developing a single common airframe to undertake widely differing Air Force and Navy missions.* It has become fashionable in some quarters since the time of the F-111 to criticize McNamara's naive belief in the F-111. It must be noted, however, that many senior Air Force officers were at that time confident, optimistic, and even exuberant over the anticipated benefits that they believed would accrue from this joint-service, multipurpose, horse-designed-by-a-committee airplane.[10]

If McNamara erred with the F-111, his instincts with the F-4 and A-7 were absolutely correct. Tactical Air Command had wished to replace the F-100 with the F-105. But after President Kennedy took office in 1961, McNamara directed the study of several replacement candidates for the F-100: the A4D attack bomber, the F-4, and the F-105. In part, he was responding to the Army's increasing discomfort that the "tactical fighters" deployed by the Air Force—such as the massive F-105—were largely aircraft intended primarily for nuclear strike and, as such, were unsuited to furnishing the kind of battlefield air support that the Army sought. Additionally, however, there was a rising climate of dissatisfaction with the Air Force's fighter procurement strategy

within a newly created Systems Analysis Office in DOD headed by Dr Alain Enthoven. The results of this activity, together with a cost-effectiveness study that supported F-4 acquisition, encouraged McNamara's excellent decision in late 1961 directing the Air Force to procure the Phantom. Eventually, the Air Force acquired 2,675 Phantoms for its own use, with extensive foreign sales as well. Further, the F-4 acquisition enabled McNamara to achieve his goal of expanding the Air Force tactical fighter wing structure from 18 to 24 wings.[11]

McNamara's decision on the Air Force version of the Navy's A-7 attack airplane followed his decision on the F-4 and reflected his continued belief that the Air Force needed to strengthen its close-air-support (CAS) commitment to the Army and that this could best be accomplished by equipping the service with numbers of specialized attack aircraft. It was also, in its own way, a "replace the F-100" issue, since the aging low-payload F-100 was the Air Force's primary air-to-ground CAS airplane at the time. For a while, the lightweight Northrop N-156F (the F-5) loomed as a possible candidate. By the fall of 1965, however, TAC and Air Staff spokesmen had convinced—though it had not been a difficult sell—both Gen John McConnell (the Air Force chief of staff) and Harold Brown (the secretary of the Air Force) that (1) the A-7 rather than the F-5 was a better airplane for the battlefield support role because of its much better payload, and (2) a special cannon-armed version of the F-4, dubbed the tactical strike fighter (TSF), should be acquired to complement the all-missile F-4s already introduced into service. Brown and McConnell bought off on the conclusions. Seeing the mix of F-4s, A-7s, TSFs, and F-111s as an ideal future force structure, they recommended implementation to McNamara in early November 1965. The secretary of defense approved the A-7 immediately but balked at the TSF on grounds of cost and time delays, initially disapproving it before eventually reconsidering and authorizing go-ahead eight months later, in mid-July 1966. The TSF became the F-4E, the most versatile and successful of the entire Phantom family.[12]

A flashy but limited-utility interceptor and nuclear-strike airplane, the F-104 proved disappointing both as a conventional bomb-dropper and as a dogfighter.

Vietnam

Although a wide range of Air Force fighter, bomber, and attack aircraft operated over North Vietnam, the only two that really flew consistently against the MiG-17, -19, and -21s were the F-4C, D, and Es, and the F-105s. While the F-4s flew offensive fighter sweeps, F-105s fought no-less-deadly defensive air com-

Originally designed to serve as a nuclear weapons strike aircraft, the F-105, flown with courage and élan, was used in a number of diverse roles in Southeast Asia and took fearsome losses.

bats. Overall, of the 135 MiG kills by Air Force fighters, F-105s shot down 27 (all MiG-17s) and F-4s shot down a total of 107 MiGs; there was one shared kill. Thirty-five Air Force F-4s and 21 F-105s fell to MiGs. Air Force fighter crews thus destroyed 2.41 MiGs per fighter loss; in contrast, Navy and Marine fighter crews destroyed 5.6 MiGs per friendly fighter loss. The 8:1 ratio of World War II and the 10:1 ratio of Korea were things of the past; an exchange rate of 2.41 to 1 clearly necessitated changes in tactics, training, and acquisition.[13]

The Vietnamese experience, and the lesson the Israeli Air Force offered in 1967 of just how deadly a traditionally oriented fighter force could be, elicited two responses from the Air Force and Navy.[14] The first response was a total change in fighter weapons training. The so-called fighter weapons schools of the Navy and Air Force, which emphasized air combat hassling in the tradition of the Second World War and Korea, were revitalized. The results of training could be incorporated in combat in a much briefer span of time than developing and fielding a new fighter force. Following Korea, the air combat "lessons learned" from F-86s versus MiG-15s had been distilled into an influential fighter primer entitled "No Guts, No Glory!" by Frederick C. ("Boots") Blesse.[15] Sadly, however, the lessons had largely been ignored. Writing in 1968 Gen Bruce K. Holloway, himself a noted fighter ace, stated that

> between 1954 and 1962, the USAF training curriculum for fighter pilots included little, if any, air-to-air combat. *This omission was partly a result of doctrine, which then regarded tactical fighters primarily as a means for delivering nuclear ordnance* [emphasis added]. It was partly a reflection of concern for flying safety. In any event, as late as October 1963, it was reported that only four of 30 pilots in one fighter squadron had ever shot aerial gunnery.[16]

This revitalized fighter training, emphasizing air combat maneuvering and stressing the continuity of the fighter experience from the days of Oswald Boelcke and Edward Mannock of the First World War, was in place in time for the renewed and intensified air war that broke out in 1972.[17]

The second response to the disturbingly low victory/loss rate in Vietnam was a

America's first combat-worthy swing-role jet fighter, the P-80, was a typical first-generation jet warplane, blending the established aerodynamics of the subsonic propeller-driven airplane with the revolutionary jet engine.

clamor for better fighter aircraft, particularly highly maneuverable airplanes having excellent acceleration, agility, visibility, an internal gun system, and a thrust-to-weight ratio exceeding one. Vietnam, it may be said, provided the impetus for the sixth-generation superfighters of the late 1970s and 1980s: the F-14, F-15, F-16, and F/A-18. So, too, did the threat of a new generation of Soviet fighters, particularly after the 1967 Tushino air show, where a wide range of prototype fighters was displayed before Western observers. While many of these remained in the prototype stage, others did spawn operational derivatives in the same fifth-generation category as the F-4.

The Road to the Present

The first of the sixth-generation fighters, the F-14, was born of the abortive F-111 experience. The Navy and the Grumman Corporation, having done the best they could to turn this unsuitable plane into a fighter, were able to convince Congress to cancel the program and allow the service to procure its own fighter unencumbered by the dubious requirement for commonality. The result was the F-14A Tomcat, which first flew at the end of 1970. Production deliveries began in May 1972, two months before the first flight of an Air Force sixth-generation equivalent, the F-15A Eagle.[18]

The evolution of the F-15, F-16, and F/A-18 is intertwined. All stemmed from Air Force research and development, and all were largely products of what some termed the *Fighter Mafia*, a small, key group of individuals dedicated to breaking the traditional post-1945 dogmas that had afflicted fighter development, particularly after the Korean War. There were four key individuals in this mafia: Charles ("Chuck") Myers, a former test pilot and Lockheed salesman turned private consultant; Maj (subsequently Col) John R. Boyd, Pierre Sprey of the Systems Analysis Office within DOD; and Col Everest Riccioni. One "outsider" deserves more attention for his part in reasserting the primacy of the air superiority fighter within the Air Force: Maj Gen Arthur C. Agan, the Air Staff's director of plans. Agan, a former World War II fighter pilot, triggered the first interest in a new high-performance air combat fighter in the tradition of those of the Second World War. He established a prestigious study group of fighter aces and pilots to examine the future of Air Force fighter development. In May 1965, armed with their report, Agan sold Gen John P. McConnell, then the chief of staff, on the notion of acquiring a new air superiority fighter. From the work of these five men sprang the F-15 and the F-XX—which inspired the so-called lightweight fighter (LWF) technology demonstration program between the General Dynamics YF-16 and Northrop YF-17, and which ultimately resulted in the F-16 and F/A-18 fighters.[19]

It is interesting to note that there was a "bubble-up" quality to the development of

these advanced airplanes arising largely from the midlevel defense and military bureaucracies. Proponents had to battle the aerospace engineering community's notions that future fighters should merely extrapolate the kind of "bigger, faster, heavier, more complex" thinking that had governed so much of the century series. This thinking had resulted in a proposed future experimental fighter, the F-X, a 60,000+ pound, Mach 2.7 aircraft with a thrust-to-weight ratio of 0.75. It was this proposal that Boyd "summarily rejected" in October 1966 after joining the Tactical Division of the Air Staff Directorate of Requirements. A graduate engineer, fighter pilot, and fighter tactics instructor, Boyd argued persuasively that control and propulsion technology advances in place could enable the development of lighter, energy-efficient fighters that could trade off speed, thrust, weight, and drag loadings to achieve "energy maneuverability."[20]

Boyd's thinking found increasingly strong support within the Air Staff. By the mid-1960s, men who had flown fighters as junior officers in the Second World War and who were uncomfortable with the overspecialization of the fighter into an interceptor on one hand and an attack airplane on the other were shifting more and more into positions of command. Air Force Vice Chief of Staff Gen Bruce K. Holloway, a distinguished fighter ace, wrote in 1968 (by which time Boyd and his colleagues had succeeded in reformulating the gestating F-X) that

> [after] 1953, air superiority, so far as fighter aircraft were concerned, was again limited largely to the defense of the U.S. against enemy bombers. Our tactical fighters were designed primarily for nuclear war where penetration was more important than maneuverability, ordnance load-carrying ability more important than armament, alert status more important than sustained sortie rates.

The F-100 was the last of the "Century Series" of supersonic jet fighters that had a genuine swing-role air-to-air and air-to-ground ability until the introduction of the F-4.

> The tactical fighter became less and less an air superiority system, more and more what once was called an attack aircraft.
>
> Since the beginning of jet aviation, it is only in the last three years that real recognition has been given to the need for a true air superiority fighter in the types of war most likely to occur. *With the exception of the F-4* we do not even now have a first-line tactical fighter that was designed primarily for air-to-air combat and only secondarily for the reconnaissance, interdiction, and close air support roles of tactical aviation. *We now see quite clearly the need for one* [emphasis added].[21]

The airplane he was referring to, of course, was the recast F-X, which had been under development since 1966, and which in October 1968 would become the F-15. Whenever a notion is discredited and replaced with another one, the initial result is usually as diametrically extreme as the one replaced. In the case of the F-15, which followed two decades of building aircraft to a fighter formula that had led inexorably to the F-111, the result was a profound emphasis on air-to-air combat performance only. In the F-15 System Program Office (SPO) at Wright-Patterson AFB, partisans worked under a banner that read "Not a pound for air-to-ground!"[22] This, of course, ultimately proved as farfetched as ignoring the air-to-air mission would have. With the exception of a few specialized interceptors, vir-

An F-86 test-fires "Mighty Mouse" rockets from a retractable launching pod beneath its fuselage. The Air Force took a less-than-aggressive approach in pursuing air-to-air missile (AAM) technology in the 1950s and early 1960s and eventually relied heavily on Navy-developed AAMs during the Vietnam War.

The F-86 gained dominance over MiGs in the skies of Korea. Later variants proved effective in an interdiction role.

tually all air superiority fighter aircraft that have fought in wars since the First World War have been called upon to drop bombs and attack ground targets. However, it is important to note that while air superiority fighters have been successfully modified as bomb droppers, there are no cases of "going the other way"—taking a dedicated ground attacker and making it into a decent fighter. If the Air Force "erred" in stressing the F-15's counterair mission, it was better that it emphasize air-to-air performance, for that was the side that traditionally had to dominate in the development of a decent fighter-bomber. (Eventually, the Air Force did proceed with a competitive evaluation of F-15 and F-16 variants for the interdiction role, leading to the F-15E.) Several key factors enabled the creation of the F-15, particularly electronic stability augmentation systems that were, in effect, first-generation fly-by-wire flight control systems, smaller and more capable air-to-air radars, and the lightweight high-thrust afterburning turbofan engines. The F-15 completed its maiden flight in July 1972; it entered squadron service in November 1974, achieving initial operational capability (IOC) with TAC the following September.[23]

Given how suitable the F-15 would ultimately prove to be for both the air superiority and air-to-ground roles, it is somewhat ironic that in 1968 (fearful that the Mach 2+ F-15 would turn out to be just another big, fast sled) Boyd, Sprey, and the others began arguing for a highly agile, single-engine, and less-than-Mach 2 "austere" fighter, the so-called F-XX. They were unsuccessful in getting the Air Staff to redirect the F-15 program again—a wise decision on the part of the Air Force. Instead, the climate of thought that they proposed with the F-XX germinated at the end of the summer of 1971 in the so-called lightweight fighter program. The LWF program received a significant boost by a dramatic redirection of defense acquisition in June 1970, when then-president Richard M. Nixon's "Blue Ribbon Defense Panel"

recommended ending so-called total package procurement and returning to competitive prototyping, something that had been abandoned since the late 1950s.[24]

Ultimately this interest spawned a competitive fly-off between the General Dynamics YF-16 and the Northrop YF-17, and out of this fly-off came both the F-16 and F-18 airplanes. Although ostensibly intended for technology demonstration, there was little doubt that the "winning" aircraft would have an excellent chance for full-scale production. In mid-January 1975, the Air Force declared the YF-16 the winner, awarding a contract for full-scale development. The first F-16A, which was a slightly larger and more refined aircraft than the YF-16 demonstrator, flew in December 1976. The Air Force activated its first F-16 squadron in January 1979, roughly a decade from the time the fighter mafia initially called for its development. Widespread foreign sales followed. (The YF-16/YF-17 competition was a win-win situation for both contestants, for the losing YF-17 was subsequently adopted, in greatly modified form, as the basis for the McDonnell Douglas F/A-18. Mirroring pilot opinion of the F-15 and F-16, naval aviators generally were enthusiastic over its performance.)[25]

Unlike the F-15, the F-16 was a true fly-by-wire aircraft, using three computers constantly "voting" on each other's performance to maintain control of what was basically an unstable airplane. The F-16 thus possessed superlative maneuverability, really making it a six-and-one-half-generation airplane, demonstrating performance only now being approached by foreign designs such as the Soviet MiG-29, the European fighter aircraft (EFA), Israeli Lavi, French Rafale, and Swedish Gripen. It is worth noting that going beyond the original air superiority intentions of its parents, the Air Force acquired the F-16 as a dual-role air-to-air *and* air-to-ground fighter-bomber. By acquiring it, the Air Force intended to complement the more expensive and capable F-15 carrying a mix of medium- and short-range air-to-air missiles with a cheaper swing-fighter carrying Sidewinders that could assist in winning the air battle, and then fight airland war. It is the F-16's multimission capabilities that subsequently resulted in orders for 3,000 of this type aircraft, placing it among the most successful of postwar jet fighters.

What was it that made these latter machines—particularly the F-15, F-16, and F/A-18—so desirable and successful compared to their predecessors? First and foremost, it was the climate of hard, pragmatic thought from which they sprang—a thought rooted in the combat experiences of Europe, the Pacific, MiG Alley, North Vietnam, and the Middle East—coupled with insightful appreciation of how future warfare was likely to evolve and what contemporary and future technology could realistically offer. As for the airplanes themselves, they were successful because they offered a *package* of attributes rather than overemphasizing any *one* quality such as speed. The advantages that these aircraft possessed reflected the shrewd application of available technology. These advantages included extraordinary agility, superlative handling qualities, sophisticated user-friendly avionics, greatly improved reliability and maintainability, intensive incorporation of human-factor considerations, enhanced flight safety, and unprecedented weapons accuracy. In addition, they had the ability to be configured for both air-to-air and air-to-ground missions and to carry a variety of weapons. Finally, they had an innate ability to be adapted for a variety of other roles. All were qualities previously lacking in the fighters the Air Force had procured for its own use since Korea, and even the Navy-derived workhorse, the F-4, had proven deficient in most of them. The sixth-generation aircraft were so clearly superior to their fifth-generation predecessors that there was a pronounced bias away from anything associated with the *ancien régime* (presixth-generation aircraft). This was dramatically affirmed a half decade ago by the failure of Northrop to sell the otherwise generally excellent F-20 Tigershark, a derivation of

the F-5 that incorporated a great deal of sixth-generation advances.[26]

Aircraft design has always involved the integration of diverse technologies—aerodynamics, structures, propulsion, controls, avionics—to synergistically achieve capabilities. The sixth generation of fighters accomplish this at levels previously unattainable and point the way for future development as well—a seventh generation (of which the YF-22 and YF-23 are the first) stressing greater reliance on built-in low observables, electronic flight control systems, avionics, weapons integration and management, integrated fire and flight controls, reliability and maintainability, modular design approaches, sophisticated seventh-generation propulsion, possible sensor fusion, improved pilot displays including "pilot associate" technology, and the like. In the fighter future, however, such glamorous technology must not dominate planning and management factors, for as the history of post-1945 Air Force fighter development clearly reveals, what is more important is how well planners *anticipate* future warfighting environments, *understand* the systems acquisition process and what it can accomplish for them, *comprehend* the state of technology to meet the needs that (hopefully) they have thought out, and—yes—*appreciate* national political and economic nuances. In the last analysis, failure to realistically address these factors brought forth the disappointments of the 1950s and early 1960s. Addressing them spawned the remarkably successful sixth-generation fighters.

Today, Air Force decision makers grapple with the development of the seventh-generation advanced tactical fighter (ATF), which incorporates the services' and industry's best current answers to such generic questions as how much maneuverability is enough; is sustained supersonic cruise necessary; how much "stealth" is desirable; is there a role for "supermaneuverability"; what is the ideal weapon, sensor, and avionics mix for next-generation fighter and attack aircraft; and should future fighters be specialized or multirole aircraft. They should not automatically assume that the ATF or any other subsequent Air Force fighter will be the newest heir of a long line of *successful* fighters. Rather, they traverse a dangerous mire, hopefully cognizant that all too frequently, the path of post-World War II Air Force fighter development has been fraught with pitfalls and littered with the detritus of mediocrity. □

Notes

1. See I. B. Holley, Jr., USAF, Retired, "Of Saber Charges, Escort Fighters, and Spacecraft: The Search for Doctrine," *Air University Review* 34, no. 6 (September–October 1983): 2–11; Richard P. Hallion, "Girding for War: Perspectives on Research, Development, Acquisition, and the Decisionmaking Environment of the 1980s," *Air University Review* 37, no. 6 (September–October 1986): 46–61; Richard P. Hallion, "Doctrine, Technology, and Air Warfare: A Late Twentieth-Century Perspective," *Airpower Journal* 1, no. 2 (Fall 1987): 16–27; and Robert F. Futrell's *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force, 1907–1964*, 2 vols. (Maxwell AFB, Ala.: Air University Press, 1989); Robert Schlaifer and S. D. Heron, *Development of Aircraft Engines and Fuels* (Boston: Harvard University Press, 1950); Edward W. Constant II, *The Origins of the Turbojet Revolution* (Baltimore: Johns Hopkins University Press, 1980). The supersonic revolution is a fruitful subject for inquiry; useful works are Alex Roland, *Model Research: A History of the National Advisory Committee for Aeronautics, 1915–1958* (Washington, D.C.: National Aeronautics and Space Administration, 1985), and John V. Becker, *The High-Speed Frontier: Case Histories of Four NACA Programs, 1920–1950* (Washington, D.C.: National Aeronautics and Space Administration, 1980). For the electronic revolution, see Paul E. Ceruzzi, *Beyond the Limits: Flight Enters the Computer Age* (Cambridge, Mass.: Massachusetts Institute of Technology Press, 1989).

2. This is my own classification system, and it is at odds with an earlier and broader one that classifies the evolution of fighters after 1945 into four generations, with the fourth being the generation of the F-16 and its equivalents. I believe that the six-generation scheme is more precise and categorical than the four-generation notion. USAF Technical Order 00-25-30, *Technical Manual: Unit Costs of Aircraft, Guided Missiles, and Engines* (Tinker AFB, Okla.: Air Logistics Center/MMEDT, 15 May 1983), 7–9; M. Lipow, "Number of Faults per Line of Code," *IEEE Transactions on Software Engineering* 8, no. 4 (July 1982), passim. I wish to acknowledge information received from Charles E. ("Pete") Adolph, deputy director, Defense Research & Engineering (Test and Evaluation), particularly his draft study (with Phillip Montgomery), "Cost-Effective Testing of Software-Intensive Systems." See speech by Gen Bernard P. Randolph, commander, AFSC, before the Annual Reliability and Maintainability Symposium, Los Angeles, Calif., 23 January 1990. I wish to thank Maj Brian Hoey for making this available to me.

3. The best and most reliable source of information is Marcelle Size Knaack's *Post-World War Two Fighters, 1945–1973*, vol. 1 of the *Encyclopedia of U.S. Air Force Aircraft and Missile Systems* (Washington, D.C.: Office of Air Force History, 1978), which contains a wealth of factual data that can be profitably exploited by researchers. Not surprisingly, the Rand Corporation researchers have issued a number of monographs offering interesting perspectives on post-World War II fighter development. Some of the best are L. L. Johnson, *The Century Series Fighters: A Study in Research and Development*, RM-2549 (Santa Monica, Calif.: Rand Corp., 20 May 1960); Thomas A. Marschak, *The Role of Project Histories in the Study of R&D*, P-2850 (Santa Monica, Calif.: Rand Corp., January 1964); William L. Stanley and Michael D. Miller, *Measuring Technological Change in Jet Fighter Aircraft*, R-2249-AF (Santa Monica, Calif.: Rand Corp., September 1979); Michael Rich and Edmund Dews with C. L. Batten, Jr., *Improving the Military Acquisition Process: Lessons from RAND Research*, R-3373-AF/RC (Santa Monica, Calif.: Rand Corp., February 1986); and M. B. Rothman, *Aerospace Weapon System Acquisition Milestones: A Data Base*, N-2599-ACQ (Santa Monica, Calif.: Rand Corp., October 1987); see John T. Greenwood, "The Emergence of the Postwar Strategic Air Force, 1945–1953," and David Alan Rosenberg, "American Postwar Air Doctrine and Organization: The Navy Experience," in *Air Power in Warfare*, ed. Alfred F. Hurley and Robert C. Ehrhart (Washington, D.C.: Office of Air Force History, 1979), 215–78. The best monographic source is Herman S. Wolk's *Planning and Organizing the Postwar Air Force, 1943–1947* (Washington, D.C.: Office of Air Force History, 1984). See memorandum, Secretary of Defense James V. Forrestal to the service secretaries, subject: [Functions of the Armed Forces and the Joint Chiefs of Staff], 21 April 1948; and President Harry S. Truman to Secretary of Defense James V. Forrestal, letter, subject: [Functions of the Armed Forces and the Joint Chiefs of Staff], 21 April 1948, both reprinted as Document 7 in *The United States Air Force Basic Documents on Roles and Missions*, ed. Richard I. Wolfe (Washington, D.C.: Office of Air Force History, 1987), 151–66. This episode is also discussed in John Schlight's "Elwood R. Quesada: TacAir Comes of Age," in *Makers of the United States Air Force*, ed. John L. Frisbee (Washington, D.C.: Office of Air Force History, 1987), 198–203. For Quesada's own perspective on the significance of tactical—that is, battlefield—air power, see his "Tactical Air Power," *Air University Quarterly Review* 1, no. 4 (Spring 1948): passim.

4. Theodore von Karman, *Where We Stand: A Report Prepared for the AAF Scientific Advisory Group, August 1945* (Wright Field, Ohio: Headquarters Air Materiel Command, May 1946), iv; see also 8, 38. See also Michael H. Gorn's *Harnessing the Genie: Science and Technology Forecasting for the Air Force, 1944–1986* (Washington, D.C.: Office of Air Force History, 1988), 11–50.

5. The best lessons-learned source on Navy operations in Korea is the six *Interim Evaluation Reports* prepared for the commander in chief of the US Pacific Fleet, 1950–1953. Copies of these are in the Naval Historical Center, Washington Navy Yard, and the Naval Aviation History Office, Washington Navy Yard Annex.

6. See USAF Historical Division Liaison Office, *USAF Tactical Operations: World War II and Korea with Statistical Tables* (Washington, D.C.: USAF Historical Division Liaison Office, 1962, 162; see also Robert F. Futrell, *The United States Air Force in Korea, 1950–1953* (Washington, D.C.: Office of Air Force History, 1983), 690. I have benefited from discussions with Maj Gen Tom Collins, USAF, Retired, the first Air Force pilot to flight-test the MiG-15. The best case study on the F-104 is in Marschak, 82–91; see also Knaack, 175–89, for the Air Force acquisition history of this airplane.

7. Bruce K. Holloway, "Air Superiority in Tactical Air Warfare," *Air University Review* 19, no. 3 (March–April 1968): 8–9; and Futrell, *Ideas*, vol. 1, 243–496. As a perusal of Futrell clearly indicates, there were clashes throughout the post-Korean period between strategic proponents (typified by SAC) and tactical ones (by TAC). Though some TAC spokesmen, such as Gen O. P. Weyland, argued vigorously for a doctrine confronting the needs of limited war, during the 1950s, the fighter acquisition policy of the Air Force turned more and more away from such concerns and toward such systems as the abortive F-108 Mach 3+ bomber interceptor.

8. James E. Johnson, *Full Circle: The Tactics of Air Fighting, 1914–1964* (New York: Ballantine Books, 1964), 103; Holloway, 8. The century-series data is taken from Knaack.

9. For information on the Harrier, see John W. Fozard, *The Jet V/STOL Harrier* (Kingston-upon-Thames, England: British Aerospace Aircraft Group, July 1978), a case study for the American Institute of Aeronautics and Astronautics aircraft design seminar offered by one of the plane's designers. Arthur K. Marmor, *The Search for New USAF Weapons, 1958–1959* (Washington, D.C.: USAF Historical Division Liaison Office, April 1961), 49–50; this is a previously classified manuscript, but these portions were declassified at my request by Dr Sheldon Goldberg of the Office of Air Force History, copy in history file at Headquarters Air Force Systems Command; memorandum, Joint Chiefs of Staff to the secretary of defense, subject: Status of Guided Missile Projects, 15 March 1950, reprinted as Document 13 in Wolfe, 213–18; for an analysis of gun and missile effectiveness in Southeast Asia, see R. Frank Futrell et al., *Aces and Aerial Victories: The United States Air Force in Southeast Asia, 1965–1973* (Washington, D.C.: Office of Air Force History, 1976), 155–60; and John B. Nichols and Barrett Tillman's more analytical *On Yankee Station: The Naval Air War over Vietnam* (Annapolis, Md.: Naval Institute Press, 1987), 75–79, which, despite its title, offers an excellent perspective on both the Air Force and naval air war in Southeast Asia. See the memoir by Ron Westrum and Howard A. Wilcox entitled "Sidewinder," *American Heritage of Invention & Technology* 2 (Fall 1989): 56–63; and Rothman, 178–80; see also Gerald K. Hendricks, "The Emphasis on Limited War—and Its Impact on Research and Development in the USAF," student report no. 82, Industrial College of the Armed Forces, Washington, D.C., 1 April 1988, 38–42, copy in the history file at Headquarters Air Force Systems Command; Jacob Van Staaveren, *Air Operations in the Taiwan Crisis of 1958* (Washington, D.C.: USAF Historical Division Liaison Office, November 1962), 38, copy in the history file at Headquarters Air Force Systems Command.

10. Robert S. McNamara, *The Essence of Security: Reflections in Office* (New York: Harper & Row, 1968), 92–93; George M. Watson, "Man in the Middle: Eugene Zuckert as Secretary of the Air Force," *Air Power History* 36, no. 2 (Summer 1989): 20–29. The best sources are the congressional hearings themselves, notably the 10-volume Senate Committee on Government Operations, *TFX Contract Investigation* (Washington, D.C.: Government Printing Office, 1963–1964); the 3-volume Senate Committee on Government Operations, *TFX Contract Investigation* (Second Series) (Washington, D.C.: Government Printing Office, 1970); and the summary report of the Senate Committee on Government Operations, *TFX Contract Investigation*, Report No. 91-1496 (Washington, D.C.: Government Printing Office, 1970). The best book source is Robert F. Coulam, *Illusions of Choice: The F-111 and the Problem of Weapons Acquisition Reform* (Princeton, N.J.: Princeton University Press, 1977), which superseded Robert J. Art's earlier *The TFX Decision: McNamara and the Military* (Boston: Little, Brown and Co., 1968); see also Richard P. Hallion, *The Evolution of Com-*

monality in Fighter and Attack Aircraft Development and Usage (Edwards AFB, Calif.: Air Force Flight Test Center History Office, November 1985); a shorter version of this study appeared as *The Commonality Chimera: Joint Service Development of Fighter and Attack Aircraft and Its Implications for the Advanced Tactical Fighter* (Edwards AFB, Calif.: Air Force Flight Test Center History Office, 17 December 1985).

11. McNamara's role in building Air Force tactical forces—including acquiring the A-7 and the F-4, and expanding the Air Force wing structure—is detailed in an excellent dissertation. Maj (subsequently Brig Gen) Richard G. Head's "Decision-Making on the A-7 Attack Aircraft Program" (PhD diss., Syracuse University, 1971), passim. Glenn E. Bugos's more narrowly focused dissertation, "Testing the F-4 Phantom II: Engineering Practice in the Development of American Military Aircraft, 1954–1969" (PhD diss., University of Pennsylvania, 1988), is also of use.

12. Head, 215–16, 252–90.

13. Futrell et al., *Aces*, 155–60; Nichols and Tillman, 75-79. I have refined their figures slightly to incorporate additional data reflecting the air-to-air war.

14. John F. Kreis, *Air Warfare and Air Base Defense, 1914–1973* (Washington, D.C.: Office of Air Force History, 1988), 311-17; in the first two days, Israeli Air Force pilots shot down 58 aircraft in dogfights, but this paled beside the estimated 451 Arab aircraft destroyed on the ground.

15. Frederick C. Blesse, "No Guts, No Glory!" reprinted by the Headquarters 57th Tactical Training Wing, Tactical Air Command, in the *USAF Fighter Weapons Review*, 1977, 26–30, 55.

16. Holloway, 9.

17. Nichols and Tillman, 85–86; Futrell et al., *Aces*, 124–25, 154.

18. Rothman, 58–59. I also wish to acknowledge discussions I have had with George Spangenberg, former chief designer of Naval Air Systems Command, and, in particular, two memos that he sent to me: memorandum for record, subject: Multi-Service Aircraft Procurements, 30 August 1974; and memorandum for record, subject: The VFAX/ACF Program—A Review, 21 October 1974.

19. Rothman, 60, 62; Knaack, 334–35; Jacob Neufeld, *The F-15 Eagle: Origins and Development, 1964–1972* (Washington, D.C.: Office of Air Force History, November 1974), 6–19. The Neufeld work is a classified study at the SECRET level, but a "sanitized" version exists and thus the references cited in this paper to the Neufeld work are to unclassified material. I wish to thank Bill Heimdahl of the Office of Air Force History for making the sanitized version available.

20. Neufeld, 18; W. B. Herbst, "Dynamics of Air Combat," *AIAA Journal of Aircraft* 20, no. 7 (July 1983): 594–98; and Klaus Huenecke, *Modern Combat Aircraft Design* (Annapolis, Md.: Naval Institute Press, 1987), 202–8. The cockpit perspective is thoroughly presented in Robert L. Shaw's *Fighter Combat: Tactics and Maneuvering* (Annapolis, Md.: Naval Institute Press, 1985); particularly useful is the discussion on pages 387–417 regarding fighter aircraft performance. For an interesting "speed is life" counterpoint to some of this, see Mike Straight, "Being Fast," *USAF Fighter Weapons Review*, Spring 1989, 4–7. This persistent interest in the dogfight arena, coupled with Boyd's continuing championing of highly agile fighters able to transit from low- to high-energy states, has led to the creation of a new field of inquiry—"agility metrics," which is the search for meaningful air combat measures of merit to help designers and pilots come to grips with the challenge of future air combat. See William L. Hamilton and Andrew M. Skow, "Operational Utility Survey: Supermaneuverability," Technical Report 84-04 (Torrance, Calif.: Eidetics International, September 1984); and Andrew Skow, *Advanced Fighter Agility Metrics* (Torrance, Calif.: Eidetics International, July 1985); I have benefited from discussions with Skow; Col John Taylor, USAF, Retired; and Col Jim Manly, USAF, Retired, of the Eidetics staff. The "design requirements" side was well captured in a General Dynamics presentation of 1981; see Herbert F. Rogers, "Expectations for the Future: Military Aircraft" (Paper presented at the International Aerospace Symposium, Paris, France, 3 June 1981).

21. Holloway, 8.

22. Private recollection of Col William J. ("Pete") Knight, USAF, Retired, who worked in the F-15 System Project Office at Wright-Patterson AFB, Ohio.

23. Neufeld, 44–63; Rothman, 60–61; Tom Lennon and Jim Wray, *Bringing the F-15 to Operational Readiness* (Langley AFB, Va.: 1st Tactical Fighter Wing, June 1977).

24. Neufeld, 64–65; Rothman, 62–63.

25. Deborah L. Gable, "Acquisition of the F-16 Fighting Falcon (1972–1980)," Report 87-0900 (Maxwell AFB, Ala.: Air Command and Staff College, 1987), is a useful survey, copy in the history files at Headquarters Air Force Systems Command; Rothman, 62–65. Like the F-15, the F-16 proved infinitely more tractable than its century-series forebears. Further, I have benefited from conversations regarding the F-16's flight control system with three noted test pilots who shepherded the plane from its YF-16 phase into full-scale development and on into operational service: Phillip Oestricher; Col Robert C. Ettinger, USAF, Retired; and Col David Milam, USAF. See also Spangenberg's VFAX/ACF program memorandum. All aircraft tend to have quirks and faults of one sort or another. Unfortunately, the very earliest production models of the F/A-18 have experienced significant problems with structural cracks, and this condition may limit the service lives of some 61 airplanes. See Barbara Amouyal and Robert Holzer, "Structural Flaws Halve Life of Early F/A-18 Hornets," *Defense News*, 20 November 1989, 3. Somewhat balancing this is that as a combat airplane, the Hornet has been very impressive to its flight and ground crews from performance, reliability, and maintainability standpoints. The Navy is planning to procure a total of 1,157 Hornets.

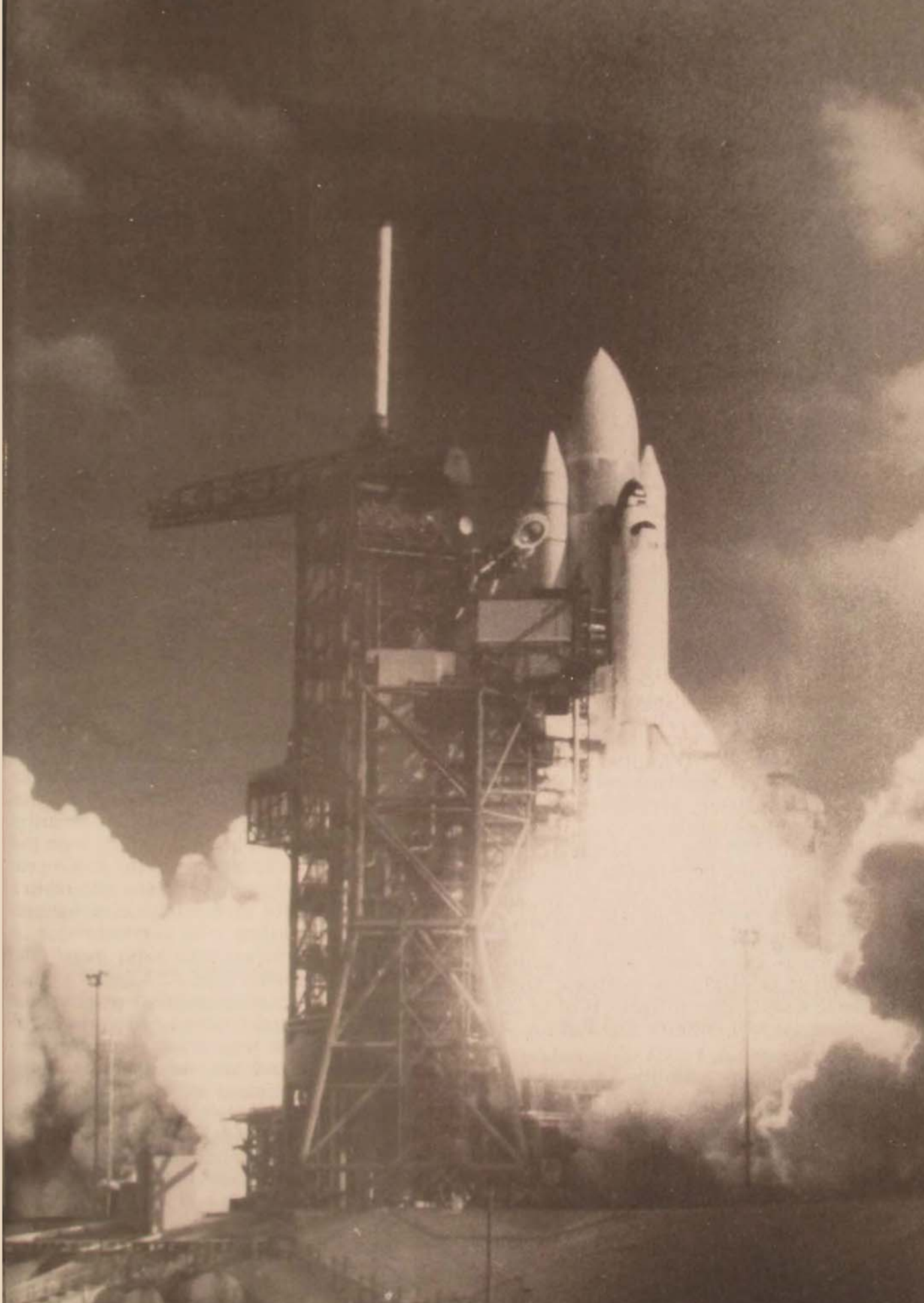
26. See General Randolph's speech cited in note 2; see Robert P. Lyons, Jr., "The Search for an Advanced Fighter: A History from the XF-108 to the Advanced Tactical Fighter," Report 86-1575 (Maxwell AFB, Ala.: Air Command and Staff College, 1986), 38–49. Also, I have benefited from conversations at Edwards Air Force Base on the F-15E, F-16XL, and F-20 aircraft with Col Mart Bushnell, USAF; Col Ed Thomas, USAF; Col Jim Doolittle, USAF; Brig Gen Charles ("Chuck") Yeager, USAF, Retired; and Col Pete Knight, USAF, Retired. There are two other programs that should be mentioned in passing: the Marine/McDonnell Douglas AV-8B Harrier II VSTOL, and the Air Force/Lockheed F-117 "stealth" fighter. Both of these were special-purpose airplanes developed to meet particular service needs. Though largely beyond the scope of this paper, it is worth noting that both have been successful programs, and both point to demonstrable future fighter needs: STOL and perhaps vertical-takeoff-and-landing (VTOL) performance, and reducing observable signatures.

SPACE CONTROL IN THE POST-COLD WAR ERA

THE LAST 10 years saw an advancement of a US military presence in space unlike any peacetime expansion of a new theater of operations. The creation of the Air Force Space Command (AFSPACECOM) and the US Space Command (USSPACECOM), together with the visions of the Strategic Defense Initiative (SDI), gave the impression that the United States intended to pursue a military presence in space with the same vigor that it used to strengthen strategic offensive forces in the 1950s and 1960s. At the close of the eighties, however, the tensions between the East and West that caused such a buildup began to crumble with the Berlin wall. The likelihood of large-scale combat in Europe and strategic confrontation with the USSR continues to diminish. At first blush, this outbreak of peace would seem to spell the end of any expansion of a military role in space. If no space-faring nation is an enemy, why should the United States bother with a space military? The answer is that, as the superpowers loosen their sway over the other countries of the world, the number of nations with the potential to create crises—with or without nuclear weapons—increases.

Furthermore, for most of the space age, space systems merely augmented terrestrial systems and operations. Over the past 10 years, however, the situation has reversed, and many terrestrial systems now augment or serve as backups for space systems. Such is the case in communica-

CAPT JOHN W. POWER, USAF



tions, weather, navigation, and reconnaissance. This trend holds true not only for military systems but also for large commercial industries. Thus, the rapidly changing world order and the dependence of US military and industrial assets on space systems justify the need for a US space control capability.

During the eighties, the subject of space control devolved into a discussion of space weapons, whether simple antisatellite (ASAT) weapons or the complex systems of SDI. Such weapons, however, make up only one of the components for real space control. That is, space control entails both free access to space and the ability to deny this access to a potential enemy. Further, one must remember that control does not necessarily imply deterrence. The latter is a political rather than a military concept. To assure true space control, the United States must secure access to space before it develops weapons to deny access to others.

Establishing Access to Space

In *On Space Warfare: A Space Power Doctrine*, Lt Col David Lupton outlines what he considers the five pillars of space power: logistics, personnel, reconnaissance and surveillance, weapons, and organization of forces.[1] Interestingly, he places logistics first. Indeed, since logistics includes the launch systems for getting into space, this ranking makes sense. After all, space-control weapons that lack the means to access space are little more than small-scale doomsday weapons. The ability to deny access to space is of little consequence to a country that has no access itself.

Air Force Doctrine on Access to Space

The type of force needed to access space is different from the one needed to deny access. Lupton illustrates this difference by using a naval analogy. For example, the logistics of accessing space are comparable to the function of a merchant fleet. Moreover, weapons for denying access to space are analogous to submarines and surface ships that strike against other ocean vessels. This analogy is also implicit in the basic principles of the US space program contained in AFM 1–6, *Military Space Doctrine:*

> [The United States] rejects any claims to sovereignty by any nation over space or over celestial bodies, or any portion thereof, and rejects any limitations on the fundamental right to acquire data from space.
>
> [The United States] considers the space systems of any nation to be national property with the right of passage through and operation in space without interference. Purposeful interference with space systems shall be viewed as an infringement upon sovereign rights.[2]

Terms such as *right of passage* bring to mind the right of passage in international waters, just as referring to spacecraft as national property is in keeping with current tenets of international law on the high seas.

But AFM 1–6 fails to adequately address the duality of space control (in fact, the term *space control* does not appear in the document). Rather, the manual speaks somewhat haphazardly about a duality of programs: military (i.e., national security) and civilian. The portion dealing with the national security aspects of the space program and what should be done turns into a laundry list of technological programs (e.g., those dealing with survivability and endurance) and systems being developed or already fielded (e.g., ASAT, early warning). Although the manual states that "the Air Force must continue to prepare for quick reaction launch and short-time regeneration and turn-around for space launches from more survivable facilities," one must note that this comment on launch capability appears in the section on future activities.[3] Thus, Air Force doctrine considers the capability for space access, including launchers and logistics support,

The centerpiece of US space efforts for over a decade, the space shuttle represents the vague demarcation between military and civilian space efforts. By relying on the space shuttle, we may have done serious harm to our military's ability to access space in wartime.

to be of secondary importance—it can be added later.

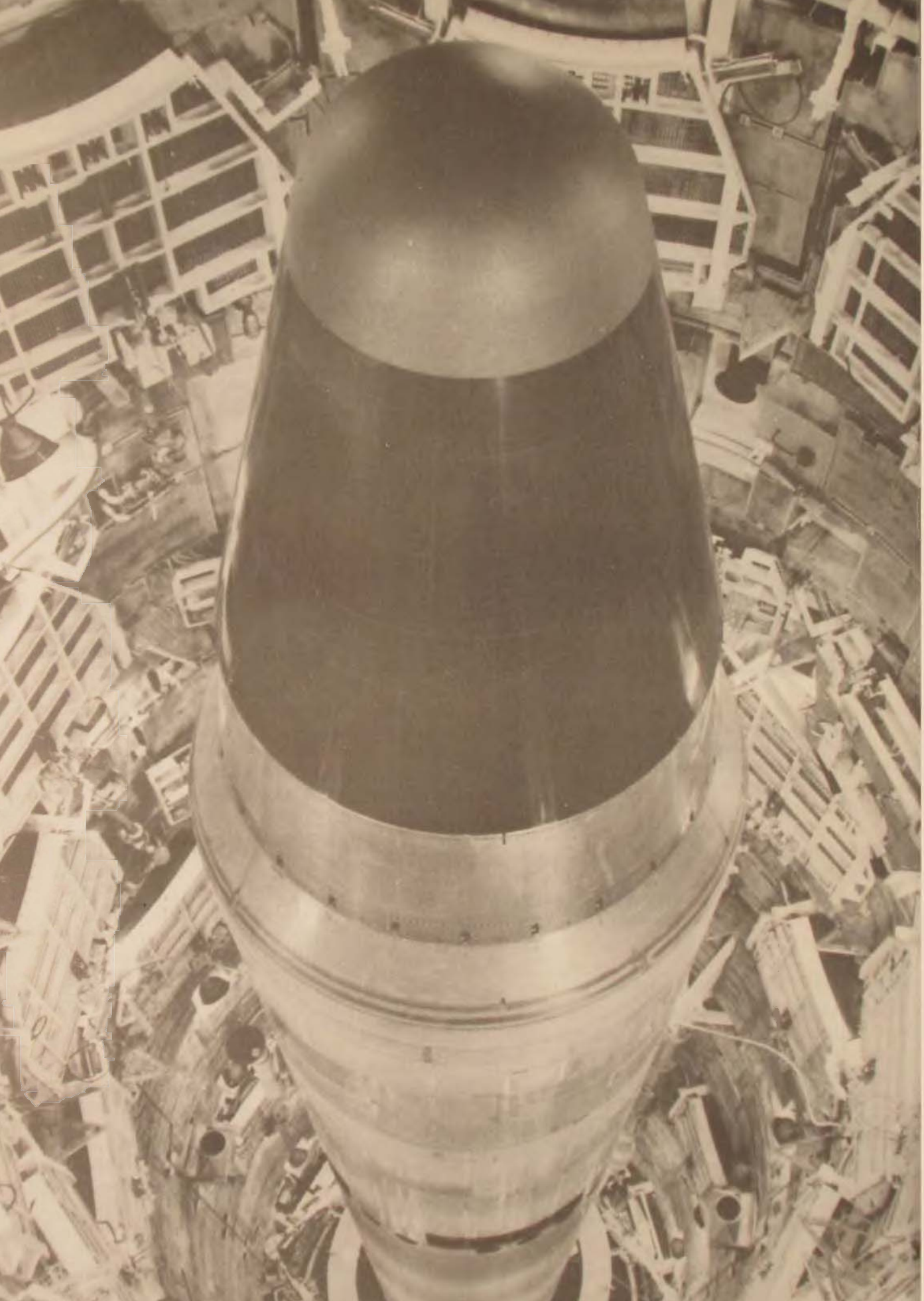
Military Views on Access to Space

At least two senior commanders recognize the two facets of space control, if not their relative importance. Gen John L. Piotrowski, commander in chief of USSPACECOM, points out that the current US space infrastructure is not adequate for war fighting.[4] He also emphasizes that the needs of battlefield commanders demand that US launch capabilities have speed and flexibility:

> The launch structure must be capable of reconstituting degraded or destroyed spacecraft on demand. To this end, then, operational requirements must drive the design and development of space systems, launch vehicles and launch priorities.[5]

Gen Crosbie E. Saint, commander in chief of US Army in Europe, is also aware of deficiencies in our wartime launch capability and worries that the Soviets could replace all of their satellites in two or three months, assuming they have spares on hand.[6] Nevertheless, General Saint believes that ASATs are more important to the US than is launch capability:

> The contemporary NATO commander wants to see the entire battlefield. And he fully appreciates that the side which controls space may well prove to be the victor. From my forward-deployed observation post, I see an effective ASAT system as the key to the control of space and also conceivably as the key to victory.[7]



Similarly, General Piotrowski emphasizes weaponry rather than launch capability:

> Even worse, our current space force is one-dimensional. It has no offensive capability. We lack an anti-satellite system to deny the enemy the combat support he desires from space.[8]

Furthermore, General Piotrowski's recent article in US Naval Institute *Proceedings* reveals his preference for denial of access as a means of space control. He argues that the US needs the ASAT because the Soviets will use space as a force multiplier to increase the cost-effectiveness of forces constrained by shrinking budgets.[9] Yet, he does not advocate that the US use space as a force multiplier by enhancing its space-support infrastructure. Like Air Force doctrine, both commanders emphasize the offensive aspect of space control—the ASAT.

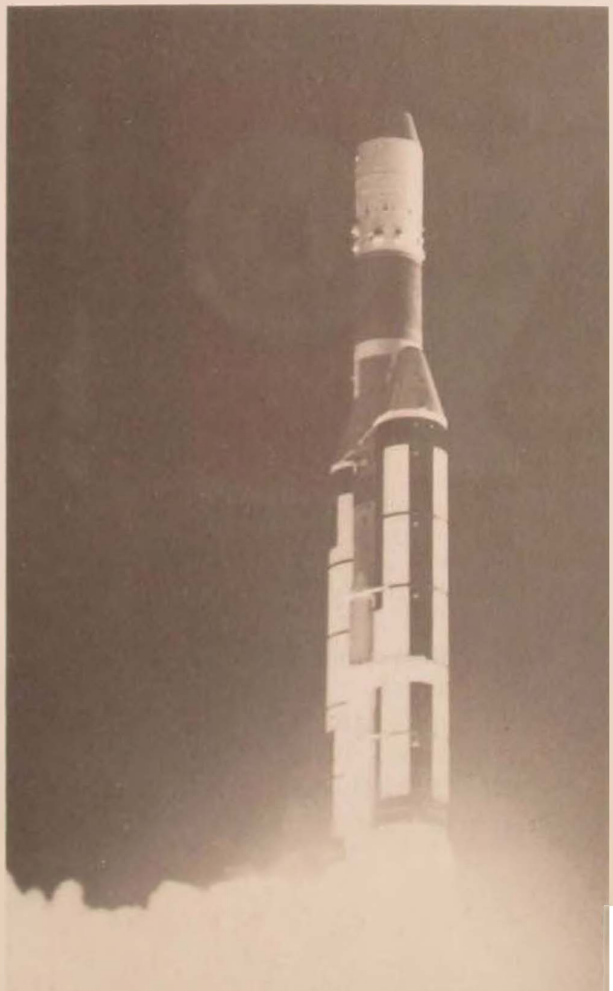
Problems with ASATs

Although ASAT weapons are an integral part of space control, they probably should not have first priority for several reasons. First, the last 15 years have seen considerable resistance to ASAT weapons, and there is no reason to think it will lessen, particularly with the easing of East-West tensions. For example, the congressional ban on ASAT testing prevented tests of the F-15 miniature homing vehicle (MHV) ASAT:

> The Secretary of Defense may not carry out a test of the Space Defense System (anti-satellite weapon) involving the miniature homing vehicle against an object in space until the President certifies to Congress that the Soviet Union has conducted, after the date of the enactment of this act, a test against an object in space of a dedicated antisatellite weapon.[10]

Ironically, the House Armed Services Committee has fully funded the new ASAT development effort currently headed by the Army and even added $20 million for laser research. Nevertheless, the committee banned use of the Navy's mid-infrared advanced chemical laser (MIRACL) at White Sands Missile Range, New Mexico, in tests against space targets.[11] Unless the world political situation changes and the Soviets resume ASAT testing, Congress is unlikely to allow anything other than lab testing of possible ASAT components.

Second, current budget constraints will likely prevent the approval of any new weapon system. Changes in Europe and attempts by Department of Defense (DOD) officials to cut $180 billion from the Five Year Defense Program (FYDP) during FY 1992 through FY 1994 will probably slow down or scrap the development of major weapon systems that already have strong constituencies.[12] Defense spending, which



Although the Air Force has about 54 Titan II missiles (left) on hand for future space launches, it has no comprehensive plan for accessing space in an emergency. Other heavy-lift vehicles, such as the Titan IIIC (right), are available for satellite launches during peacetime, but they require a long lead time and can be launched from only two sites in the US.

peaked in 1986 at 6.5 percent of the gross national product (GNP) has slipped to 6 percent of the GNP.[13]

Third, because of reliability problems with their satellites, the Soviets have to launch more of them during a given year than does the United States. Consequently, the Soviets have a greater surge or reconstitution ability in launch vehicles.[14] The point of an attrition strategy is to reduce enemy forces to prevent mission accomplishment and to prevent reduction of one's own forces. If I destroy 10 enemy satellites but my enemy launches 10 more and accomplishes his mission, then I lose. The US does not have the wartime launch capacity to make an ASAT attrition strategy credible.

Fourth, an ASAT war of attrition produces considerable collateral damage. Debris in a space war would act just like shrapnel in a terrestrial conflict. But shrapnel on earth falls to the ground in a few seconds, whereas debris in space continues in orbit—usually a very unpredictable one—until it hits something or falls into the atmosphere. A high-speed collision in space only serves to create more shrapnel. Hence, Carl von Clausewitz's "fog of war" takes on a deadly significance in space. The Soviets inadvertently demonstrated this fact during their ASAT testing in the seventies, which was responsible for 9 percent of the space objects currently tracked by the US military.[15] Conceivably, then, more US satellites could be destroyed by collateral damage than by direct Soviet attack.

The Need for Access to Space

Despite these formidable obstacles, military leaders should judge future systems by how well they will contribute to war fighting. If new systems such as the ASAT are truly needed to carry out national security policy, then the services should promote them. But USSPACECOM and AFSPACECOM should have a methodical approach to space control. If the United States continues to justify the ASAT on the grounds of its deterrent value, then our first priority should be the development of a responsive and survivable launch capability, which we will need to pursue a space war of attrition. Such a war demands much more than simply denying access to space; we must be able to reach space and quickly replace damaged or destroyed systems. The bottom line is that the US must be able to accomplish its mission.

Military Launch Systems. Having access to space is also essential for the effective monitoring of incidents short of war. Controlling a crisis may require that space surveillance and reconnaissance assets be changed or moved rapidly by means of inexpensive, quick-reaction systems. Alternatively, the US could maintain enough systems in orbit for constant global coverage or modify orbiting assets for multiple orbit changes. Although these measures satisfy the need for flexibility while monitoring a crisis, they do not address the problem of rapid replacement if the crisis escalates. That scenario calls for an adequate launch capability and accompanying logistics support. The Air Force is already studying these matters through its responsive replacement vehicle and its tactical satellite (TACSAT) programs.[16] The Army and Navy are also looking into the use of small, quickly launched satellites for communications and reconnaissance.[17] Furthermore, the British Defence Ministry is studying a proposal to use rings of two-pound satellites (Nanosats) for communications with deployed troops.[18] Help in establishing a responsive launch capability may also come from US industry and research groups.

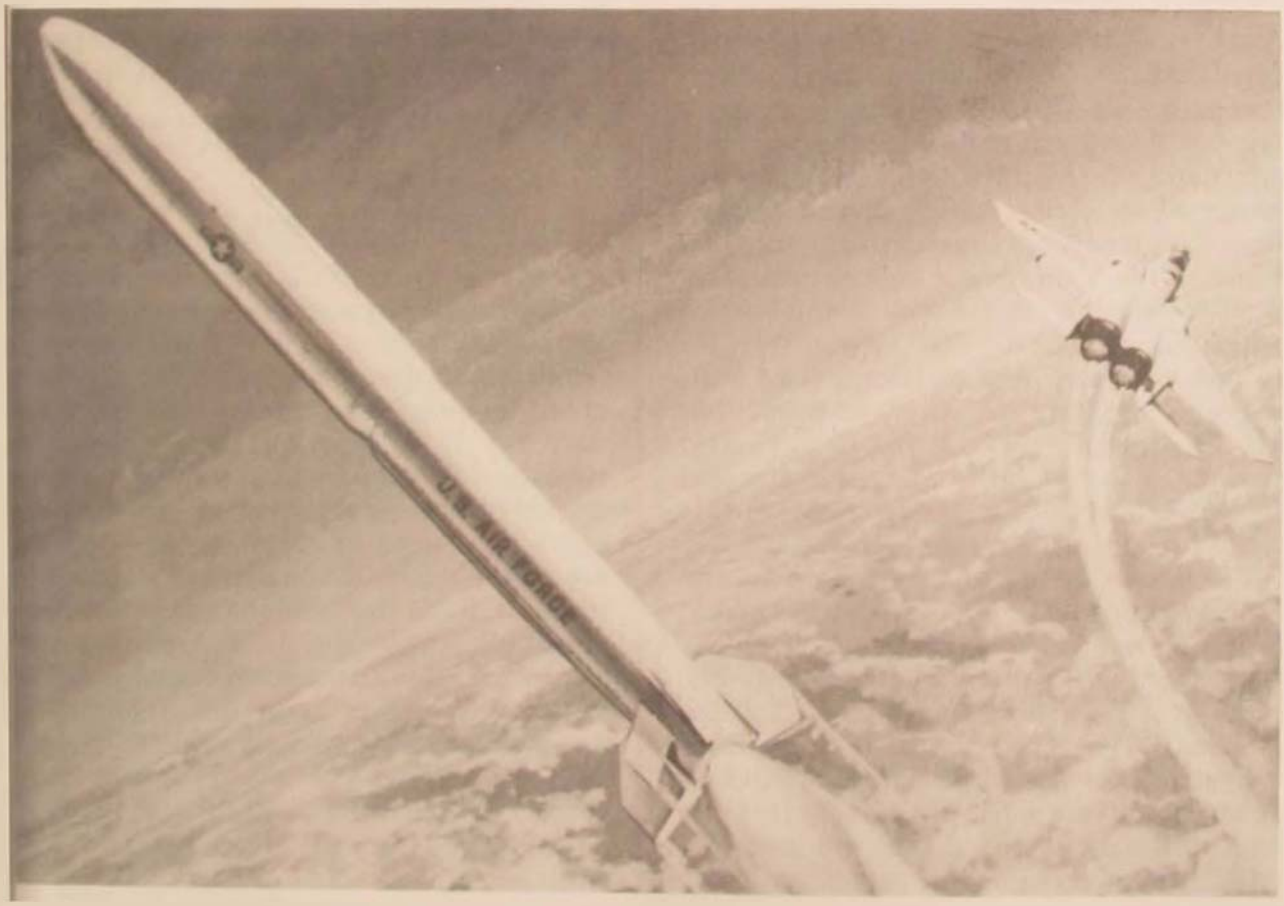
Commercial Launch Systems. Orbital Science Corporation (OSC) of Fairfax, Virginia, produces the Pegasus and Taurus launchers. Fifty feet long and 50 inches in diameter, the delta-wing Pegasus uses solid propellant and resembles an overgrown cruise missile. Currently launched from the National Aeronautical and Space Administration's B-52 at Edwards AFB,

California, the Pegasus is designed to put a 500-pound payload in a 300-nautical-mile polar orbit. Assuming that the booster sections are already mated, launch time from arrival of the payload is six days.[19] At least two launches of the Pegasus are scheduled for 1990.[20] Still in the concept phase is OSC's Taurus, essentially a ground-launched Pegasus, minus the wing and control fins, mounted atop a Peacekeeper first stage. This launch vehicle could put 3,000 pounds in low polar orbit or 3,700 pounds in low earth orbit (due east). The proposed timeline for a Taurus mission is 19 days from analysis of mission requirements to postflight activities.[21] Conceivably, predeployment of the system with an inventory of standard satellite packages could reduce this time even further.

Our senior military leadership argues that an ASAT system is necessary for space control, but it may do more harm than good. We should explore other defensive means and establish a quick, reliable relaunch capability.

The rail gun is another source of quick-launch capability. The advanced applications group at Lawrence Livermore National Laboratory in California is planning to launch a small projectile in a 200-kilometer suborbital flight in January 1991 using a rail gun known as a hydrogen gas coil gun. The Livermore group is one of three organizations in the US exploring the use of coil guns to boost small payloads into orbit. A full-scale, gas-powered coil gun would cost about $467 million, would be three-quarters of a mile long, and could put a 4,000-kilogram payload into orbit. Because coil guns subject their payloads to high G forces, these devices are suitable for launching only raw materials or machinery.[22]

In addition to quick-reaction boosters,



the commercial space industry is exploring the use of small, simple satellites like the Air Force's TACSAT. For example, Orbital Science Corporation has requested Federal Communications Commission approval to orbit 20 small satellites (330 pounds each) in 600-mile orbits to provide short message transmission and position data.[23] And Hughes Aircraft Company wishes to launch a 250-pound, remote-sensing, commercial satellite known as a sea wide field sensor (SeaWiFS) into a 700-kilometer polar orbit to monitor oceans for fishing and environmental interests.[24]

Such efforts are a good start, but they need to be tied to a clear, cohesive plan for space control. If this launch capability is portrayed as nothing more than a desirable augmentation to terrestrial operations, it has little chance of surviving a climate of economic austerity.

Defensive Weapons

After establishing an operational launch capability, the United States must protect its space assets with defensive weapons—but not ASATs. Whereas most arguments advocating ASATs are couched in the language of deterrence (i.e., offense as defense), defensive weapons in the military sense of the term are for protection rather than retaliation. In AFM 1–6, the United States asserts that it "will pursue activities in space in support of its right of self-defense."[25] Certainly, there is precedent for this assertion. Returning to our naval analogy, a carrier task force projects naval air power but dedicates quite a bit of this capability to protecting itself. Indeed, US F-14s shot down Libyan MiGs over the Mediterranean in defense of a US carrier. Self-defense on the high seas is an accepted principle of international law. The same principle should hold true for space systems.

Systems developed to defend high-value space assets are both politically feasible and militarily useful. If they are designed with little or no offensive capability, these weapons could help blunt an enemy ASAT attack yet pose no threat to other nations. Kinetic kill vehicles (KKV) seem best suited for this purpose. These self-guided missiles have a limited range and a discriminating kill mechanism (i.e., direct transfer of kinetic energy by collision). In contrast, a nuclear or high-explosive projectile has a less discriminating kill mechanism and, therefore, greater potential as an offensive weapon. Similarly, directed energy weapons such as lasers and particle beams are quite discriminating but perhaps more powerful than necessary for this purpose. Furthermore, their long range makes them easily adaptable to an offensive role.

High-value, low-orbit reconnaissance satellites are logical choices for KKV protection. As with naval vessels, the US would establish a keep-out zone encompassing protected satellites and warn other space-faring nations against interfering with these satellites. Thus, a KKV attack on unauthorized spacecraft would constitute a defense of national property rather than an offensive threat to other satellites.

Denying Access to Space

Only after establishing an effective launch capability and a system for defending satellites should the United States turn its efforts to denying adversaries access to space by means of offensive weapons (e.g., ASATs). One must question, however, whether this objective would best be served by a ground-based ASAT—the type currently being pursued. These systems are restricted in that the targets must come to them. Even the miniature homing vehicle developed by the Air Force to be fired from an F-15—although theoretically deployable to any air base—had to launch in a specific window against selected targets. Such ASAT systems have the operational characteristics of coastal artillery: they are quite deadly, but only if the enemy comes close enough.

More probably, the best way to deny access to space is by using space-based weapons. Lupton described the use of a space cruiser armed with either kinetic-energy or directed-energy weapons and operated like a warship.[26] In fact, both types of weapons would be useful. The kinetic-energy weapons—the KKVs—would protect the cruiser, while the directed-energy weapon—either a laser or a neutral particle beam—would fire on enemy satellites. The long-range feature of directed-energy weapons makes them well suited for warfare in space, where vast distances between spacecraft would be the norm. Granted, such a cruiser would be difficult to field in the short term. This article, however, assumes a methodical buildup of space capability. Therefore, when the time came to consider building such a vehicle, after the launch and defensive systems were in place, the step would be evolutionary rather than revolutionary.

Conclusion

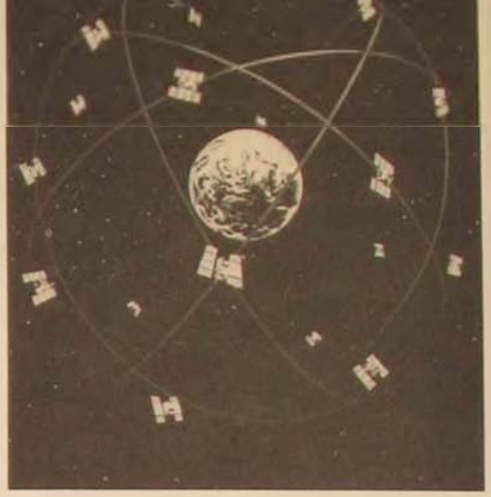
Clearly, current space doctrine and public pronouncements of military commanders indicate that space control should be a high priority for US armed forces. Indeed, it stands to reason that some form of space control is necessary to ensure that the US can quickly react to changing world events. Political and budgetary constraints in the post-cold war era, however, may preclude development of the offensive aspects of space control systems until a more tangible threat emerges. But the Air Force should not abandon its plans for space control in the face of such constraints against ASAT systems. Rather, it should rearrange its priorities to facilitate the development of operational launch systems and active defense systems for high-value space platforms, thereby establishing a foundation for further operations in space. □

Notes

1. Lt Col David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell AFB, Ala.: Air University Press, June 1988), 127.
2. AFM 1-6, *Military Space Doctrine*, 15 October 1982, 2.
3. Ibid., 9.
4. Gen John L. Piotrowski, "The Right Space Tools," *Military Forum* 5, no. 5 (March 1989): 46.
5. Ibid., 48.
6. Gen Crosbie E. Saint, "CINCUSAREUR Places High Priority on ASAT," *Armed Forces Journal International* 127, no. 2 (September 1989): 40.
7. Ibid.
8. Piotrowski, 47.
9. Gen John L. Piotrowski, "A Joint Effort," US Naval Institute *Proceedings* 116, no. 2 (February 1990): 33-34.
10. Text of law quoted in Les AuCoin, "ASATs and American Security Don't Mix," *Defense Science* 7, no. 6 (June 1988): 37.
11. Patricia A. Gilmartin, "Defense Dept. to Launch Design Competition for New Antisatellite Weapon for the 1990s," *Aviation Week & Space Technology* 131, no. 4 (24 July 1989): 30.
12. Susan Dentzer, "The Peace Outbreak Sparks a War on Defense Spending," *U.S. News & World Report* 107, no. 22 (4 December 1989): 52.
13. Ibid., 51.
14. William J. Durch, *Anti-Satellite Weapons, Arms Control Options, and the Military Use of Space* (Cambridge, Mass.: President and Fellows of Harvard College, 1984), 7.
15. Nicholas L. Johnson, "Artificial Satellite Break-Ups (Part 2): Soviet Anti-Satellite Programme," *Journal of the British Interplanetary Society* 30, no. 8 (August 1983): 357.
16. Neil Munro, "Air Force Eyes New Generation of Small, Multirole Satellites," *Defense News* 4, no. 48 (27 November 1989): 3, 26.
17. Vincent Kiernan, "Military Plans Tacsat System," *Space News*, 13 November 1989, 45.
18. Joan Wisner-Carlson, "British Study Novel Plan for Softball-Sized Tactical Satellites," *Space News* 1, no. 9 (12-18 March 1990): 6.
19. Orbital Science Corporation, *Pegasus Payload Users Guide* (Fairfax, Va.: OSC, December 1988), 1, 17, 23.
20. Lon Rains, "Changes Prompt DARPA Request for Third Airborne Pegasus Test," *Space News* 1, no. 2 (22-28 January 1990): 28.
21. Orbital Science Corporation, *Taurus Standard Small Launch Vehicle*," briefing to the Defense Advance Research Projects Agency, September 1989, 3, 19, 22, 24.
22. Lon Rains, "Livermore Plans Gun Launch Test," *Space News* 1, no. 7 (26 February–4 March 1990): 3, 21.
23. Daniel J. Marcus, "Orbital Enters Small Satellite Market," *Space News* 1, no. 9 (12–18 March 1990): 19.
24. James R. Asker, "Hughes May Build Lightsat to Gather Ocean Data," *Aviation Week & Space Technology* 131, no. 16 (16 October 1989): 24.
25. AFM 1-6, 2.
26. Lupton, 141.

THE AIR FORCE IN THE TWENTY-FIRST CENTURY

CHALLENGE AND RESPONSE



LT COL PHILLIP S. MEILINGER, USAF

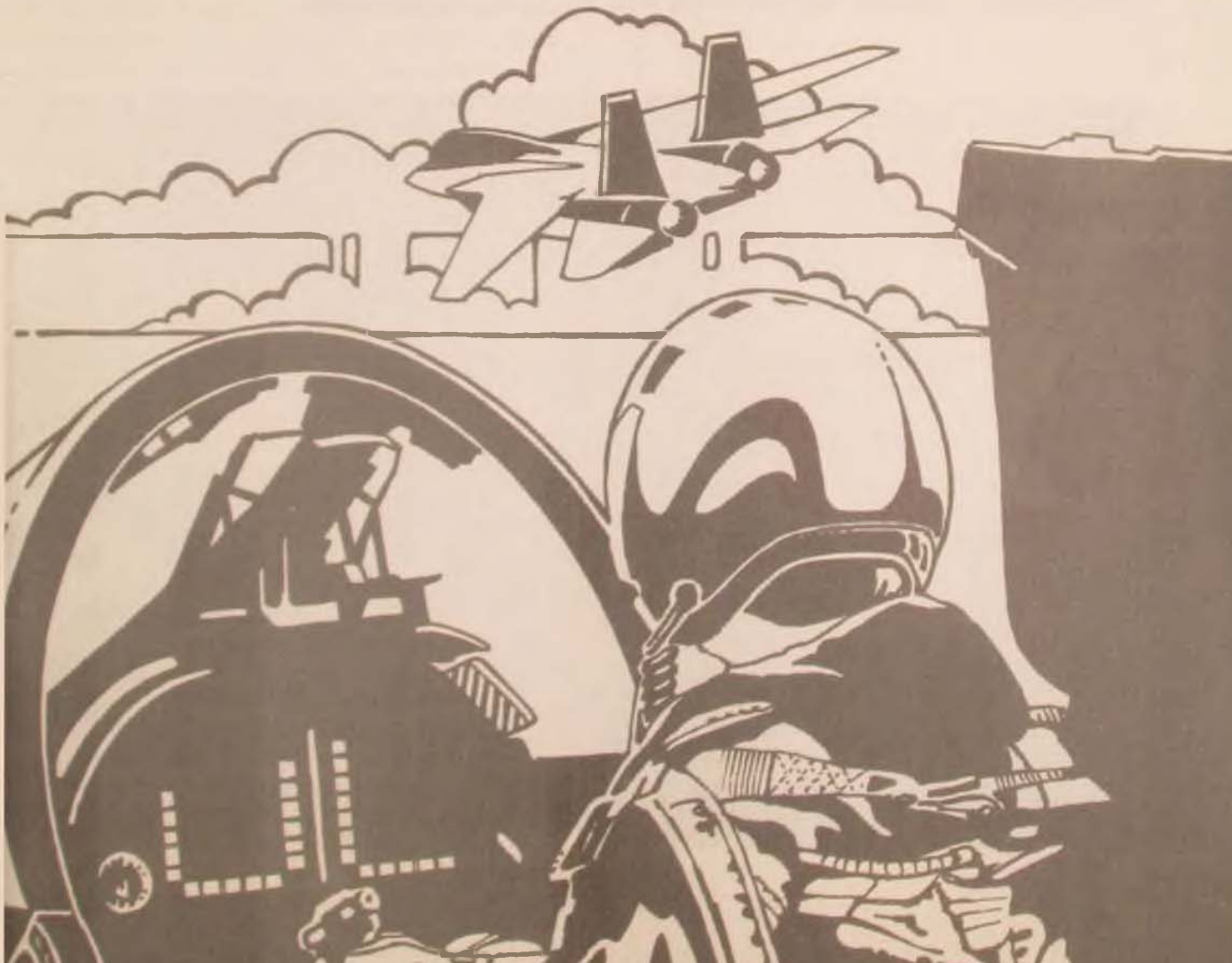
BY THE year 2000, the United States military will be completely new. The fundamental assumptions that have governed its size, composition, and focus have been unhinged in a staggeringly short period of time. The perception of a diminished military threat, combined with economic im-

peratives occasioned by record budget deficits, will produce enormous changes. Whom, when, where, and how the military will fight (if, indeed, it is necessary to fight at all) have become basic questions. It is essential that our military and civilian leaders consider this situation with open, flexible minds. The world will always be a dangerous place in which to live; such is human nature. Thus, the US has a vital interest in minimizing the dangers and risks that it faces. The world is changing, and we must change along with it. Specifically, the US Air Force must adjust to meet the challenges of a far different environment.

By employing the following process, we can clarify our vision of the future Air Force: (1) project the likely threats to US interests (as defined by our civilian leaders), (2) note the probable constraints on the use of our military forces that would deal with those threats, (3) determine the capabilities that aerospace weapons would need to meet such threats within the designated limits, (4) outline the type of force structure that would most effectively execute those capabilities, and (5) examine the support infrastructure needed to complement that force structure. This approach, though necessarily broad, is intended to generate thought on some fundamental issues regarding our Air Force.

Threats

Attempting to predict what will happen in Europe is practically useless because changes there are occurring rapidly and unexpectedly. Nonetheless, any discussion of US security must address the situation on the Continent. Because of the Soviet Union's enormous store of thermonuclear

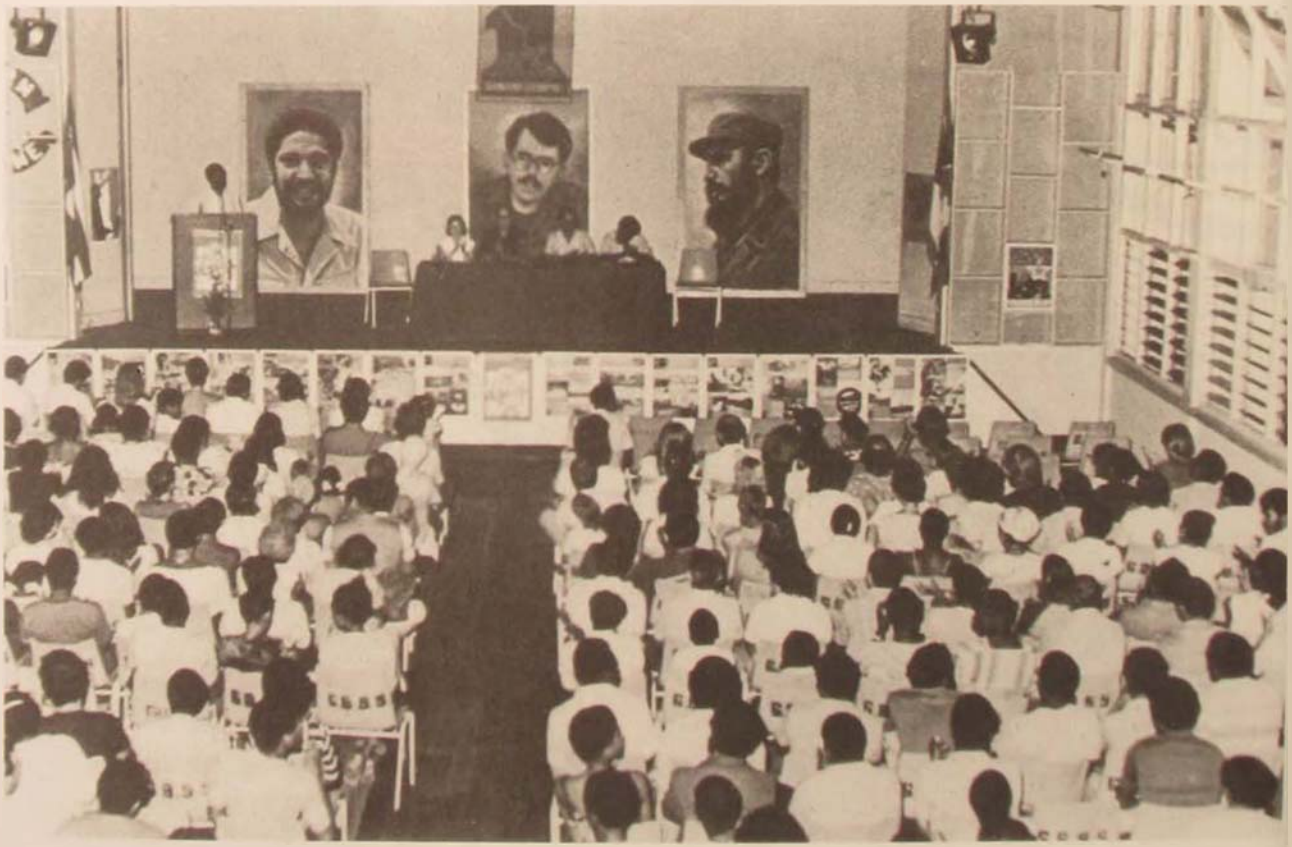


weapons and delivery vehicles, the USSR remains the major military threat to US interests for the foreseeable future. Although the military aspects of this threat should continue to diminish as *perestroika* progresses and the Soviets cut their forces, they will remain potentially dangerous adversaries, capable of inflicting massive damage on the US and its allies. Indeed, ignoring their impressive military capabilities would be irresponsible. However, the number of Soviet troops and equipment confronting the North Atlantic Treaty Organization (NATO) should drop dramatically. Fragmentation of the Warsaw Pact will also serve to lessen tension. Further, the captive nations of Eastern Europe have always been questionable allies for the Soviets, and this centrifugal tendency is continuing. In fact, it is now almost impossible to imagine any of the Eastern European countries participating in an attack on the West.

Competition between East and West will certainly not disappear; it may even intensify in the economic arena. Under the right stimuli, the Soviet economy could develop markedly. Indeed, a reformed Soviet economy based increasingly on capitalist principles could turn the USSR into a major competitor. Even under optimistic scenarios, though, the Soviet Union will not become an economic giant for some time, but the country has great natural resources and a large population. Further, the quantity and quality of Soviet military forces attest to the competence of the USSR's industrial leaders and engineers.

Therefore, although the Soviet threat should decrease in military terms, at some point in the future it may take the form of an economic rivalry that could eventually lead to a renewal of the military threat.

Although ideologically based revolution supported by outside sponsors may decrease in the future, the US military must remain prepared to deal with the ongoing threat posed by insurgency and rebellion.



Such was the pattern of mercantilism and conflict in the sixteenth through nineteenth centuries.[1] Furthermore, once the Soviet Union rids itself of apathetic and lethargic allies, its streamlined and efficient bureaucracy could cultivate a more powerful economy. In other words, when the Soviet Union returns from wandering in the woods, it may be an even more formidable adversary than it is today.[2] We should also keep in mind that the world's fastest-growing economies are in Asia. Japan, South Korea, Taiwan, and other Pacific nations offer strenuous economic challenges to the US. Thus, conditions are right for the development of economic and military rivalries in this region as well.

The Soviet Union is not the only threat to the United States. Nationalism is an unpredictable and potentially violent force that can easily lead to war in a variety of locations. Nationalist aspirations of the Serbian minority living in the Austro-Hungarian Empire precipitated an assassination in the Balkans which in turn led to the First World War. Numerous ethnic minorities remain scattered among the nations of Eastern and Southeastern Europe. Clearly, their nationalist urges have not spent themselves, as indicated by events in the Baltic region and along the Soviet southern rim. Even though these movements talk loudly of democracy and freedom, we would do well to remember that the Liberty, Equality, and Fraternity proclaimed by the French Revolution led to 20 years of bloody wars that engulfed all of Europe. Moreover, the nations of Eastern Europe have often been in bitter conflict with one another for centuries. The Soviet empire and, to some extent, NATO have contained such squabbles for the past four decades; but old disputes, still smoldering, may relight once fresh air is allowed to sweep in.[3]

Related to the issue of nationalism and the quest for self-determination is the danger from people whose rising expectations have been frustrated. The information revolution has permitted people all over the globe to see the freedom, vitality, and—especially—the affluence of democracy and capitalism. Millions of East Europeans have crossed their borders in recent months merely to buy food and other goods unavailable in their own countries. Governments are bending to provide these benefits to their people, but antiquated and debilitating bureaucracies prevent true reform. Of course, even well-intentioned governments are discovering that prosperity is not a tap to be turned on and off at will. The Western democracies, for example, suffer periodic and severe bouts of recession, inflation, and unemployment, thus demonstrating that economics is indeed the dismal science. But the peoples of the world seem unwilling to wait for

We can expect drug trafficking—including state-sponsored involvement, such as this loading of cocaine in Central America—to be a threat for years to come. The United States must decide whether its response to this problem should include the use of military force.

gradual and incremental change. They neither understand nor appreciate the vagaries and complexities of markets and monetarism. Governments, therefore, may find it increasingly difficult to keep the lid on restive populations who, like Oliver Twist, want more.

Religious fanaticism is also an unpredictable and dangerous force. Weakened by war and the death of Khomeini, Iran's Islamic fundamentalism seems to be temporarily in check, but it is not extinguished. In addition, the festering wounds of religious wars in Lebanon and Northern Ireland show little sign of healing soon. Finally, liberation theology in Latin America also has within it the potential for violent conflict. For centuries, people have fought and died over religious beliefs; apparently, they will continue to do so.

Insurgencies have been the major source of third-world conflict since World War II. Conceivably, though, the theoretical basis for many of these insurgencies has been irrevocably shattered. Leaders in Moscow and Beijing have declared by their actions, if not their words, that Marxism/Leninism/Maoism is not the salvation originally thought. As Communist countries turn increasingly towards a more capitalist brand of socialism, Communist insurgencies worldwide may begin to lose both credibility and direction. The stunning elections in Nicaragua may be the harbinger of future trends. As have-nots battle haves, the world will always experience revolutions, but such conflicts may lose their ideological color. If the United States no longer believes itself threatened by a monolithic communism bent on world domination, it will be less inclined to intervene in third-world conflicts. The overthrow of governments, even those friendly to the US, will not seem as menacing if we realize that the Kremlin has played no role. We cannot concern ourselves with every tree that falls in the forest.

Terrorism, especially that related to the narcotics trade, is an increasing threat. Certainly, the drug problem is an issue of great concern to the American public. Drugs are big business, lucrative not only for drug lords but also for countless farmers, processors, transporters, and distributors as well. Andean drug traffickers are extremely well financed, well organized, and well armed. The Bolivian, Colombian, and Peruvian governments are having a difficult time trying to bring these ruffians to heel or—in some instances—deciding whether or not they *should* bring them to heel. The US, although anxious to do something active and constructive, has not yet formulated a coherent strategy to deal with this threat, but the use of military force could be an option.[4] The drug war could actually become a war in the usual sense of the word. We can also expect the more "traditional" forms of terrorism involving hijackings, bombings, and assassinations to continue. As in the past, the US will be a favored target.

All of these threats have proven volatile and dangerous over the past century, and the drug problem continues to grow. The potential for conflagrations affecting American interests is great, given the fact that technology is making third-world countries and insurgent/terrorist groups increasingly formidable adversaries. The proliferation of high-tech conventional weapons—as well as nuclear, biological, and chemical weapons—will soon make far more nations and groups a potential threat to the US.[5] For example, the chemical weapons and delivery capability of Iraq, combined with Saddam Hussein's demonstrated willingness to use these weapons, have caused widespread concern. US forces deploying to the Persian Gulf region for Operation Desert Shield are therefore equipped with chemical warfare protective clothing and equipment.

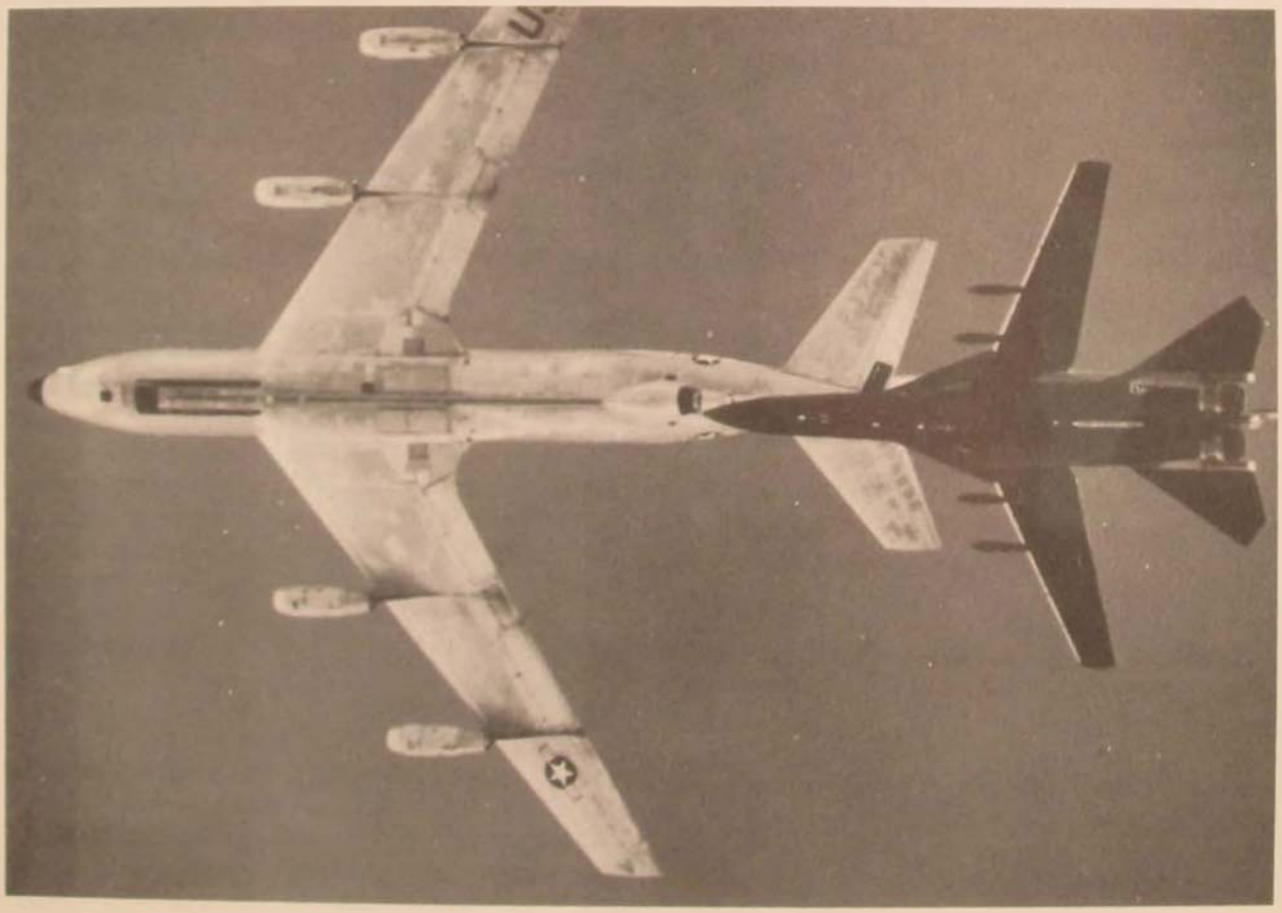
In sum, the varied threats facing the United States mandate that we develop a similar variety of responses. First and foremost, we must continue to deter nuclear war, since such a conflict would threaten our very existence. This deterrence entails maintaining not only a credible nuclear strike force, but also a sophisticated reconnaissance and surveillance system to monitor arms-limitation agreements and

potential trouble spots. Second, we must be capable of fighting in intense, localized conflicts generated by a civil war or by border disputes occurring in an area vital to American interests. Third, we must have the ability to launch a short-notice retaliatory, rescue, or punitive raid in reaction to a terrorist attack against the US or its citizens anywhere in the world. Thus, an increasingly diverse, multithreat world is being grafted onto the relatively stable and predictable bipolar environment of the postwar era, bringing both new hope and new dangers.

Limits on the Use of Force

More than likely, the Congress—and, ultimately, the American public—will impose limits on military actions designed to respond to the threats mentioned above. These constraints will be based both on tradition and our recent experience.

Due to the lessening of the Soviet threat, we can anticipate significant cuts in the defense budget over the next several years. The American people are not militaristic and have traditionally mistrusted large armies and entangling alliances. As a consequence, pressures will increase to cut defense spending and decrease overseas deployments/commitments. Therefore, our ability to project military power from American soil—or from international waters—will become increasingly important. Further, we can no longer expect to



Aerial-refueling capability, always a key part of American air power, will become even more important as the number of our forward-deployed troops diminishes and we revert to power projection from the CONUS.

maintain expensive and contentious bases overseas. Relatedly, the straitened economies of our allies will dictate severe cuts in their defense budgets as well. Disarmament talks and superpower initiatives will accelerate the pressure for demobilization among our allies, on whose military strength we depend to augment ours in the event of a European crisis.

The United States will not start a war and will react with a major military response only if vital interests are directly threatened. Panamanian dictator Manuel Noriega's declaration of war and subsequent attacks on American citizens are the types of actions that will produce US activity. Moreover, the US will be reluctant to respond to a low-level threat to a friend or ally. We would prefer to let countries take care of their own problems, although we may supply arms and economic aid (which will generally be of the "humanitarian" variety). This type of response is not surprising: the American public has not recovered from the Vietnam experience, and our isolationist impulse has always been strong. Indeed, recent events indicate its resurgence. If, however, Soviet involvement is obvious or if the area concerned is vital, we may act but will do so under the following constraints:

1. If possible, we will seldom provide conventional—therefore, highly visible—ground troops. Instead, we will use special operations forces. Large-scale operations, like those in Panama and the Persian Gulf region, will be an exception.

2. The draft will not be reintroduced, especially to fight the types of low-level conflicts that the future will likely bring. It is one thing to have volunteers and professional soldiers, sailors, and airmen fighting in covert operations overseas. It is quite another thing to send conscripts to fight in foreign wars. Once again the specter of Vietnam casts its shadow. Thus, we can expect limits on the manpower available to wage future conflicts.

3. If our ground troops are used, there will be great pressure to extract them quickly.[6] The American public is monumentally impatient with long wars and has a low threshold of pain regarding casualty figures. The loss of 58,000 Americans during the Vietnam War caused one of the greatest societal rifts in our history. The "American way of war" is to rely on technology, preferably in copious quantities, in order to save blood and to end wars quickly. The War Powers Resolution of 1973 certainly reinforces this predisposition.

4. If we apply air power in lieu of ground forces, we must do it with precision and minimal collateral damage. Even after 10 years of war in Vietnam, the Air Force took great pains to minimize civilian casualties during the climactic Linebacker II strikes of 1972. This same concern caused several pilots participating in the Libyan strike of 1986 not to release their ordnance because they were uncertain whether it would hit the designated targets.[7]

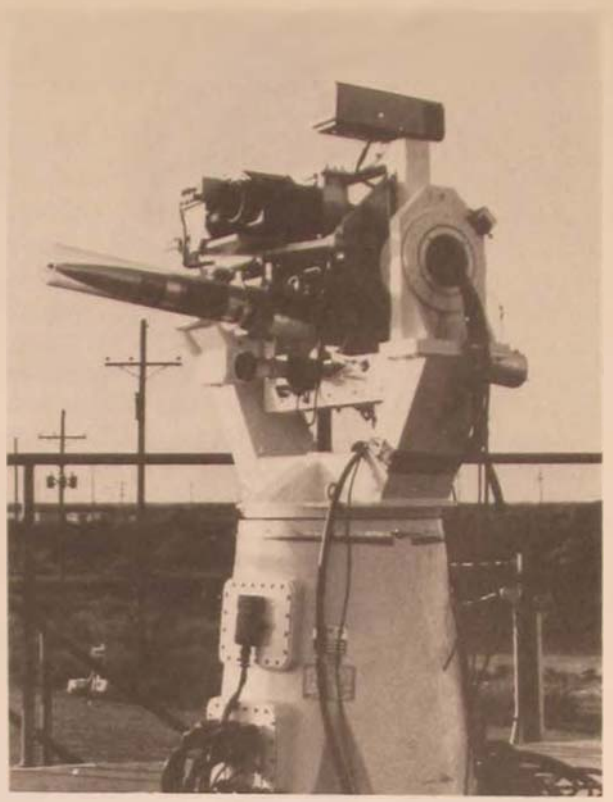
5. Civilian leaders will maintain extremely close control over military operations. Instant global communications have allowed the passing of near-real-time information from the field to Washington. Thus, most of our recent presidents have been unable to resist the temptation to become personally involved in military operations, even down to the tactical level. Tales of presidential intervention in the Cuban blockade, the Vietnam War, the *Mayaguez* incident, and the Iranian rescue attempt are well known.[8] Given the high stakes involved with world opinion and the sensitivity of political relations, the perceived need for such tight civilian control will not diminish.

Military Capabilities

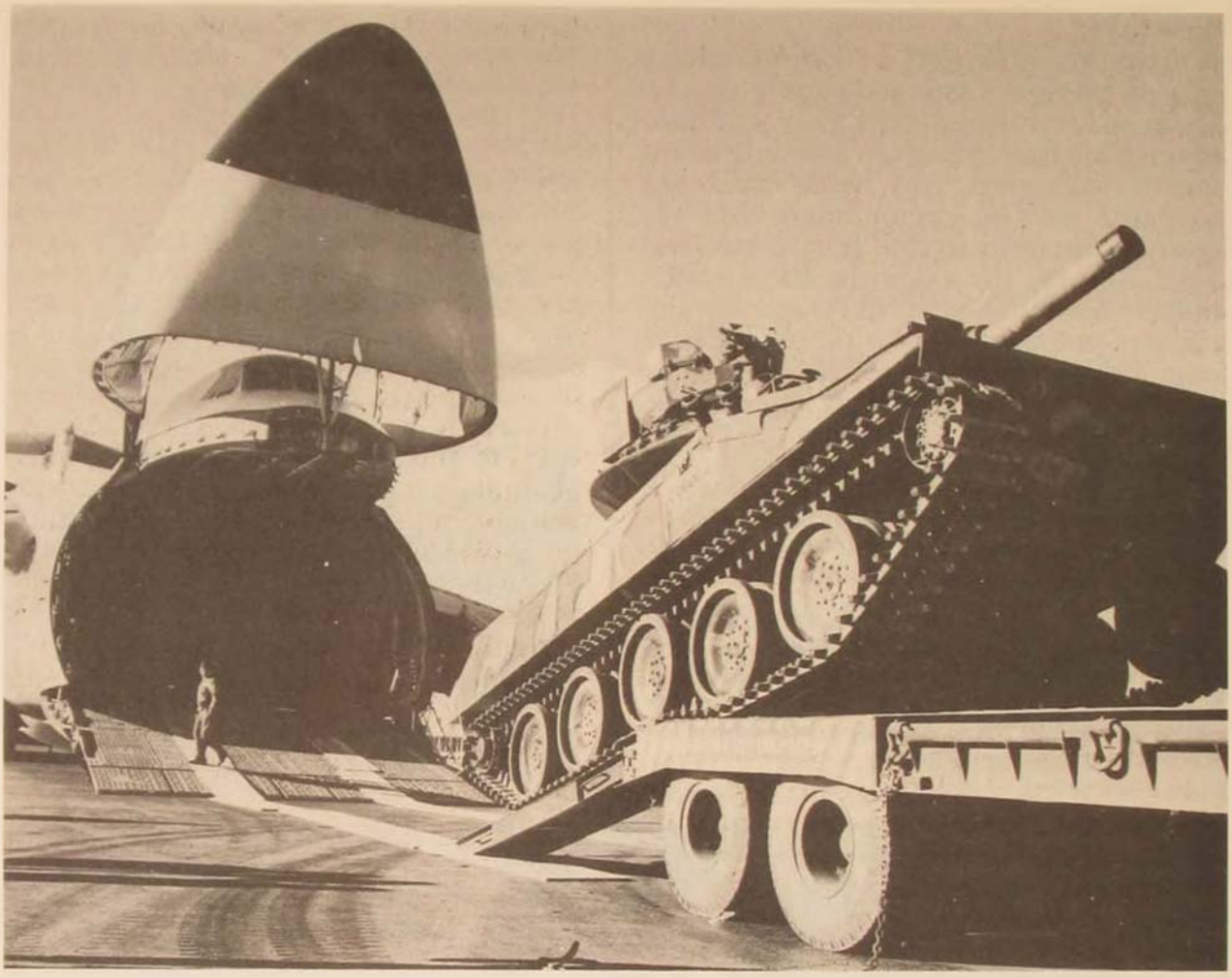
In order to confront threats, yet remain within domestically imposed limits, future US Air Force weapons systems will require certain capabilities.

Long Range

As mentioned earlier, we can no longer rely on overseas bases and supply depots. Quite possibly, future air strikes will have to originate from American soil or from international waters. Any bases remaining overseas will be encumbered with restraints imposed by the host countries. NATO bases, for example, have traditionally been limited to NATO activity: the US was not permitted to refuel at European airfields during the airlift to Israel in 1973, and the use of British bases in the 1986 Libyan strike caused a furor in Parliament. The use of European bases during



High-technology weapons, such as the surface-to-air missiles shown here, have helped to establish the US's military superiority. Unfortunately, as this technology becomes cheaper and more readily available to smaller nations and insurgent forces, it increases the lethality of the threat they represent.



The rollback of forces from Europe puts increased responsibility on our airlift assets. Operation Desert Shield has clearly demonstrated the importance of effective airlift in reacting to crises around the world.

Operation Desert Shield is an exception, based primarily on the vital importance of the Persian Gulf and its oil. Clearly, we must take into account the trade-off between military utility and political liability.

Consequently, the airlift of forces and supplies from the US to threatened areas will assume greater importance. Numerous examples in the past several decades underscore airlift's decisive impact in both peace and war: the Hump operation over the Himalayas during World War II, the Berlin airlift, the siege of Khe Sanh, the resupply of Israel in 1973, and the Falklands War, to name a few. During crises, airlift delivers with a timeliness that is impossible for surface transportation to match. As overseas support depots are removed, we will turn to airlift to demonstrate our resolve and to move national resources.

In addition, most Air Force combat aircraft require an air refueling capability to reach targets or destinations anywhere in the world in a matter of hours, without having to rely on forward bases.[9] Thus, the establishment of additional bases in our overseas territories seems logical. For example, the freedom of action provided by our bases on Guam greatly simplifies military planning.

High Tech

The battlefields of the future at all levels of conflict will be increasingly dominated by technology. Indeed, battlefield lethality has increased to the point that cheap but effective weapons—such as the Stinger and tube launched, optically tracked, wire command (TOW) missiles—may restore the infantry to dominance after a 100-year hiatus. If so, the antidote to infantry dominance (including guerrilla actions) may be more technology. Complexity and sophistication are growing at an exponential rate and should continue to do so for the foreseeable future.

Intelligence

The rapid pace of world events necessitates a continuous inflow of information at both the strategic and tactical levels. We must be able to monitor and perhaps predict the actions of potential adversaries with a high degree of accuracy. (We must not overlook human intelligence, because in some areas and situations electronic sensors and devices are simply inadequate.) Furthermore, the ability to verify arms control agreements will lead to reduced tensions worldwide. In this sense, aerospace power in the form of surveillance and reconnaissance satellites can be considered a force-protection asset.

Coupled with these intelligence requirements is the need for secure, reliable communications. Our military and civilian leaders must be able to react quickly and then rapidly transmit their directions and intentions to all levels of command. Thus, sophisticated command, control, communications, and intelligence (C^3I) apparatus will become crucial. The latter will help to ensure civilian control over military operations and lessen the chance of events escalating beyond intended limits.

The importance of intelligence also strongly suggests an expanded role for the Air Force in space. Though at first reluctant to move into "the final frontier," the Air Force has now decided to advance briskly into this arena. The appointment of the first assistant secretary of the Air Force for space punctuates this trend.

Stealth

Electronic defenses, part of the high-tech environment described above, are driving aircraft ever closer to the ground, thus to some degree stripping them of their unique ability to operate in the third dimension. To overcome this trend, the Air Force may add passive defensive measures as an essential ingredient of all aircraft (reconnaissance and airlift included) that attempt to penetrate a combat zone. Stealth technology is enormously expensive and complex but seems to offer equally enormous dividends. Although not invisible, stealth aircraft present problems to enemy defenses that, in the aggregate, seem insurmountable. If an enemy detects stealth aircraft, he probably cannot track them; even if he can track them, he probably cannot engage them in a timely fashion. Consequently, stealth aircraft will suffer less attrition, will require fewer support aircraft (escorts, jammers, suppressors, etc.), will be more fuel efficient (since they can afford to fly slower and higher, thus allowing greater range and payload), and will achieve tactical surprise (which enhances their destructive ability by catching enemy equipment and personnel in the open).[10]

Speed

Nonstealth aircraft operating over the lethal battlefield must be able to penetrate, perform their mission, and egress at the highest possible speed in order to decrease their exposure to interception and destruction. The absence of adequate speed over the modern, automated battlefield is one of the main factors working against the A-10 and any potential follow-on "mudfighter."

Payload

The fewer the aircraft needed to carry out a particular mission, the better.[11] Therefore, they must carry as much ordnance/

Instant, worldwide communication has been a mixed blessing for the military. Although it facilitates the job of field commanders, it tempts civilian officials to manage events that were formerly left to their military counterparts.

cargo/fuel/reconnaissance equipment as possible. However, aircraft may become so valuable (thus, so few in number) that few missions are worth their risk.

Precision

Again, if aircraft are to survive future battlefields, they must perform their mission the first time, without a return sortie or even a return pass over the target. All-weather/nighttime capability, exceptional radar/communications equipment, and smart—even brilliant—munitions will be a must. Munitions are particularly important: a highly sophisticated weapons carrier is wasted if tasked to deliver inaccurate, World War II-vintage iron bombs.

Reduced Force Size

The number of aircraft that we can afford to field will decline because the incredible capabilities demanded of them will drive up unit costs dramatically. No doubt, the Air Force will extend the service life of its fleet by upgrading existing airframes rather than procuring completely new weapons systems. The B-52, for instance, is still viable after 30 years; the F-16 and its variants may have to last just as long. Similarly, multirole aircraft (such as the various models of the F-15) that are especially efficient in the areas of maintenance and logistics will become more desirable. Cost-effectiveness will also demand increased reliance on unmanned aerial vehicles (UAV) of all types. UAVs may be anathema to many pilots, but manned aircraft are simply not necessary for all missions, especially those that are exceptionally long or dangerous.[12] The Israelis have used UAVs to great effect, saving money, lives, and resources. By the same token, standoff weapons should grow in importance. During the Iran-Iraq War, both combatants increased their use of missiles as a way of reducing the risk to valuable combat aircraft and aircrews. Thus, it seems logical to continue the development of highly capable air launched cruise missiles (ALCM), especially stealthy ones. In short, a manned penetrator may be neither necessary nor desirable in many future scenarios.

Force Structure

To meet future challenges and constraints, the Air Force will require a smaller—yet more capable—force that emphasizes range, secrecy, speed, power, precision, and cost-effectiveness. Weapons systems that meet these criteria, in order of importance, are as follows:

- ICBM-centered deterrent forces
- Reconnaissance systems (both space- and land-based, including secure and reliable communications that connect all levels of command)
- Air superiority fighters
- Tankers
- Long-range bombers (whether they need either a penetration or standoff capability bears further study)

- Airlift forces (both inter- and intratheater)
- UAVs and standoff weapons
- Medium-range strike forces

The Air Force should take advantage of the opportunity presented by our defense reorientation by reorganizing its operational units to maximize efficiency and combat effectiveness. For ease of maintenance and logistics, the Air Force is presently arranged in wings of homogeneous aircraft: F-16s, A-10s, C-130s, and so forth.

Commanders in future conflicts will need to "see" the entire battlefield, regardless of the location. Airborne warning and control system (AWACS) aircraft (below) give us that capability in the air. Whether at the tactical conventional level or the strategic nuclear level, effective command and control of forces is a necessity.

(There are minor exceptions, such as composite wings of bombers and tankers.) Yet, when the Air Force must fight, it generally does not do so in such standardized groupings.[13] Rather, planners often construct force packages consisting of reconnaissance, strike, escort, jammer, tanker, and defense suppressor aircraft. Under the present system, the personnel in these force packages of diverse aircraft may not have trained together until the actual operational mission. The commanders of such forces may not, therefore, have a thorough knowledge of the capabilities and limitations of the aircraft under their new command, since they have not led them before. This situation invites confusion and inefficiency on just those occasions when the fog of war is already thickest.

The future Air Force might benefit greatly if operational units were formed into force packages consisting of the various aircraft types needed for a typical strike mission. These units would live together, train together, and fight together. In truth, such composite air units were the standard in World War II. The Ninth Air Force in the European theater, for example, was composed of medium bombers, attack aircraft, air superiority fighters, fighter-bombers, night fighters, reconnaissance aircraft, transports, and gliders. The efficiency and effectiveness achieved by the diverse Ninth Air Force in 1944–45 are well known. We can re-create this type of teamwork and effectiveness, even if on a smaller scale. Also of importance, the consolidation of existing units into these new composite wings might generate savings in money and manpower in the long term.

The Air Force might also have to make other fundamental changes to its organization and composition. Because of diminished threats and increased strategic warning time, we no longer need to maintain the entire Air Force at today's standards of readiness; in fact, such a posture might be economically impossible. Rather, we should rely much more heavily on the reserves and establish different levels of readiness within that component. The challenge to the Air Force will be to establish an organizational structure and an active/reserve mix that allow it not only to respond quickly and effectively to likely threats, but also to expand rapidly to meet contingencies.

We should organize this structure so that incremental mobilization would provide combat forces—together with their corresponding support forces—thereby guaranteeing a "fightable" force, no matter what degree of mobilization is attained. One portion of the reserves would remain at the highest state of readiness. Another part would maintain a low capability in the assigned weapons system or support function. Personnel would attend ground schools and take part in reorientation flights periodically, but in the event of a crisis, they would need a short but intensive refresher course to bring them up to an operational level of performance. The remainder of the reserves would be inactive. After training and an initial tour in their specialty, personnel would return to civilian life, and the Air Force would not attempt to keep them current. In the event of mobilization, however, these people could be activated. Like rated supplement pilots who have been out of the cockpit for five years or more, they would require thorough requalification training (though this training would be far less time-consuming and costly than starting from scratch). Overall, this system would allow the Air Force to maintain a smaller but highly capable force that is tailored to meet mid- and long-term commitments in an effective manner.

Support Infrastructure

Based on this need for long-term expertise, the Air Force should study the issue of longer careers. Given the expense involved in retirement after 20 years, coupled with the cost of more frequent retraining to accommodate the present retirement policy, the service might be better off allowing a greater number of se-

Despite decreased tensions, the Soviet Union is still, potentially, our most capable opponent. For that reason, the US should maintain its ability to react at a moment's notice and deliver nuclear retaliatory weapons anywhere in the world.

lected personnel to remain on active duty beyond the 30-year point. Strangely, the Air Force has seemed intent on forcibly retiring some of its most capable people at the peak of their managerial and executive abilities—indeed, just when they are most desirable to civilian industry. But if it is to fight in an environment of increasing technological complexity, the Air Force needs experienced people. In part, the problem is psychological. To compete with industry, the services have had to entice people with promises of "upward mobility" and career progression to high rank (the prospect of retiring as a major after 30 years of service would not be acceptable to most officers). This mind-set that equates professional worth with high rank must change. The solution may lie in awarding pay increases for longevity and creating jobs that emphasize individual responsibility (therefore yielding high satisfaction).

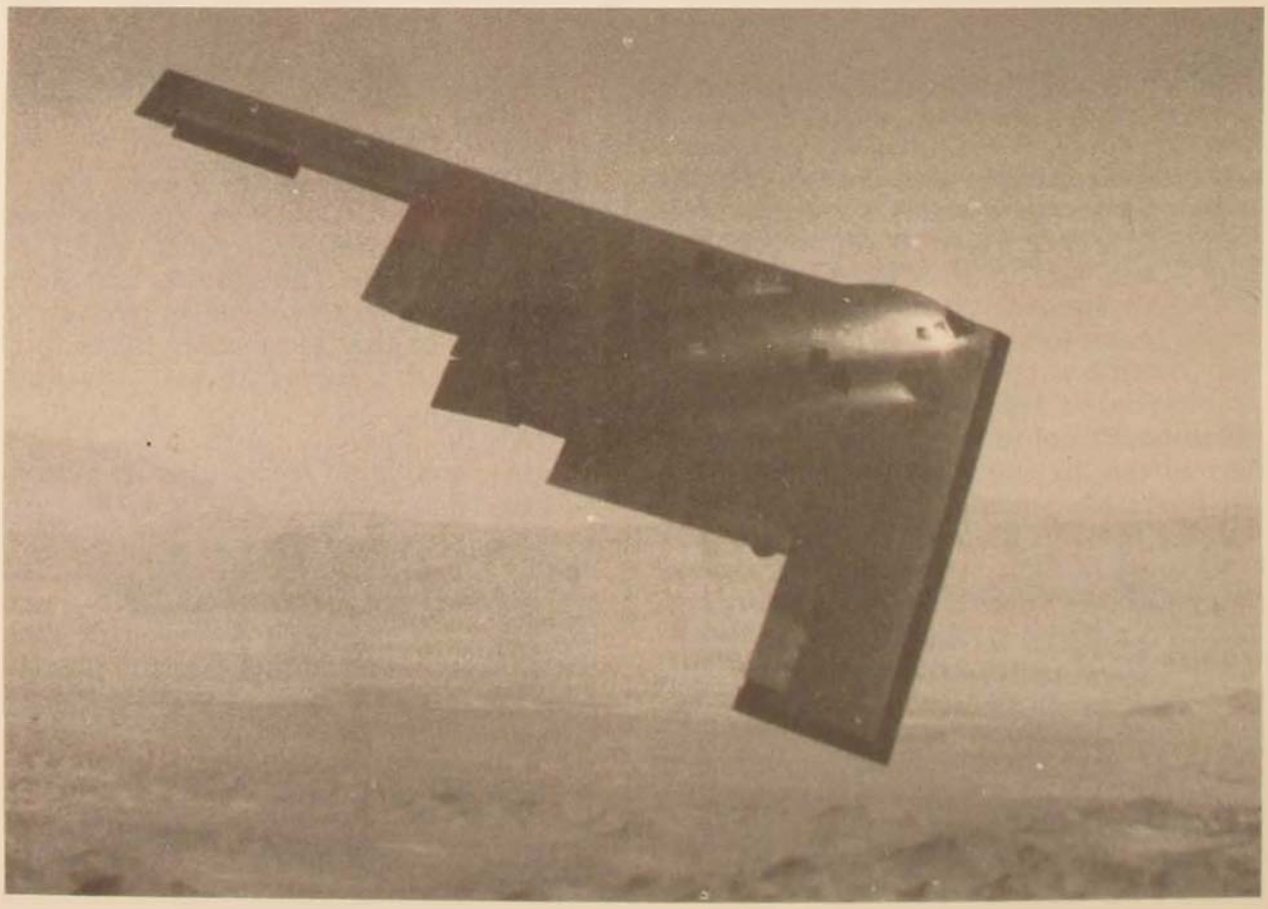
Along this line, the Air Force has an outstanding reputation for training its personnel. Civilian industry considers the Air Force a training ground for pilots, engineers, and technicians of all types. The service need not feel uncomfortable about this situation, especially if it can call upon the product of its training at a later date, as described above. However, the Air Force's efforts at educating its officers have not enjoyed the same success.

People need a better education if they are to cope in a world that is becoming increasingly complex. Thus, the Air Force should encourage more of its officers to

earn advanced degrees and grant them sabbaticals to work at civilian institutions and think tanks. Such a policy would provide the senior officer corps with a broad purview of the international environment and create a rare opportunity for reflection and introspection. One criticism of this idea is that it will induce the officer corps to think more of civilian management and administration than of war fighting—the real purpose of military forces. Perhaps, but this tendency would be outweighed by the benefits gained from an officer corps that is constantly in touch with its philosophical roots and is reminded of its place within and beneath our country's civilian leadership structure. Another argument against the idea of advanced education is that the Air Force would not realize an equitable return on its investment, in terms of either time or money. If career lengths are increased, however, both the Air Force and the nation would benefit from an increasingly well-educated officer corps whose longevity would in turn provide needed expertise and wisdom for the decades ahead.

Professional military education (PME) also needs rethinking. For some time, observers have commented on defects in the Air Force PME program—specifically, that it tends to emphasize the principles of management and administration to the detriment of war-fighting skills. In other words, PME is designed to help run a peacetime Air Force rather than educate warriors to fight and win future wars.[14]

As air defenses become more sophisticated, stealth technology acquires increasing importance, not only for fighter and bomber aircraft, but for airlift and reconnaissance assets as well.



This focus must change. Although the Air Force will always need highly trained technical experts, it will also need broadly educated generalists because most real-world problems are seldom simple or unidimensional. (That's why they call them "generals" and not "specifics.")

Traditional command structures are also subject to change. Despite the fact that only 28 percent of Air Force officers are pilots, most senior commanders come from this group. As mentioned previously, however, the number of aircraft and aircrews will decrease as aircraft production costs increase. Will this tendency reduce the number of command billets for pilots? The issue involved here is fundamental and defines the very nature of the Air Force culture. As technology and economics move us increasingly into space, will the technician at the computer terminal replace the person at the throttle as the backbone of the service?

Last, research and development (R&D) will play a major role in the support structure of the future Air Force. Our policy in the past has been to offset our numerical inferiority with technological superiority. In the main, this practice has served us well. If we are to maintain our technological lead and continue to modernize existing forces, the proportion of the Air Force budget spent on procurement versus that spent on R&D becomes crucial. Below are two possible options:

1. Continue with the modernization of Air Force systems and reduce R&D. Although this proposal would ensure maximum capability in the short term and midterm, it presents some problems. First, the force would be at optimal strength when the threat of major hostilities is low. Second, reduced R&D would extend the already lengthy weapon-development cycle, resulting in fewer weapons at higher cost. Third, reduced R&D spending would lead to an inevitable loss in the industrial base as defense contractors turn to other projects.[15] This situation could have severe global repercussions for the American defense infrastructure.

2. Extend the service life of existing systems and move forward with R&D of next-generation systems. This alternative presupposes a reduced threat of major war in the near term, a gamble that could prove costly. But advanced systems would be available in the long term (20 years hence) when the threat facing the US may increase. Of course, this option assumes the availability of funding for modernization in the near term and midterm, as well as for significant R&D expenditures. On the other hand, if development and procurement are reduced or terminated, we will lose a significant amount of production capability, and the defense industry will suffer.

Because neither of these options will sit comfortably with Air Force leaders, we may wish to pursue other possibilities. The key point, however, is that R&D is vital to our country's security. Technology is one of America's greatest strengths. We cannot allow short-term budget cutting to result in the loss of our technological edge. Competitors around the globe are waiting anxiously for us to slacken our developmental pace so they can overtake and eventually surpass us in this crucial arena.

Conclusion

The severity of the threats facing the United States is likely to diminish in the years ahead; however, the frequency, diversity, and technological complexity of lesser conflicts may actually increase. These events could occur at a time when US military budgets and forces are decreasing significantly and when the American public is becoming preoccupied with domestic concerns. To respond effectively to these varied and contradictory inputs, the Air Force of the future must become an instrument of both power protection and power projection, capable of performing anywhere at any time. US air power must dominate space as well as the atmosphere; it must be technologically superior to the systems of our potential enemies; and we

must apply the highest standards in maintaining it and training our personnel to use it. Characteristically, R&D, training hours, and spare parts are cut during fiscally austere times. We must not allow this to happen. The Air Force of the year 2010 may not be as large as it has been in the past three decades, but it must maximize the unique characteristics of air power: flexibility, speed, range, precision, and punch. □

Notes

1. The clearest explanation of this phenomenon is in Paul Kennedy, *The Rise and Fall of the Great Powers* (New York: Random House, 1987). For another interesting view, see Edward N. Luttwak, "From Geopolitics to Geo-Economics: Logic of Conflict, Grammar of Commerce," *The National Interest*, Summer 1990, 17–23.

2. On a more ethereal note, commercialization of space will intensify. The destruction of the *Challenger* space shuttle dealt this process a severe blow, but the enterprise is recovering. Further, we can expect the Soviets to continue their *Mir* and shuttle programs. The final frontier could become the most important of all commercial markets in the decades ahead. One analyst predicts that by the year 2000, space will yield up to $50 billion annually in revenue, most of that coming from communication satellites. "Commercial Space: Leadership in the High Frontier," *Aviation Week & Space Technology*, 13 November 1989, 50S. See also "Space Available: U.S. Industry Edges into the Space Race," *Scientific American*, 28 October 1989, 4.

3. One school of thought maintains that democracies do not fight democracies. Therefore, if the Communist bloc becomes more liberal, tensions with the West will lessen correspondingly. A similar argument is that economic liberalization in Eastern Europe will lead to interdependence with Western Europe, which in turn will lead to decreased tensions. These theories may be beguiling and overly facile. For a good discussion, see Owen Harris, "Is the Cold War Really Over?" *National Review*, 10 November 1989, 40–45; and Samuel P. Huntington, "No Exit: The Errors of Endism," *The National Interest*, no. 17 (Fall 1989): 3–16.

4. Michael J. Dziedzic, "The Transnational Drug Trade and Regional Security," *Survival*, November–December 1989, 533–48. We must handle the military option in the drug war very carefully. The Colombians, for example, believe that the drug trade is more a police problem than a military one and were outraged by a proposed US naval presence off their coast. Even before Operation Just Cause in Panama, Latin America's receptiveness to US military involvement was doubtful; that tendency has certainly increased. Eugene Robinson, "Latins Leery of Any U.S. Military," *Washington Post*, 9 January 1990, 16.

5. Twenty-seven nations currently have short- and intermediate-range ballistic missiles that are operational; five more countries are developing them. Duncan Lennox, "The Global Proliferation of Ballistic Missiles," *Jane's Defence Weekly*, 23 December 1989, 1384–85. See also Barbara Starr, "Ballistic Missile Proliferation: A Basis for Control," *International Defense Review*, March 1990, 265–67. The possibility of a rogue launch of a nuclear, biological, or chemical ballistic missile at the United States—or, for that matter, at anyone else—might be the strongest case to support continued development of the Strategic Defense Initiative (SDI). Such a defensive system might never be able to stop an all-out attack by the Soviet Union, but it could protect against isolated launches. This scenario brings to mind the Reagan dream of sharing SDI technology with the world to ensure that no one is threatened by an isolated ballistic missile attack. Despite international law and moral dictates, several countries have allegedly employed chemical weapons since World War II: Egypt against Yemen; Iraq against Iran and Kurdish dissidents inside Iraq; the Soviets in Afghanistan and against dissidents in Georgia; Vietnam in Cambodia; and Cuba in Angola. For an overview, see Michael Ledeen, "The Curious Case of Chemical Warfare," *Commentary*, July 1989, 37–41. The United States employed chemical defoliants in Vietnam, but they were not directed against personnel.

6. Within hours of the start of the Panamanian operation, Sen Robert Dole stated that American troops would not be "occupation forces" and that as soon as they were able to "launch democracy" in Panama they would be brought home.

7. For information on the US's attempts to limit collateral damage, see Charles H. Bogino, "Psychological Warfare Reportedly Saves Lives," *Baltimore Sun*, 8 January 1990, 1. Even though civilian casualties and damage were extremely light, given the magnitude of the operation in Panama, some observers still criticized the US for using heavy artillery. They argued that these weapons produced "indiscriminate fire" and caused needless damage. Edward N. Luttwak, "Just Cause—A Military Score Sheet," *Washington Post*, 31 December 1989, C4.

8. Stephen T. Hosmer, *Constraints on U.S. Strategy in Third World Conflicts*, Rand Report R-3208 (Santa Monica, Calif.: Rand Corporation, 1985), 48–53. The Grenada and Panama operations are exceptions. Presidents Reagan and Bush left operational matters largely in the hands of their military subordinates.

9. We are overcoming the incompatibility that exists between Air Force aircraft that employ the boom and receptacle system and Navy aircraft that use the probe and drogue. Plans call for the entire KC-10A fleet to have both systems installed. Robert Salvy and Greg Willis, "In-Flight Refueling: Greater Flexibility for Air Power," *International Defense Review*, November 1989, 1509–11.

10. Jasper Welch, "Assessing the Value of Stealthy Aircraft and Cruise Missiles," *International Security* 14, no. 2 (Fall 1989): 47–63. For an excellent discussion of stealth technology's impact on Soviet air defenses, see John W. R. Lepingwell, "Soviet Strategic Air Defenses and the Stealth Challenge," *International Security* 14, no. 2 (Fall 1989): 64–100. He concludes that stealth presents insurmountable technical problems for Soviet air defenses.

11. This maxim would seem to violate the principle of mass; however, the experiences of the Royal Air Force Bomber Command during World War II may be instructive. The British discovered early in their night-bombing offensive that German night fighters tended to "bag their limit" each time they intercepted a British attack, regardless of the number of bombers involved. Therefore, Bomber Command launched mass strikes to decrease their frequency of vulnerability. By late 1943, however, as a result of German advances in radar and electronic warfare, the British decided

that it was safer to launch numerous small attacks rather than a single large one. This tactic reduced losses significantly. Sir Charles Webster and Noble Frankland, *The Strategic Air Offensive against Germany, 1939–1945* (London: Her Majesty's Stationery Office, 1961), 3:124–29.

12. As one "Pentagon source" allegedly put it, "If it isn't launched from underneath an airplane wing, forget about Air Force support." John G. Roos, "'Harpy' Antiradiation Attack Drone Again Seeks Elusive Pentagon Champion," *Armed Forces Journal International*, January 1990, 79.

13. The Air Force's global responsibilities will still require the concentration of certain air assets in a central pool to ensure that they are used most effectively. These assets include intertheater airlifters, airborne warning and control system (AWACS) aircraft, tankers, and Strategic Air Command's nuclear bombers.

14. For a comparison of the war colleges—the senior schools in the services' PME structure—see Williamson Murray, "Grading the War Colleges," *The National Interest*, no. 6 (Winter 1986–1987): 12–19.

15. Numerous articles on this subject appear regularly in newspapers, magazines, and journals, but the best overall view is in James Blackwell et al., *Deterrence in Decay: The Future of the U.S. Defense Industrial Base* (Washington, D.C.: Center for Strategic and International Studies, May 1989).

EDITORIAL

Defending the Faith

SOME months ago in the pages of the *Air Force Times*, an article challenged the need for a separate Air Force. A number of officers responded by writing to the *Times* in defense of their service. The result of this point of controversy—and of numerous other problems the Air Force has had in recent years—is that it has caused others to adopt the belief held by some that the Air Force has done a very poor job of understanding the purpose for its existence and of explaining that purpose to others. The accusation is that, as a group, Air Force officers—regardless of rank—tend not to understand doctrine, strategy, or operational art but prefer to remain immersed at the tactical level. As a result, these critics question the reason for our existence.

The answer to that question is eminently defendable but too complex to be printed in this brief editorial. The point is that the current events in the Persian Gulf have given the Air Force the opportunity to answer its critics in a way that no amount of speechmaking or letter writing can. We have seen in this crisis the largest airlift of troops and materiel in the history of air power. Our airlift forces have operated around the clock to position air and land forces so that they are ready to aid an American ally faced with a serious military threat. We may not have provided enough congressional testimony to justify the C-17, but our airlift aircrews, ground crews, and aerial port squadrons are visible testimony of our worldwide airlift capabilities. We may not have done a sufficient job of explaining why we need large tactical air forces even though the threat in Europe appears to be diminishing, but there they were in the Saudi Arabian desert, the first forces deployed to meet the sudden threat and ready to fight, if necessary.

The way that we explain the reason for our existence needs to be addressed. We need to do a better job of educating our officers in basic and operational doctrine. We must get our heads up, out of the cockpit, and learn how to employ air forces at the theater level and in coordination with land and naval forces, as well as with other air forces. Development of air strategists must become an Air Force priority. In the meantime, however, airmen in the air and on the ground are making a statement to the nation. They are demonstrating with their actions what they have not adequately explained in words. Air power is ready for immediate response. It is flexible and prepared to meet whatever threat arises. It is—contrary to the opinion of some critics—sustainable and prepared to meet short- and long-term threats.

The next time someone suggests that we don't need an Air Force, hand him a picture of an aircraft in the desert and say, "Sleep well tonight. Your Air Force is awake!" MAK

Fall 1990

IRA C. EAKER AWARD WINNER

Lt Col Bruce L. Ullman, USAF

for his article

Officer Professional Development for Lieutenants

Congratulations to Lt Col Bruce L. Ullman for his selection as the Ira C. Eaker Award winner for the best eligible article from the Fall 1990 issue of the *Airpower Journal*. Colonel Ullman receives a $500 cash award for his contribution to the Air Force's professional dialogue. The award honors Gen Ira C. Eaker and is made possible through the support of the Arthur G. B. Metcalf Foundation of Winchester, Massachusetts.

If you would like to compete for the Ira C. Eaker Award, submit an article of feature length to the *Airpower Journal*, Walker Hall, Maxwell AFB AL 36112-5532. The award is for the best eligible article in each issue and is open to all US military personnel below the rank of colonel or equivalent and all US government civilian employees below GS-15 or equivalent.

A REAL HOG WAR
THE A-10 IN LOW-INTENSITY CONFLICT

CAPT ROBERT H. BROWN, USAF

D FLIGHT got the call at 0600 that they were to stay home and rest. At the same time, the remainder of the squadron, except for the planning cell, was boarding a single C-130, as were all the maintainers and gun loaders. They took with them all the parts and ammo they needed to deploy and stay in business for the next two weeks. Later that day, as the sun faded beyond the offshore oil rigs in the gulf, D (call sign "Popper") Flight was leveling off at 21,000 feet. Each aircraft in the four-ship formation of A-10s was hauling two laser guided bombs (LGB), two infrared (IR) Maverick missiles, and two cans of cluster bomb units (CBU-87), as well as 1,150 rounds of 30-mm ammo, a Pave Penny laser detector pod, and 480 self-defense flares in the ALE-40 infrared countermeasures system. Two air refuelings later, Popper Flight coasted into the objective country.

In the meantime, a special forces laser team lay dug in on a hill two kilometers

from the target. An MC-130 Combat Talon had "infilled" them the night before, and now all they had to do was wait. At precisely H-hour minus two minutes, Popper Lead and his wingman, in their blacked-out A-10s, silently departed the initial point, wings level, at 10,000 feet. Exactly one minute later the ground laser team squeezed the triggers on their laser designators, and the cue "diamond" appeared as advertised in the heads up display (HUD) of both A-10s. When the cue overlaid the computed aiming reference, the Hog drivers pickled their LGBs, B-17 style, without ever rolling in. The following 27 seconds seemed like an eternity, but at H-hour straight up, the two bombs found their mark. Two 37-mm gun pits at opposite ends of the long mountain airstrip disappeared in a blinding flash as the special forces team moved toward the place where the hostages were being held.

In the meantime, as Popper Three and Four escorted an AC-130H Spectre gunship into its orbit, Popper Lead and Two, now rid of the LGBs and established in a high-cover orbit, engaged their autopilots and clipped their night vision goggles (NVG) into place. They would now get a slight breather as they conserved fuel and watched Three and Four do their "tag team" act with the Spectre down below. The special forces team, having rescued the hostages, was now pinned down in a firefight. The AC-130 stood off and designated the bunkered command post and barracks with its laser, allowing the two A-10s to demolish the targets with IR Mavericks and LGBs. Three and Four held in a position to cover the gunship as it put down a withering stream of pinpoint fire around the perimeter of the compound.

Just as Popper Three, low on fuel, called "bingo" and commenced the swapout with Lead, Two saw 37-mm tracers coming out of the north gun pit. Lead called the gunship to withdraw while Three rolled in from out of the dark for one last pass to take out the gun pit with CBU-87, but the fuze malfunctioned and the intact cannister hit long. Three and Four then bugged out for the recovery field 100 nautical miles across the border to the southwest. Popper Lead was about to earn his flight pay.

As if the fire hose of tracers weren't enough, an SA-14 surface-to-air missile (SAM) suddenly rose toward Popper Two from near the gun pit. Lead instinctively yelled for flares, and they came out just in time. The threat was getting too hot for the AC-130 to hack the fight in its ultimately predictable orbit, so it offset to the east and called in the A-10s to silence the gun. The special forces team was still pinned down. Popper Lead rolled in from the south to suppress the gun pit, taking advantage of his low altitude safety and targeting enhancement (LASTE) gun solution. He fired a rock-steady 30-mm burst for two and one-half seconds from 9,000 feet away, pumping flares as he pulled off. As Lead's bullets hit their target, Popper Two rolled in from the west for a high 45-degree dive delivery, releasing both cans of CBU-87. The LASTE continuously computed impact point (CCIP) found its mark, and the gun pit was swallowed up this time in a rippling cascade of brilliant, blue white fire. Now back to work.

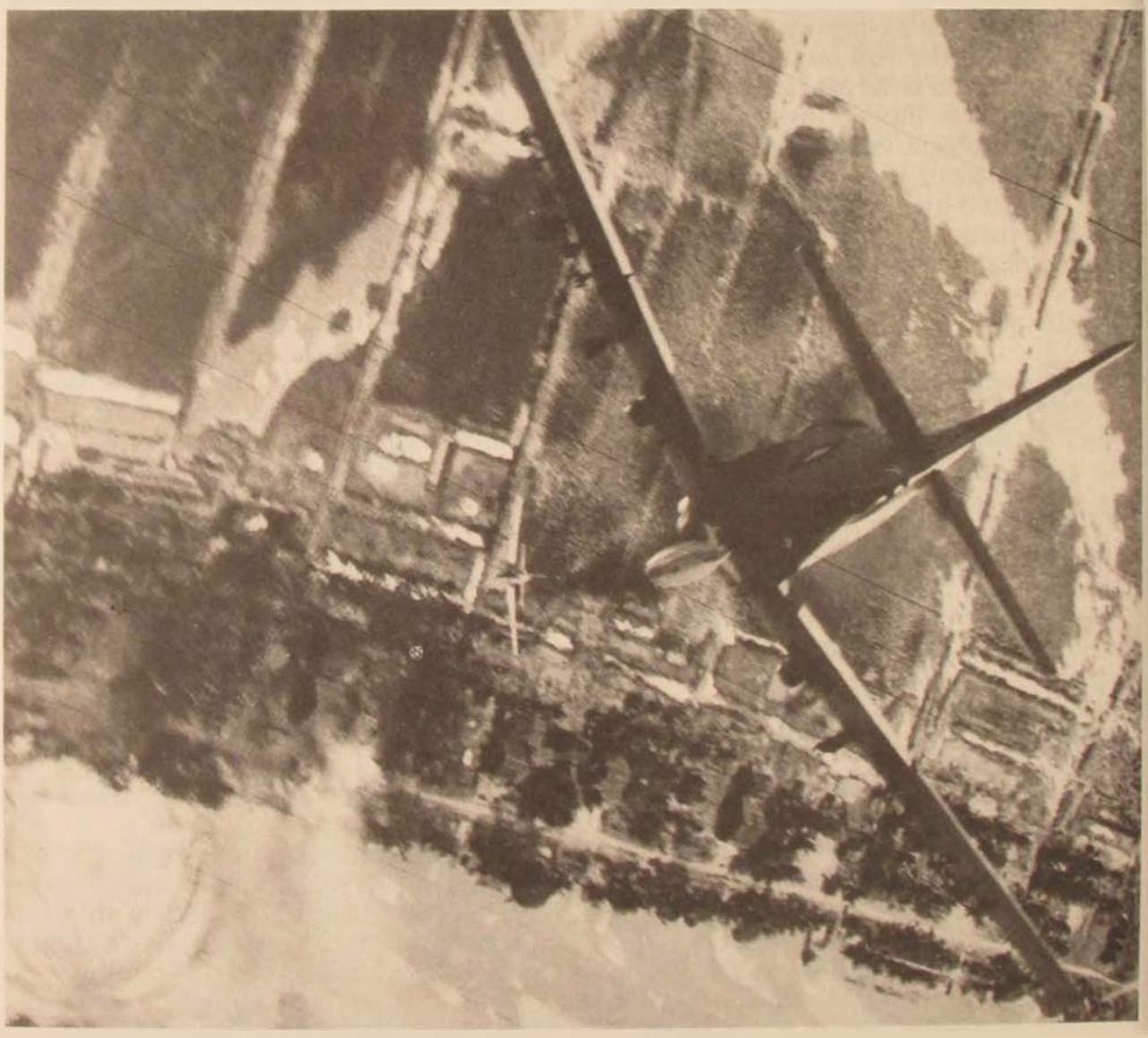
Popper Lead and his wingman climbed back to their high-cover orbit, clearing the way for the AC-130 to move back into position. The Spectre crew could sense the urgency in the special forces team leader's voice over the secure FM radio net. The guerrilla troops had closed to within 25 meters of the friendly position on the southeast side of the compound, and the team was taking heavy automatic weapons fire. But the gunship's sensors were already trained on the enemy location. Seconds later, the staccato report of the guerrillas' AK-47s was drowned out by a precise hail of 20-mm fire from the AC-130.

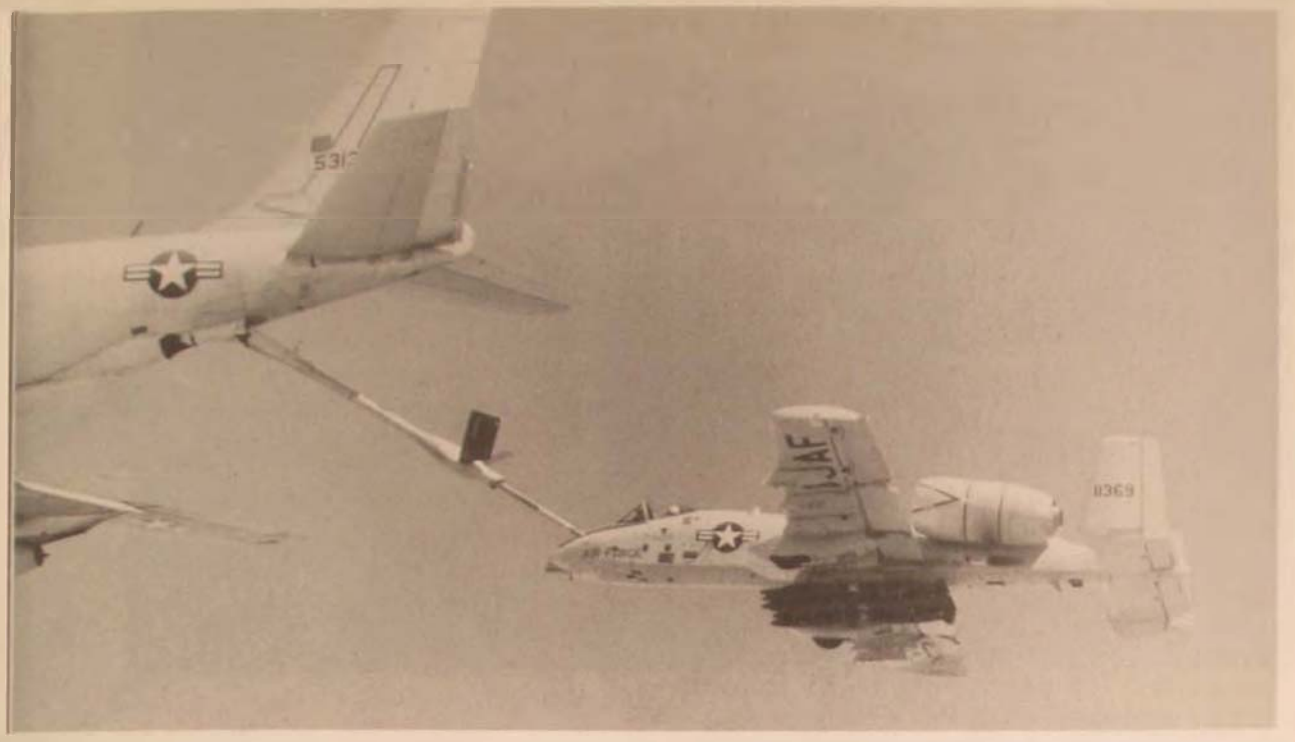
The special forces team was already hurrying to the pickup point when Popper Lead heard Hitman Flight's two-ship formation of A-10s checking in with the inbound Pave Low III MH-53J helicopters. Popper Two had just called bingo minus

one, so Lead started a maximum-range climb cruise toward the recovery base as he briefed Hitman on the swapout. Hitman's task was to join with the gunship to protect the helicopters during the crucial pickup and exfiltration of the special forces team and rescued hostages to friendly territory.

Twenty minutes later as Popper approached the recovery strip (across the border in a neighboring country), he and his wingman went to 100-percent oxygen. They'd had a long night, and it wasn't over yet—they would have to land on the narrow 4,000-foot strip. The short-field training at all those Army forts in the States was about to pay off, Popper Lead thought, as he set his HUD flight-path marker just short of the runway and slowed to minimum-run landing airspeed. Both aircraft stopped within 2,000 feet. When they finally shut down and went to the intel-

The A-1E Skyraider was legendary for its special operations and close air support roles in Vietnam. Eventually forced out of service by the high-intensity threat, it is an example of the versatile fighter aircraft needed in today's environment of low-intensity conflict.





A workhorse of an aircraft, the A-10 is available for duty worldwide because of its air-refuelable capability.

ligence tent for debriefing, the operations officer told them the latest news. Their mission had been successful, but resistance at some of the other objectives had been much stiffer than predicted. When the sun came up, the operation was likely to continue for at least several more hours, if not days. For now, they and their A-10s were the only show in town. Furthermore, he said that the squadron was already being tasked for a wide variety of missions, such as escort for helicopter and fixed-wing airlift, combat search and rescue (CSAR), hunter-killer suppression of enemy air defenses (SEAD) operations with AC-130s, interdiction, antihelicopter operations, and emergency close air support (CAS), if necessary. The operations officer went on to say that what had started out strictly as a special operation was quickly evolving into a classic low-intensity conflict (LIC). It looked like this was going to be a Hog war if ever there was one.

This hypothetical scenario could very well occur in contingency operations of short duration involving both special and conventional forces—the type of armed conflict in which the United States is most likely to find itself in the foreseeable future. James R. Locher III, assistant secretary of defense for special operations and LIC, remarked that "as we enter the 1990s, Third World instability looms as a global problem, creating threats of terrorism, insurgency, regional warfare, violence engendered by narcotics trafficking and other forms of unconventional conflict."[1] Indeed, the secretary predicted that the budget for special operations to confront these threats will increase roughly 6 to 8 percent each year over the next five years, despite projections that overall spending on defense will decrease during the same time period.[2]

The A-10 is a near-perfect aircraft for combatting such third-world conflicts. No other aircraft in the US inventory could successfully fly the entire sortie described

above. I do not claim that the A-10 is better suited for delivering LGBs than an F-111 equipped with Pave Tack or that it is a better interdiction platform than an F-15E or F-16. The A-10 *can*, however, deliver precision standoff weapons to suppress defenses or destroy hardened targets. Additionally, it *can* loiter for long periods of time to support an AC-130 gunship; provide emergency surgical CAS for engaged troops; escort airlifters to protect them from hand-held SAMs and antiaircraft fire; recover to a short, unimproved airstrip; *and* conduct virtually self-sustained operations out of that airstrip for weeks, if necessary. The A-10 stands alone in its ability to perform all of these missions and more. The current and future capabilities of the A-10 could make it pivotal to the success of future special operations and low-intensity conflict (SOLIC) missions.

Force Survival

The proliferation of infrared SAMs throughout the third world means that aircraft designed for special operations and conventional airlift are more likely than ever to encounter these threats, as well as fire from heavy caliber antiaircraft artillery (AAA). A-10s employed in an escort role would greatly enhance the survivability of conventional fixed-wing airlifters and helicopters. That is, A-10s can employ as a dedicated escort to the force, fly ahead to sanitize ingress/egress routes, or perform landing-zone preparation as required. With its heavy external-load capacity and GAU-8 30-mm cannon, the A-10 can use decisive ordnance to eliminate threats or draw fire ahead of the force and steer it clear. Moreover, the A-10's relatively slow airspeed makes it uniquely capable of escorting even slow helicopters. These escort

The C-130 (above) is one of the most successful aircraft ever to enter the Air Force inventory. A single Hercules can airlift the maintenance personnel and equipment necessary to support six A-10 aircraft in austere conditions for a month. The AC-130 gunship model (left) can work closely with A-10s in a mutually supportive role to produce effective combat air power in low-intensity conflict.

tactics might normally be counterproductive for special operations aircraft in some purely covert scenarios, where additional aircraft would risk highlighting or exposing the mission. However, in situations requiring a forced entry or on "Day Three," where a special operation has evolved into a broader conflict, an armed A-10 escort could prove crucial to force survival and mission success.

This concept is not new. A-10 pilots have flown airlift escort for years, having inherited it from the A-1 drivers. The A-10's infrared countermeasures (IRCM), though, *are* new. The 480-flare ALE-40 system currently installed on the A-10 can give airlifters an effective, sustained IR screen against hand-held IR SAMs for long periods of time—whether en route, during an airdrop or a pickup, over a target, or during takeoff and landing. In fact, the A-10 can put out a flare every three seconds for 24 minutes![3] In addition, it can engage AAA threats and destroy them with a variety of standoff weapons: IR and electro-optical AGM-65 Mavericks, cluster munitions, LGBs, and the GAU-8 30-mm cannon. The new LASTE system (already purchased and being fielded) will allow A-10 pilots not only to improve their capability to safely employ low-altitude terrain masking, but also to deliver even free-fall munitions with pinpoint accuracy from high, standoff altitudes. Further, the system allows precise employment of the aircraft's gun at ranges as great as two nautical miles.[4] Thus, the A-10's maneuverability, firepower, and IRCM suite make it an excellent platform for supporting airlift and helicopters in the SEAD/escort role.

A-10s employed in the SEAD mission offer immense support to AC-130 gunships. Confined to a circular, predictable orbit, the gunships are vulnerable to

A-10 aircraft can work in concert with special operations helicopters on raids and other contingencies short of war, providing close air support, defense suppression, and escort.

medium-caliber AAA such as 23-mm and 37-mm guns. (Actually, the AC-130s are less vulnerable to the guns they know about and can target with their onboard weapons than to the unknown guns outside their orbit that can take unobserved "belly" shots.) When A-10s are in a high-cover "stinger" orbit above them, the gunships have at their disposal immediate, reactive firepower from long, standoff ranges to take out these threats. If the threats around the target itself are too "hot," the AC-130 can stand off and, if necessary, designate the enemy weapons with its laser, so the A-10s can come in and take them down. Once the threat is knocked out, the Spectre can move back in and survive. This tag-team concept is not merely hypothetical. Tactical Air Command (TAC) successfully directed a test of these tactics in 1987,[5] and, since then, operational A-10 units have employed them in training with AC-130s.

Last, the advent of armed helicopters in the 1990s poses a new threat to the AC-130 in a target area, particularly if the scenario forces the gunship to operate during daylight. But the A-10, now armed with AIM-9M air-to-air missiles, is well equipped to defend itself, the AC-130, and other assets against helicopter threats.

Firepower

In addition to providing a dedicated and potent defense against potential threats, the A-10's firepower complements the current (and even future) AC-130 weapons suite by offering an effective, proven capability to destroy hard targets. The AC-130 cannot destroy bunkers, hardened fuel-supply areas, ammunition storage areas, bridges, heavy tanks, and fortified buildings, but the gunship's versatile sensors can pinpoint and designate such targets, allowing the A-10 to take them out quickly and economically. In essence, the AC-130 acts as a forward air controller (FAC), marking the target with gunfire

and/or laser, while the A-10 rolls in for the kill with the appropriate munitions: LGBs, free-fall bombs, Maverick missiles, Rockeye CBUs, combined effects munitions, or 30-mm munitions, as required. The advent of LASTE-equipped A-10s will make the AC-130/A-10 hunter-killer combination even more formidable.

In situations where collateral damage must be kept to a minimum and where AAA/IR SAM threats create an unacceptable risk for the AC-130, the gunship again can stand off to acquire and designate for the constantly maneuvering A-10 while it employs its 30-mm cannon. The A-10 can orbit high above the threat envelope and then roll in to strafe from high dive angles to reduce ricochets and minimize the weapon-impact "footprint." Loading the A-10's cannon only with target practice rounds will reduce collateral damage even further (since no rounds explode) but still produce effective firepower against troops and trucks.

The ultimate result of employing A-10s in concert with AC-130s is a force package whose weapons effectiveness, mutual support, and survivability are greatly enhanced. (Such benefits are also evident in the joint air attack team—JAAT—concept, whereby fixed-wing CAS aircraft integrate in the target area with attack helicopters.) Furthermore, the A-10's slow airspeed, maneuverability, range, and loiter time make it eminently suitable to work with the AC-130s, whether the mission is special operations, CAS interdiction, or armed reconnaissance.

Operational Flexibility

Like other fighter aircraft in the US inventory, the A-10 is air refuelable and capable of rapid deployment worldwide on very short notice. However, unlike many other aircraft, the A-10 requires a very small logistics support package. A single C-130 can put six A-10s, maintenance troops, tools, support equipment, and spare parts "in country" for four weeks. As any A-10 crew chief or specialist will confirm, the Hog is simple, reliable, and easy to maintain, even under austere field conditions. While I was assigned to the 74th Tactical Fighter Squadron at England AFB, Louisiana, we deployed to a bare base in the Central American region in 1987 with six A-10s and only those parts we could carry on one C-130. We flew a total of 509 sorties with those same six jets in 44 flying days.

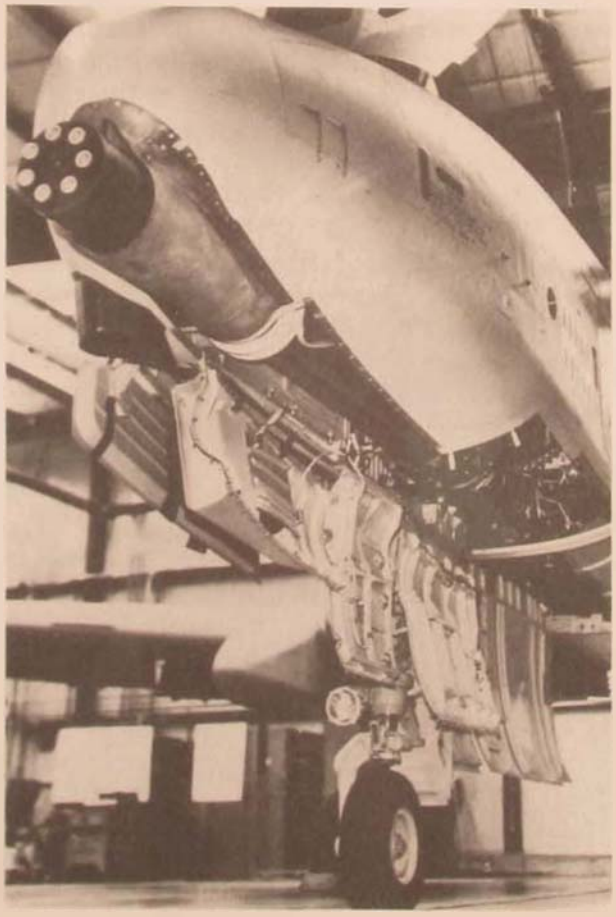
The ruggedness of the A-10 airframe is legendary. The A-10's systems redundancy and "hardness" allow it to withstand battle damage that would cripple any other aircraft. Although operations during an intense war in Europe would require the Hog to fly into the heart of the threat envelope (and spend a lot of time there), in a lesser conflict the A-10 could stand off above and beyond the threat much of the time and avoid getting hit in the first place.

The A-10 can also operate from unimproved runways inaccessible to other fighters. Foreign object damage, insufficient runway length, lack of arresting cables, or unavailability of other support equipment do not deter the Hog. A-10s routinely deploy to short Army airfields and have even operated from dry lake beds, taking fuel and ammunition from a C-130 equipped with fuel bladders and 30-mm automatic loading systems. This ability—together with its maintenance turnaround time, payload, range, and loiter time—makes the A-10 ideally suited for the bare-base operations likely to be required in many contingency or covert operations.

In addition to the missions already discussed, the A-10 demonstrated during the TAC testing of 1987 that it could resupply special forces teams in remote locations. In that test, A-10s loaded with supply containers paradropped them to ground forces in the field.[6]

Furthermore, the fact that the A-10 has a low political profile is a subtle, yet important, attribute that should make the aircraft attractive to special operations and LIC planners. It is "low tech," can't carry

The internally mounted GAU-8 30-mm Gatling gun is the most notable feature of the A-10, providing it with immense firepower.



nukes, and is quiet (ever hear two A-10s fly overhead at 10,000 feet?). As mentioned, it can operate at out-of-the-way forward bases and is fully combat capable (thanks to the GAU-8), despite the fact that no bombs hang on the wings for TV camera crews to film. When a distinctly American show of force is necessary, however, the A-10 is ideally suited to this task because it is unique to the US inventory.

Last, in an era of shrinking defense budgets, single-mission aircraft may no longer be affordable. Although a war in central Europe would find the A-10 performing close air support exclusively, LIC opens up an entirely new spectrum of viable A-10 missions. Not only can it perform CAS, but also it can support special operations by flying armed reconnaissance, interdiction, SEAD, CSAR, FAC, antihelicopter operations, resupply, and fixed-wing/helicopter escort missions. In the LIC environment, then, the A-10 is truly a multi-

mission airplane, and it is bought and paid for.

Night Capability

Speaking strictly in terms of current aircraft capabilities, the concern most often voiced in discussions about an expanded role for the A-10 in special operations and LIC is its alleged lack of any night capability whatsoever. In point of fact, however, A-10s have conducted reduced-threat CAS training at night for as long as the airplane has been in existence. Admittedly, though, in order to acquire targets at night, the A-10 must rely either on illumination/marking devices—airborne flares, "logs" (ground-illumination markers), or artillery-marking rounds (e.g., 40-mm misch metal or 105-mm white phosphorus [WP])—or on the target-cueing ability of the Pave Penny laser detector.

Illumination flares work well but don't last long and can highlight the employing aircraft. Worse, they can easily give away the position of a covert mission; thus, they may often be unsuitable for special operations. Logs don't give away the employing aircraft, and they allow an adequate aiming reference on the ground, but they are hard to see and difficult to place accurately. The 40-mm misch-metal rounds fired by the AC-130 can be used to "sparkle" the target, marking it for A-10 acquisition. The 105-mm WP rounds can be used in conjunction with a laser spot to identify the target. For example, the gunship puts down a WP round to point the A-10 toward the general vicinity of the target. The AC-130 (or ground/helicopter laser team) then lases the target, and the A-10's Pave Penny acquires the laser spot. The pilot places the Maverick boresight over the Pave Penny diamond in the heads up display and thus acquires the target.

Of all these target acquisition/cueing methods, the Pave Penny is currently the most accurate, compatible system for the A-10 in night employment. This system detects the laser and presents a cue in the HUD that overlays the target. The A-10 pilot can use that cue to aim the aircraft's gun, iron bombs, or Maverick missiles. In fact, when employed with the Pave Penny, the IR Maverick gives the A-10 an excellent nighttime standoff weapon for destroying hard targets up to several miles away.[7]

Perhaps the least known, yet most dramatic, capability of the Pave Penny-equipped A-10 is its ability to deliver LGBs from high-altitude, level flight (or from a conventional dive). The A-10's Pave Penny/LGB combination actually makes the Hog a "smart" delivery platform, allowing it to drop 500- or 2,000-pound bombs from high altitudes with pinpoint accuracy, without ever pointing at the ground. In a special operations/LIC context, this system could be especially effective in covert interdiction and strikes against hard targets.

Although the A-10 can indeed work at night, it currently has no night vision capability. Pave Penny gives A-10 pilots a good target cue, but they still cannot see the target except under flares or in the IR Maverick video display. For delivering LGBs, IR Mavericks, or bullets in an interdiction or SEAD scenario, the Pave Penny alone might suffice, as testing has shown.[8] But if the aircraft is to provide truly effective CAS for troops in contact, as well as escort and night CSAR, it must have an effective night vision device. There is no substitute for the situational awareness gained by being able to see what is going on in battle. Furthermore, this asset would simplify coordination with the other players, especially in terms of radio communications. This benefit was graphically demonstrated in Operation Just Cause, which employed night vision devices extensively.[9]

Only in recent years have suitable night vision systems or devices become available for fighter aircraft. The low-altitude navigation and targeting infrared for night (LANTIRN) navigation pod currently employed by the F-15E and some F-16Cs is ideal for strike, interdiction, and bat-

tlefield air interdiction (BAI) missions. It may also prove viable for the air support role envisioned for the A-16 follow-on CAS aircraft. However, for A-10s supporting the unique spectrum of special operations/LIC missions, a forward looking infrared radar (FLIR)—for example, LANTIRN, Pathfinder, or LANA (low-altitude night attack)—*alone* would be unsuitable for two reasons. First, it would require very expensive modifications to the aircraft. Second, in terms of mission requirements, it is incompatible with the fluid nature of many of the missions discussed here. A-10 pilots *must* be able to look around in all directions to see the helicopters they are escorting, to deconflict with the gunship, or to see the target and friendlies and then plan the roll-in accordingly.

Easy to maintain, the A-10 can operate in forward locations against a wide variety of targets, thanks to the assortment of munitions it can carry—including the Maverick missile shown here.

By itself, visual information from the FLIR in the HUD would just not suffice in many cases.

The ideal system would be a head-steerable FLIR/low-light-level television integrated in the pilot's helmet (e.g., the Falcon Eye system used in the A-16 CAS demonstrator). A simple turn of the head would allow the pilot to see at night in almost any direction, thus providing the needed employment flexibility and situational awareness. Once again, however, because such a system would require extensive modifications to the aircraft, it would probably be too costly.

Helmet-mounted night vision goggles utilizing low-light intensifiers offer another alternative. They allow the pilot to "look around" in any direction, and they are about one-tenth as expensive as the FLIR options.[10] However, NVGs have had serious drawbacks in the past. Originally designed for surface forces and subsequently modified for airlift and helicop-

ters, they were very cumbersome and limited both the field of view and visual acuity. Furthermore, NVGs were simply incompatible with fighter aircraft because they were not stressed for high-G loading and were not safe to wear in an ejection. However, NVGs now in production resolve or minimize these problems and are specifically designed for fighter aircraft. They offer a wide field of view and improved visual acuity; are lightweight, streamlined (fitting underneath the visor), safe for ejection, and stressed for high-G loads; furthermore, they adapt to the current-issue helmet and clip on and off like an oxygen mask. These NVGs require no aircraft modifications other than those to cockpit lighting. However, cockpit lighting has improved to the point that these modifications are simple, cheap, and quick (taking no more than one day). The total cost is well under $40,000 per aircraft.[11] This new generation of NVGs can provide the A-10 with a simple, cost-effective night vision capability that would allow the aircraft to support special operations and LIC missions 24 hours a day.

Conclusion

Clearly, the A-10 can support US forces on the low-intensity battlefield. Furthermore, the addition of a simple, effective night vision system would substantially improve the quality of that support. Toward that end, Tactical Air Command is conducting an A/OA-10 technology demonstration program to examine the integration of various FLIR options with LASTE, as well as various NVG options and other systems improvements. We need to take this technology demonstration one step further, however. TAC should conduct a follow-on tactics development and evaluation with joint special operations forces to evaluate how well an A-10 equipped with LASTE, NVGs, and/or FLIR can support these forces in a broad range of missions. In the meantime, the tactics and techniques verified by TAC's 1987 test, mentioned previously, have been incorporated into the A-10 tactics volume of Multicommand Manual (MCM) 3-1, *Tactical Employment*.[12] A-10 units should train with these tactics in joint exercises.

LIC is the real war facing the United States today. In the A-10, the Air Force possesses a low-cost, multimission aircraft of unequalled versatility. When measured by the vital enhancements it will offer to force survival, firepower, and operational flexibility in low-intensity conflicts, the A-10 stands alone. It is uniquely suited to fight in this environment. □

Notes

1. Barbara Starr, "Crucial Role for US Special Forces," *Jane's Defence Weekly*, 16 December 1989, 1335.
2. "Growing Role for SOLIC," *Jane's Defence Weekly*, 12 May 1990, 915.
3. TO 1A-10A-34-1-1, *Non-Nuclear Weapons Delivery Manual*, 1 June 1984, 1–56.
4. Mike Spick, *A-10 Thunderbolt II* (London: Ian Allan Ltd., 1987), 87.
5. See Capt Scott A. Reynolds, *A-10 Special Operations Support Tactics Development and Evaluation Final Report* (U), TAC Project no. 87W-003F (Nellis AFB, Nev.: Tactical Air Command, February 1988). (Secret) Information extracted is unclassified.
6. Ibid., 16 (information extracted is unclassified).
7. Spick, 33.
8. Reynolds, 38 (information extracted is unclassified).
9. Maj Harold Tiahrt II, 1st Special Operations Wing/DOX, Hurlburt Field, Fla., interview with author during Air Force Special Operations Command Tactics Conference, Hurlburt Field, Fla., 27 March 1990.
10. Capt Mark Ronco, A-10 Technology Demonstrator Program project manager, 57th Fighter Weapons Wing/DT, Nellis AFB, Nev., interview with author, 10 October 1990.
11. Larry G. Hoppe, Night Vision Corp., Hurlburt Field, Fla., interview with author, 28 March 1990.
12. MCM 3–1, *Tactical Employment* (U), 1 May 1990. (Secret) No information is extracted.

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GIULIO DOUHET

More on Target Than He Knew

LT COL RICHARD H. ESTES, USAF

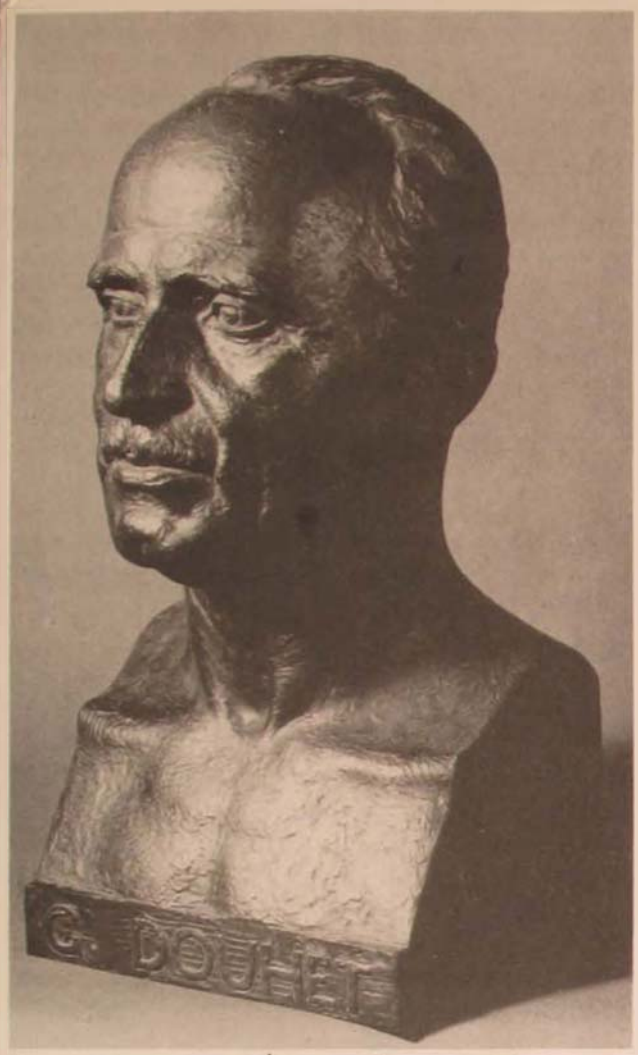
IT WAS like leaning on a giant door that would not give—an isometric exercise which lasted for over 40 years. Such was the cold war. Pressing against the unyielding door on which the seemingly unmovable Russian bear was leaning from the other side produced over a generation of frustration—and stability. Now the door has flung open, and the United States and its allies find themselves falling through, landing with a thud, and looking up with a sheepish smile. As we get up and dust ourselves off, saying, "Darn right—about time," we find ourselves in unfamiliar surroundings.

On the other side of the door we do not find an orderly society, rid of oppression and waiting for a little democratic touch-up paint, but something akin to Alice's Wonderland. Indeed, the situation is so dreamlike and confusing that it may call for a whole new way of thinking. Gone, at least for a while, is an enemy we could count on, as well as the world stability brought about by this superpower standoff.

Putting aside purely diplomatic considerations that will certainly provide endless entertainment for the US State Department, how does our military prepare itself for the coming era? How should we allocate and arm our forces? In order to produce a plan for the future, we must consider such questions, many of them seemingly unanswerable: Who is the enemy? What are his capabilities? Will the next war be limited or general? Is it even possible to conduct a general war without destroying the world? Is the expected enemy the one we will actually fight? Anyone claiming to have precise answers to these questions is uninformed; experts—aware of the world's volatility—are the least certain of all. But Gen Giulio Douhet, the maverick Italian air strategist, gone now for 60 years, had much to say about these matters. Although some of his specific recommendations were wrong, his general theories may provide a blueprint for the future.

The Strategy of Douhet

As early as 1921, General Douhet suggested that the solution to the next war—whenever and wherever it came—was not to conduct it like the last one but to use high technology to win it before the opponent can respond: "Victory smiles upon those who anticipate the changes in the character of war, not upon those who wait to adapt themselves after the changes occur."[1] Contemporary military planners ignore these words—Douhet's greatest contribution to war-fighting strategy—at their own peril. Indeed, we should use them as the basis for our plan for the 1990s and beyond.



Douhet was a product of World War I and witnessed all of the carnage that resulted when outdated tactics and strategy went up against high-technology weapons. Selected in 1912 to lead Italy's first aviation battalion,[2] he saw firsthand how ineffective the land battle had become in total war between modern powers. He was convinced that high technology—machine guns, poison gas, and aircraft—made warfare between large land armies obsolete. Further, he was certain that the technology of land warfare favored the defense.

For instance, if a World War I soldier in a defensive position (e.g., a trench) had a gun that fired one shot per minute and the attacker took one minute to cross the terrain to the entrenched soldier, Douhet reasoned that two attackers could overrun the position. However, if the defender had a weapon that could shoot 100 rounds per minute, the enemy would have to send 100 victims and one victor to take the defended ground. And if the trench were protected by barbed wire that prolonged the trip across no-man's-land to five minutes, 500 bodies would litter the battlefield before the last attacker took out the defense.[3] Thus was born the concept of the force multiplier in military planning, accompanied by the demise of the ground offensive (at least according to Douhet).

Douhet's calculations seemed precise to a fault, leaving no place for errant bullets or—as Paul Fussell points out in his book on the misery of war—"natural forces like wind and weather and psychological disruptions of purpose like boredom, terror, and self-destructiveness."[4] In other words, Clausewitz's "fog of war." Such naïveté shows up again in Douhet's bombing plans; nevertheless, the foregoing illustration demonstrates the effect of technology on warfare. Moreover, his conclusion that defense had the upper hand was essentially correct: as many as 60,000 troops in a single battle were killed in ill-advised charges, and, as a result, World War I bogged down into what he called "crystallization of the lines,"[5] sending the conflict into a stalemate.

Thus, Douhet announced the end of the era when surrogate armies roamed Europe (or anywhere else) and fought wars for their countries. Technology had converted land wars into defensive struggles, which were destined to become stalemated, obviating any possibility of clear-cut victory. All future wars would be either total or general and would involve entire nations. That is, the dirty work could not be left solely to the soldiers (some of whom at times in history had been mercenaries)—civilians, too, would be involved in the next war. Most important, Douhet suggested that by giving the air force complete independence from the other services and by making the airplane the preeminent weapon system in the military arsenal, air power could become the instrument of victory in the next war.[6]

Command of the Air

Douhet believed that, with the advent of technology, the army and navy had become "organs of *indirect* attrition of national resistance." The air arm, on the other hand, could act directly to break national resistance at the very source. But not just any air force would do. Douhet rejected the idea of an auxiliary air arm of the army or navy or a collection of "knights-errant" flying fighters. Rather, he called for a fleet of massive, self-defending bombers that would dominate not only the

Douhet, who saw the carnage of the World War I battlefield, overstated his case by saying that air power would make land armies mere auxiliary forces. Nevertheless, he still has much to teach us.

enemy, but also the military budget of Italy—or any other country that would listen to his ideas. He wanted an air force that could win not just air battles but total command of the air. This command of the air would have a debilitating effect on the capability of land and sea forces, which would be relegated to a secondary role in future conflicts. The army and navy would remain part of an "indivisible whole" of the three armed services but would no longer be a significant factor in successfully resolving a war.[7] With the ascendance of the air force, "the history of the war ... presents no more interest."[8]

A Giant Bomber Fleet

In keeping with his vision, Douhet suggested that countries maintain modest armies and navies and devote most of their attention—and money—to air power, specifically bombers. Immediately after commencement of hostilities, these aircraft would be used against countervalue targets: population centers, transportation nodes, manufacturing sites, and important buildings, both public and private. The attendant devastation would cause the people (as opposed to the military) to lose the will to fight, and the war would end quickly.[9]

The earlier the air attack the better, according to Douhet. He reasoned that waiting for an official declaration of war could be disastrous because the opponent himself might seize the opportunity for a first strike. He suggested using for the attack a combination of high-explosive, incendiary, and chemical weapons, with emphasis on the latter two. The explosives would be disruptive, the incendiaries would set fires and do the real damage, and the gas bombs (delivered last) would enhance the incendiaries' effectiveness by keeping fire fighters away. To be sure, this combination of weapons was quite nasty, and using them probably violated principles of gentlemanly fighting—but an early termination of hostilities would save lives. Douhet argued that since war is amoral—regardless of the methods—and inevitable, warring nations should get it over with as soon as possible. He was convinced that the populace under attack would give up quickly: "The time would soon come when, to put an end to horror and suffering, the people themselves, driven by the instinct of self-preservation, would rise up and demand an end to the war."[10]

No Defense

Douhet did not favor expenditures for any kind of defense against an air attack, remarking that "viewed in its true light, aerial warfare admits of no defense, only offense."[11] Writing before the advent of radar, he maintained that such a defense was untenable since any given country has more countervalue targets than it can defend. Specifically, because no country could determine whether an attack were imminent, it would have to defend all possible targets. Even if detection of an attack were possible, the enemy's selected target would remain unknown.

Given this attitude (a little surprising in light of Douhet's vision in other areas of technology), his answer to defense was to knock out the opponent's air force before he has a chance to use it; this tactic was his only concession to counterforce targeting. (To Douhet, using planes against an opponent's army was useless. Aircraft might kill two-thirds of the enemy troops, but the other third might still be willing to fight. Furthermore, the effort would not stop the opponent's war-generation capability or, more important, affect the average citizen.)[12] Although some of his fleet of self-protected flying fortresses would be lost, he felt that most would reach their targets. After taking out the opposing air force, one's own air force would have air superiority and could then fly to any target unscathed.

Few Fighters

With regard to fighter aircraft, Douhet argued that—if they were used at all—

fighters should protect the bombers. Certainly, they should not be employed in a futile defense of the homeland, and they would be completely wasted in engagements with other fighters because only a few enemy planes are destroyed, no land is captured, and the enemy's will is unaffected. All glory—no results.[13]

Douhet was equally opposed to using what he called auxiliary air forces with the army and the navy. Aircraft employed by surface forces would be wasted since, to his way of thinking, the latter's efforts could never be decisive. A country would be better served by using its resources to build more bombers. He *did*, however, favor limited use of reconnaissance aircraft for target selection and escort for bombers.[14]

Like his computations for machine guns, Douhet used exact calculations to determine the effect of individual bombing attacks. He suggested that 10 aircraft carrying two tons of bombs each could destroy everything within a radius of 250 meters, which he called a "bombing unit." (Similarly, he used "fighter units" for protection of his bombers.)[15] By determining the number of bombing units required to destroy a given target, he was able to size his force. Thus, Douhet attempted to make an exact science out of the very imprecise task of killing people.

The Efficacy of Douhet

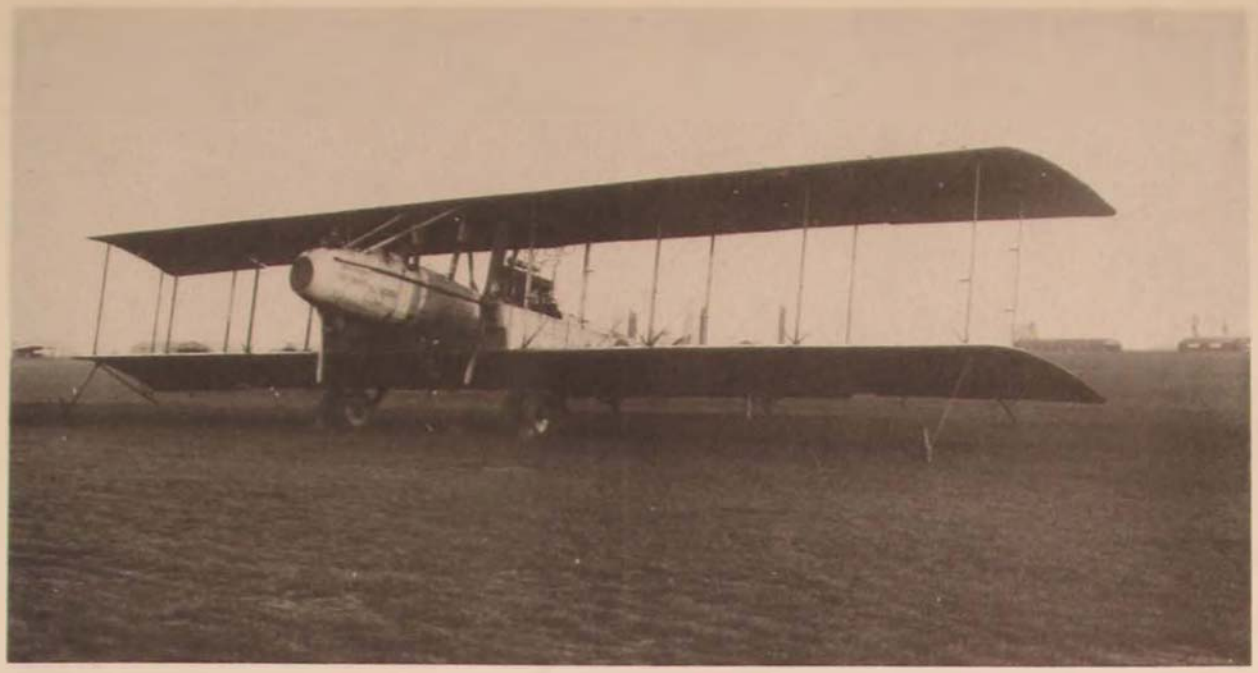
At first glance, events since Douhet's time seem to disprove his theories about air power. Take, for example, the German blitz during the Battle of Britain. The Germans poured so many bombs on London, Coventry, and other targets in 1940 and 1941 that if any people had reason to lose their will to fight, the British certainly did. Instead, the bombing strengthened their resolve and made heroes out of the Royal Air Force fighter pilots who defended their country.

However, we must note that the Germans did not use chemical weapons on top of the incendiaries, as Douhet suggested. Had they done so, and if London or some other city had burned to the ground with no chance to rebuild—or if the land victory in Germany and the atomic bomb in Japan had not overshadowed the devastation of Hamburg, Dresden, and Tokyo (which conformed somewhat to Douhet's vision)—perhaps the outcome would have been different. To this extent, Douhet's theory did not get a full airing. But other examples from World War II show that air power did not win the war by itself.

The B-17, B-24, and several other aircraft were exactly the types of platforms that Douhet had envisioned to win command of the air. They were relatively accurate, long-range bombers and were heavily fortified with turret machine guns for self-defense. Further, they were produced in large numbers in a short period of time. But both the Allies and the Axis produced equally large numbers of fighters and developed radar and accurate antiaircraft weapons. Therefore, bombers alone were unable to fly undetected and unopposed to targets deep within enemy territory.

But the air war in World War II became so large, consumed so many resources, and was effective in so many places (fighter defense in the Battle of Britain, airlift in Burma over "the Hump," naval air in the Marianas, and the bomber campaign against Germany, to name a very few) that Douhet's insistence on an independent air force was vindicated. Indeed, the air force is a separate military service in most nations today. Contrary to Douhet's sense of priorities, however, the US Air Force remains firmly committed to the support of ground forces in all of its missions, with the exception of strategic nuclear operations.[16] The attitude of our military is that, with few exceptions, wars will still be terminated on the ground.

Some point out that Japan's quick surrender following the destruction of Hiroshima and Nagasaki verifies Douhet's theory about undermining the national will. For example, in 1953 Bernard Brodie wrote that, because of the ability of atomic



Although Douhet anticipated the role of bombers in future wars, he did not foresee advances in defenses against aerial attack. In short, Douhet had the same problem as today's planners—predicting the future with complete accuracy.

weapons to quickly destroy the fighting spirit of an entire nation, Douhet was probably more correct than ever (certainly, though, he should not be credited with anticipating nuclear weapons).[17] Others argue, however, that the superpowers' ability to launch under attack and retaliate before being hit precludes the possibility of establishing command of the air (except against nonnuclear countries; even then, there is no assurance that a third party with nuclear weapons would not intervene).

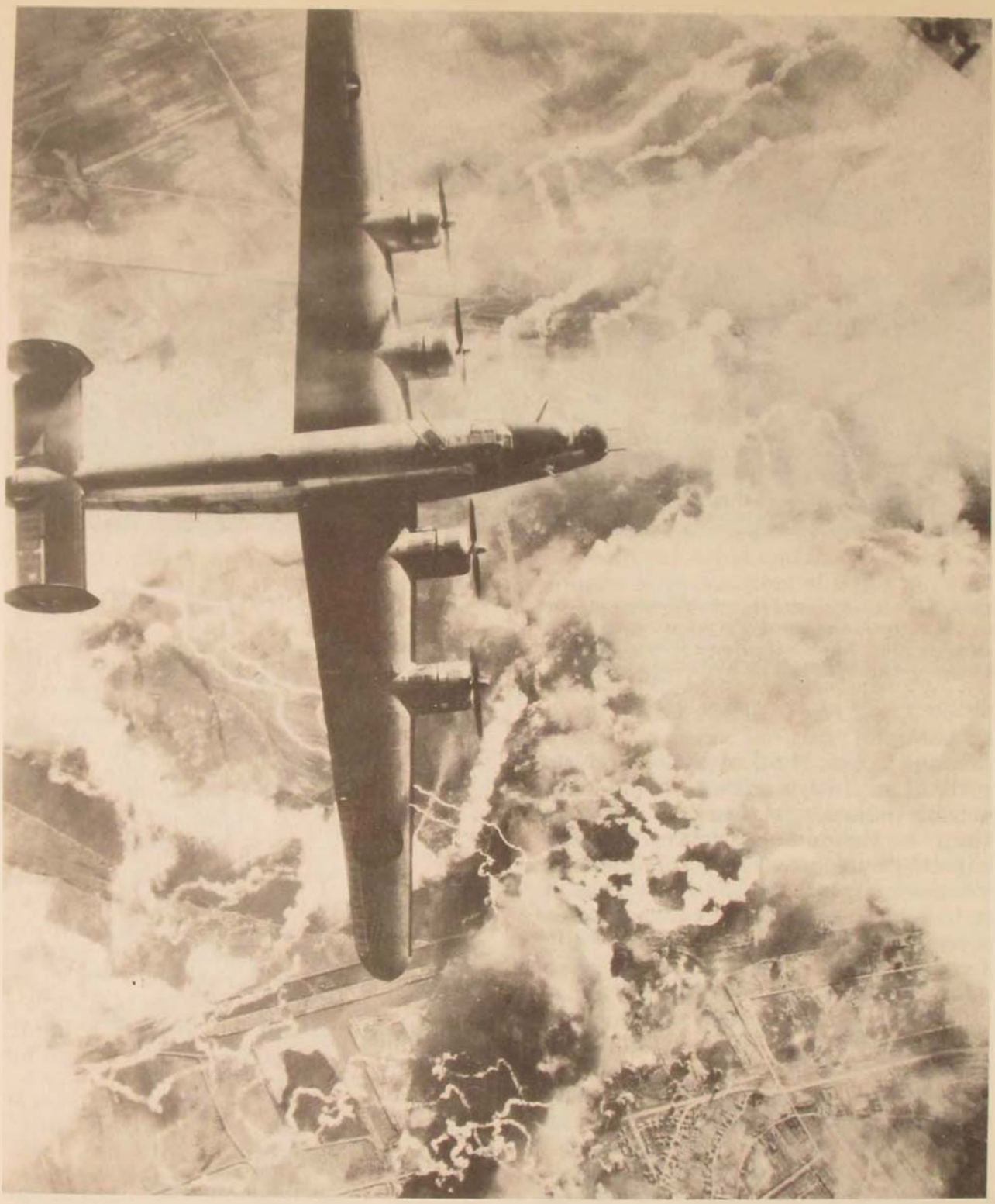
So where do we go from here? We have seen that airplanes alone, although very effective, won't win the big war—unless it is nuclear. Nuclear powers have stalemated each other, making the prospect of a nuclear exchange—much less Douhet's general war—remote. What then? The answer lies in "anticipating the changes in the character of war."

Douhet for the 1990s

Today, there are two schools of thought on the sizing and generation of our military forces. The first, heard around the defense establishment, is that our erstwhile enemy, the Soviet Union, may have changed its intentions, but it can still destroy us. Therefore, we must plan accordingly. The second, a product of those people who think that our economic problems overshadow the military situation, is that we should relax because the Warsaw Pact has folded its collective tent and left town. On the one hand, these views may be complementary—perhaps we can draw down our military and still maintain a credible deterrent. On the other hand, either—or both—may be a prescription for suicide.

Nukes and Uncertainty

Since 1945, at least one fact has become clear: no one knows what is going to happen on the world scene tomorrow, much less next year or 10 years from now. We can also be reasonably assured that world

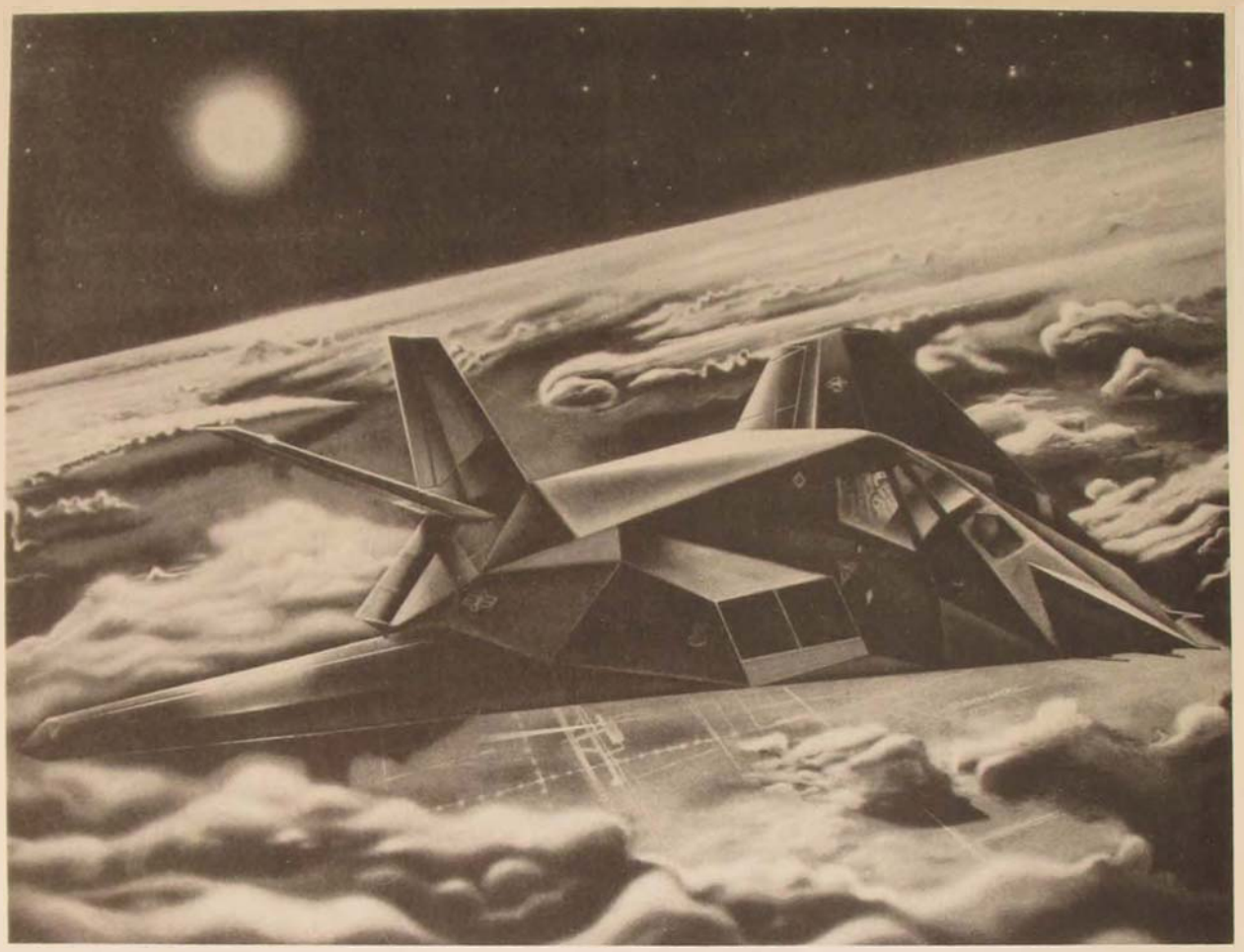


World War II disproved Douhet's theory that massive raids on cities and industry would undermine the enemy's morale and lead to his surrender. Nuclear warfare, though, has given new life to his conjectures.

Douhet's vision of huge bomber formations, self-supporting and overwhelming in their power, seemed to materialize in World War II. The bomber played a significant role in the defeat of Japan and Germany but was not solely responsible. Today, we must consider all of our technological options and not rely on any particular one as the only solution.

peace is not forthcoming and that most countries will need some kind of military capability. Had they been polled 10 years ago, many people would have said that the world would eventually be destroyed by nuclear weapons. Today, however, those same people feel that these weapons, by virtue of their very existence, lessen the chance of general war and therefore are a stabilizing factor in international relations. Although there are no guarantees, this concept has held true since 1945, and our trigger finger hasn't even itched since the Cuban missile crisis in 1962. Thus, continuation of nuclear modernization and deployment of weapons in sufficient numbers to maintain some sort of worldwide balance seems a prudent course of action and vital to our national policy. Although Douhet never mentioned the concept of deterrence per se, the principle is reminiscent of his own precepts, with a twist. That is, the advantage belongs to both sides—not just one. Beyond the nuclear foundation, we need to stop in our tracks and review every bit of past thinking to find the best answers to the questions posed earlier.

The number of possible scenarios in such a review precludes a comprehensive examination, but citing a few will demonstrate the difficulty of planning for them. First, Gorbachev could be deposed, either through the political process or a military coup, and a hard-liner could come to power. This action might reverse the clamor for independence that has swept



Stealth technology provides one way of preparing for multiple and changing threats. Capable of performing in the maximum-threat environment because of its radar-evading capabilities, the stealth aircraft is valuable in other areas of the spectrum of conflict as well.

Eastern Europe and has moved to the Soviet republics. Second, Eastern Europe, chafing under the rule of ill-chosen popular leaders, could find itself in civil war from the Baltic to the Black Sea. Third, Soviet republics could take the Lithuanian model to the extreme and elect open revolt. Thus, Gorbachev or his successor could find himself running, as George Will said, "the Duchy of Moscow" (but perhaps with a finger still on the nuclear trigger). Fourth, the two Germanys, moving inexorably toward reunification, could withdraw from NATO—shattering that organization—and become a real or perceived threat to the rest of Europe. Fifth, the non-Soviet Warsaw Pact countries could join NATO or some new alliance while the USSR festers in civil war.

Last, the US and USSR could become allies in a war in the Middle East or in one against nuclear-armed terrorist nations, or African nations engaged in border and food wars. Which scenarios are likely? We just don't know. One man in power at the right place can make all of the difference—witness Stalin, Ceausescu, Noriega, Castro, and Hitler. Therefore, the US must use the most complicated of all force-structuring strategies: hedging.

Ways, Means, and Ends

By hedging, we mean the management of risk to our national interests. Any strategy is a balancing of desired outcomes (ends) against ways and means to accomplish those ends. Risk is the mismatch between any of the three elements. When military planners seek to minimize risk, they must address several matters: perceived threat, possible scenarios, available technology, direction of planning influence (top down or bottom up), mission, and money available.

Traditionally, the US has used the perceived threat as the basis for military planning. When possible threats outnumber any conceivable mix of forces, we use a "level of effort" approach—assigning available forces to perform at a certain level, regardless of the threat. Defense of the continental US is an example. All of the other factors weigh in at some point in the planning process, but the second most notable element (in addition to threat) is the monetary one.

We would like to have enough forces to meet the threat with minimum risk, but the available dollars usually do not allow that luxury. One does not need a Phi Beta Kappa key to realize that reductions to the defense budget are in the offing. The perception, accurate or not, is that the threat has gone south, so the military needs fewer bucks. With that as a given, available finances must not be used to sustain an artificial troop level that was never enough in the first place to match up with Warsaw Pact forces. That is, the fact that the US is morally opposed to using its troops as cannon fodder obviates any possibility that we can ever outnumber the forces of a country that is less scrupulous about its troops. Consequently, we are left to hedge our bets and apply money where it will most likely have some effect. Specifically, we can invest in superior technology and readiness for the next war. Our people must be happy, well equipped, flexible (ready to go anywhere since they may not be prepositioned), and prepared for the buildup when and if it occurs.

In the event of such a buildup, having the most modern systems on the production line would require only a surge, rather than a retooling, when time may be of the essence. In a drawdown like the one we are in now, Congress *must* fund the most advanced systems available (including sufficient modern airlift and sea lift). Saddling a reduced force structure with systems from the last war would be a fatal mistake. Not only must we modernize, but also we must reshape our thinking. That is how the United States should hedge. Douhet would be proud.

To the Future with Douhet

We have spent the past 40 years trying to envision what a war in central Europe would be like. Perhaps we should stop thinking of that location as the most likely place for the next war. Relatively speaking, we may be at the same point in modern warfare that Douhet found himself in World War I. That is, just as nineteenth-century weaponry was no match for the machine gun, perhaps twentieth-century combat aircraft are no longer any competition for modern-day defenses—at least in a maximum-threat environment. Like Douhet, we should redirect our attention and look for the next leaps in technology, some of which are already here: long-range standoff weapons, accurate tactical ballistic missiles (heretofore anathema to Air Force planners), drone aircraft, and stealth technology. We should, however, continue to include aircraft in plans that we draw up to counter sophisticated threats, regardless of the risk. But we should realize that they will most likely be used to dominate a limited war. We should have no aversion to using B-2s (which would still be earmarked for our nuclear forces) in a conventional role against Libya or F-117s against Panama. Because we frequently have air superiority in a limited war and because such high-tech aircraft are highly survivable, the chances of losing them are remote. Furthermore, these aircraft could

also survive the higher threat presented by a war in central Europe—at least until the next leap in defensive technology comes along. Employment of these platforms could very likely lead to an early cessation of hostilities and the saving of lives, much as Douhet envisioned.

Finally, we must continue to pursue technological improvements in the nuclear triad (intercontinental ballistic missiles, manned bombers, and submarine-launched ballistic missiles) since it is our insurance policy against major war. For the moment, our focus should be on the Trident D-5 missile, which will provide undetected hard-target kill. But as technology moves forward, it seems almost a foregone conclusion that some day the oceans will become transparent to defenses, and we must plan for that contingency. We must not neglect the other two legs of the triad. We need to keep thinking, because technological advancements in one leg of the triad may make one of the others obsolete. For instance, perhaps a dyad of stealth bombers and submarine-launched missiles—or some other combination—is the ticket for tomorrow.

The world changes. The military that does not change with it or that is guilty of outmoded thinking can no longer be effective. Although Douhet's theories have not borne up in a number of critical areas, he was right on target with a statement that still speaks clearly to us: "Those nations who are caught unprepared for the coming war will find, when war breaks out, not only that it is too late for them to get ready for it, but that they cannot even get the drift of it."[18] □

Notes

1. Giulio Douhet, *The Command of the Air*, trans. Dino Ferrari (1942; new imprint, Washington, D.C.: Office of Air Force History, 1983), 30.
2. Lt Col William H. Tomlinson, "The Father of Airpower Doctrine," *Military Review*, September 1966, 28.
3. Douhet, 158.
4. Paul Fussell, *Wartime: Understanding and Behavior in the Second World War* (New York: Oxford University Press, 1989), 15.
5. Douhet, 159.
6. Ibid., 34.
7. Ibid., 187–88, 198.
8. Ibid., 394.
9. Ibid., 57–58.
10. Ibid., 58.
11. Ibid., 55.
12. Ibid., 188.
13. Ibid., 41–46.
14. Ibid., 121.
15. Ibid., 35–41.
16. See, for instance, Gen Robert D. Russ, "The Air Force, the Army, and the Battlefield of the 1990s," *Defense 88*, July–August 1988, 12–17.
17. Dr Bernard Brodie, "The Heritage of Douhet," *Air University Quarterly Review*, Summer 1953, 69.
18. Douhet, 30.

Ricochets
continued from page 3

C2C Diego M. Wendt's article "Using a Sledgehammer to Kill a Gnat" reflected many of the reasons that US strategy in counterinsurgency warfare failed in Vietnam. After spending the better part of a decade in the western Pacific, I can immediately think of two recent problems involving Communist insurgency—the Philippines and Thailand. A few years ago, while I was TDY to Mindanao, the Philippines, a hotel receptionist told my group that her husband had been murdered four years earlier. When queried about who had done it, she replied, "NPA [New People's Army], the military, what's the difference?" While the current situation may have improved somewhat under President Corazon Aquino, the Philippines may want to take a chapter from Thailand's success in dealing with Communist insurgency.

Although the reasons for each insurgency are similar, the outcomes have been quite different. Communist roots in the Philippines can be traced to the Hukbalahaps, who fought the Japanese during World War II before taking up arms against the Philippine government. The Communist insurgency in Thailand had its roots even before the coup that toppled the absolute monarchy in 1932. The earlier establishment of commercial agricultural operations in both Thailand and the Philippines created a population of heavily indebted, landless peasants that became a cradle for insurgency.

Another similarity between the Thai and Philippine situations was the military establishments in both countries. Upper-echelon military officers got promoted as "favors" from the central government. Front-line officers and noncommissioned officers, who bore the brunt of the Communist rebellion, suffered stagnant careers because of favoritism. This caused the formation of the Young Military Officers Group in Thailand in 1973, similar to the formation of the Reform the Armed Forces Movement (RAM) in the Philippines. Both groups were concerned that corruption and political favoritism would ultimately result in success for the Communists. In Thailand, three years of upheaval trying to establish a parliamentary democracy led to mob violence in 1976 and a return to military rule. The government's situation in Thailand was ideal for Communist adventurism.

How did Thailand overcome the problem, and how can the Philippines benefit from the Thai lesson? A backer of the Young Military Officers Group was Prem Tinsulanond, a Thai army commander. With the young revisionists' support, Prem became Thailand's new prime minister. Prem promoted the advancement of democracy in the hinterlands. It was the beginning of the end for the Communist Party of Thailand (CPT). Instead of setting his primary sights on the Communist rebels, Prem targeted the underlying causes of the rebellion. Instead of an army that sought only to "search and destroy" Communists, the Thai army concentrated on development of the rural countryside. National development became the army's number-one priority. This, coupled with mass mobilization—a tool used by the Communists in the past—was the key to their demise. Instead of just army units, local militias were formed to provide civic action projects, road-building projects, and agricultural projects, as well as provide protection for these new resources. An active psychological-warfare campaign was instituted throughout the country. Communist defections became a flood, the CPT lost popular support in the countryside, and their movement failed.

Perhaps an in-depth study by the New Armed Forces of the Philippines into the Thai solution to their Communist insurgency, coupled with an effective land-reform program, will bring an end to the New People's Army, the National Democratic Front, and the Communist Party of the Philippines. Most of all, let us hope that it brings peace and prosperity to a land that has never had much of either.

MSgt Stephen G. Southerland, USAF
Scott AFB, Illinois

MORE KUDOS FOR OUR AUTHORS

I enjoy high-tech military thriller books. Tom Clancy and Dale Brown are among my favorite authors. Lately, I've found many articles in the *Airpower Journal*, such as "Air and Space Forces: The One Endures as the Other Emerges" (Spring 1990), that satisfy my reading taste. I just want to say thanks to all of you who have contributed to the publication.

TSgt Alan D. Paylor, USAF
Zweibrücken AB, Germany

Master of Airpower: General Carl A. Spaatz by David R. Mets. Novato, California 94949: Presidio Press, 1988, 448 pages, $22.50.

David Mets, with the sponsorship of the Aerospace Education Foundation and the Air Force Historical Foundation, has written a welcome and valuable addition to the literature of air power. *Master of Airpower* is a well-written and readable study of the evolution of American air power as it developed as part of the Army and emerged as an independent US Air Force in 1947. Mets uses the experiences of Gen Carl Spaatz, a major actor in the growth of American air power, to trace the development of US aerial combat capabilities and concepts from their origins within a limited support arm of the Army, through the frustration of creating a combat force in World War I and the challenges of the interwar years, to the maturation of the US Army Air Forces during World War II. The reader is treated to a well-guided tour of the growth of theory, doctrine, and organization of American land-based air power. Although some areas are given rather brief treatment, such as the formation of an independent USAF, the work serves as a solid survey of doctrinal and organizational history.

The book is a bit less satisfying in its stated purpose of studying an important man—Carl Spaatz. This reader constantly wanted to know more about Spaatz—his opinions, emotions, and struggles with difficult issues. Mets does an exceptional job of placing Spaatz in the context of his times and of explaining the rationale for some of Spaatz's key decisions and positions on evolving doctrinal issues. However, Spaatz himself remains somewhat two-dimensional and a bit of an enigma. A stronger development of Spaatz's personal views and concerns on such controversial events as the pre-Normandy bombing campaign, the bombing of Dresden, and the decision to drop the atomic bomb could have added much more depth to the personality of a truly great air leader.

Spaatz does emerge from this study as an interesting role model for air leaders. Although often pictured as a doctrinal conceptualizer, Spaatz appears in this book as—above all else—a strong, pragmatic leader who always gets the job done, often in the face of serious difficulties. Contemporary service leaders and junior officers could benefit from an examination of Spaatz's career. This type of personal assessment is especially valuable today, when the USAF faces challenges to its doctrine and force structure. Indeed, these challenges may rival those encountered in the interwar years when the Air Service/Air Corps struggled to establish an organizational identity and gain adequate funding from Congress. The primary problem with using Carl Spaatz as a role model is that, like many of the founding fathers of the Air Force, he was an outspoken maverick and definitely not a spit-and-polish military officer. He was a doer who aggressively attacked problems and sometimes made mistakes (which would likely kill the career of a modern USAF officer). He was respected for his skills and allowed to overcome his mistakes to rise to the top of his profession. Thus, Spaatz effectively led large combat forces in war and served as the first chief of staff of the independent US Air Force.

This story of Gen Carl Spaatz is an important one and is recommended reading for all members of the USAF, as well as anyone interested in air power. David Mets has produced an admirable study of the roots of modern air power doctrine. Members of the modern Air Force can better understand the present by understanding the origins of basic organizational perspectives. The insights to be gained from *Master of Airpower*, together with the steadily growing collection of books on the evolution of air power and on great air leaders, allow today's leaders—and tomorrow's—to take a step towards better leadership and victory in any conflict. By heeding these insights, we ensure that we "know ourselves"—one of Sun Tzu's key prerequisites for victory.

Lt Col Jerome V. Martin, USAF
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Pilots and Rebels: The Use of Aircraft in Unconventional Warfare, 1918–1988 by Philip A. Towle. London: Brassey's Defence Publishers, 1989, 212 pages, $53.95.

The notion may surprise some people, but professional historians do have a certain value. Military operators tend to be pragmatists—relying on direct experience, taking each task as it comes, and priding themselves in having their feet on the ground. Although this trait is important for confronting the often brutal complexities of warfare, it can be limiting—prompting them to miss the forest for the trees. Historians, by contrast, can analyze a wide variety of such experiences and synthesize the lessons learned into useful conclusions for future action.

So it is with Philip Towle's book. Towle, a historian and fellow at Queen's College, Cambridge University, takes us on a well-written, succinct, historical tour of the French, British, American, and (briefly) Soviet experiences with air power in guerrilla warfare. He shows how aircraft were used in imperial policing in India, Africa, and the Middle East; in supporting resistance movements during World War II; and in fighting the multitude of insurgencies that infected international relations after 1945, ranging from Greece to Afghanistan. The portrait is fascinating; the author weaves a good tale. The reader sees both the successful uses of air power, as with the British in Iraq (1920s) and Malaya (1950s), and its failures, including the French and American experiences in Vietnam.

The history is good, but the lessons are even more compelling. To some readers, these lessons may be disappointing. People who love airplanes want their weapon systems to be fast, sophisticated, heavily armed, and manned. The record shows, however, that this desire often blinds us to practical alternatives for handling real problems. Based on his review of air power's 70-year history with unconventional conflicts, Towle hazards conclusions about aircraft in insurgencies from the point of view of both government and insurgents. Some examples:

- From a government point of view, air power can be the great equalizer against highly mobile guerrilla units, but it cannot defeat an insurgency by itself, particularly one supported by the majority of the population.
- Insurgency is a test of endurance. For this reason, cheap or obsolete aircraft often have been more durable and useful than expensive, sophisticated ones.
- The ideal counterinsurgency aircraft is one with a slow stalling speed and a cockpit with wide visibility, features particularly important for aerial reconnaissance.
- From the insurgent point of view, an effective counterair campaign can be waged by using selective ground attacks on air bases to destroy aircraft and kill pilots.
- If guerrillas enjoy air superiority, as they did in Yugoslavia in 1944, the combination of air power and mobile guerrilla tactics can devastate conventional defenses.
- Insurgents should make government air strikes appear indiscriminate and excessive in their use of force, even if they are not. Insurgency, after all, is a war of perceptions.

This last point suggests perhaps the most important lesson: for the government side, firepower must be used judiciously at the right time and place and in the right amount. The use of massive firepower to handle insurgent problems is very tempting, yet this tactic can quickly reach a point of diminishing returns. Bombing the Iraqis in the 1920s, for example, had a tremendous psychological impact, but only until the novelty wore off. In the long run, the liberal use of firepower tends to create more guerrillas than it kills. As British and American experiences show, it also can lead to international criticism and loss of public support.

This thought is not a new one, and much has been said in recent literature on low-intensity conflict about the relatively greater importance of the "administrative function" of air power—airlift and mobility. Towle points out, however, that even these aspects have their limitations, as shown in Vietnam at Dien Bien Phu. Raw firepower may take second place, but it is still a critical element at key moments. Time and again, the destructive capabilities of air power have provided the margin of strength necessary for friendly forces to corner and defeat guerrillas or to extricate friendlies from untenable situations.

As always, the real solution in conflicts of this nature is to meet the opponent's political grievances. This doesn't mean being co-opted by the opposition. Rather, it involves (1) understanding why people take up arms and (2) mitigating the cause. Towle points out that the flexibility and versatility of air power directly serve this end by enhancing a friendly presence throughout the area of concern. Further, appropriate cooperation between component services can prove useful in this endeavor. For example, ground-force control of discrete air force units—which appears to violate the Air Force's

doctrine of centralized control—is often the optimum arrangement when guerrillas alone are the opponents and there is no significant air-to-air threat or little conflict in selecting target priorities.

Towle's book is important for the professional officer in understanding *how* to use air power. It is well indexed and has a good bibliography. Also quite interesting is the appendix, which describes 75 aircraft types used in guerrilla war since World War I. Towle's volume should be part of the library of any officer hoping to divine the role of the Air Force in the twenty-first century.

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A Lonely Kind of War: Forward Air Controller, Vietnam by Marshall Harrison. Novato, California 94949: Presidio Press, 1989, 285 pages, $18.95.

Yes. Read this one. *A Lonely Kind of War* is a brisk, assimilating account of Harrison's daring, dirty, respectable tour of duty as a forward air controller (FAC) in Vietnam during 1969. Based upon my own experience—same time, same country—Harrison kept the faith with the FAC brethren. By changing a few names, tinkering a tad with some geographical places, and not criticizing the fighter pilots too badly, he tells the real story without pointing fingers at actual personalities.

The book commences with the statement "The radio came alive with the flight leader's voice just as I saw them." In a no-kidding, there-I-was way, you are thrust into a vivid slice of combat life. With Harrison grappling the controls of his OV-10 and skimming the trees at 140 knots, you begin to realize he is the central player in a genuine "goat rope" of a troops-in-contact air strike. He twists and gyrates above a foreboding jungle, while dodging monsoons and tracers from an unseen enemy. He listens to the crackling, screaming voice of the pinned-down US Army patrol leader. He commands the 500-knot fighter-bombers while surgically stitching rounds from an anxious artillery battery. He diplomatically placates the prickly old fart of an airborne brigade commander. And he orders more "tactical air" from his own base-camp radio link to the Air Force—all at the same time—on five different radios. Thirty-three pages later, this FAC mission is accomplished, as an exhausted Harrison is wearily dragged from the cockpit by his crew chief. Just another day—Harrison's 69th—of the year-long tour.

This outstanding first-person experience contrasts in perspective to the two other popular Vietnam-era books about forward air controllers. *Bat-21*, by William C. Anderson, was written from the viewpoint of a downed airman depending on a FAC for survival and rescue. Christopher Robbins, neither a FAC nor a pilot, wrote *The Ravens*, based upon a collection of pilot experiences from Raven FACs, but he really wasn't there. Marshall Harrison, however, lived the role and told the story from the actual, lonely perspective of the airborne forward air controller.

Air-to-ground war stories don't get much better than this one. The account follows a familiar path, beginning with stateside checkout as an instant fighter pilot in the AT-33 and his FAC upgrade in the OV-10. The tour continues with "snake" (jungle survival) school at Clark Air Base, the Philippines, and FAC "U," his in-country checkout. Next, we witness the visceral experience of a journeyman FAC, crowned by his tactical air support of the war in Cambodia that wasn't supposed to be going on "over the fence."

Harrison keeps his view of the mission clear. It boils down to short rounds versus haircuts. The FAC's ultimate goal in close air support is accurately controlling fighters to drop ordnance on the bad guys, in close proximity to—but never "short" on—the good guys. FACs learn to channel attention on the mission and not sweat the small stuff. When you spend your tour sweating with the Army, living in and flying from the dusty, muddy forward echelon, entrusted with the singularly independent responsibility of controlling dozens of multimillion-dollar fighters that are dropping bombs in close proximity to fellow Americans, it seems grossly out of proportion to be told to get a haircut by some rear-echelon headquarters weenie.

Some of the characters may seem a bit stereotyped, but that's just the way men behave during a war: some guys become John Wayne, some don't cut the program, and others just manifest their own personalities. But all become vivid characters. Harrison makes it easy to visualize the crusty US Army brigade commander, cowboying around in his helicopter,

microleading a platoon and every echelon in between. You can also picture the fast-track academy type who can't overcome his fears. Harrison packs him off to join the ranks of the air-conditioned staff pukes in Saigon.

Not forgotten are Harrison's own frustrations. He was initially humbled during his in-country checkout by the frenzied pace of forward air combat. Later, in a shockingly personal episode, he recalls survival procedures in his desperation after being shot down. Finally, we see that it was hard to live with flying the "big lie"—supporting the CIA's out-country war in Cambodia without the open support of the American people. But, like a good soldier he saluted, said, "Yes sir," and did the job.

Harrison's experience is appropriately woven with the acid wit of combat humor, including the incident about the unfortunate pilot at jungle-survival school who, while sleeping, got bit on the lip by a Hershey-bar-loving rat. Although deadly serious, he draws chuckles over the assault on the cobra that commandeered the urgently needed bunker during a rocket attack. And his experiences with some of the Aussie pilots who served combat FAC tours flying USAF light aircraft are uproarious. About the only thing he left out was the Air Ground Operations School at Hurlburt Field, Florida. Like the rest of us who were bored with a ground school about how to FAC with the Army, he probably slept through it too.

Other than savoring the daring exploits of the FAC, why read the book? What does the contemporary Air Force officer need to know about FACs? The FAC force is dying. It took about 20 years to exhaust all their combat experience. Guys who stayed in the tactical air control system rarely got promoted to lieutenant colonel, much less colonel. No new dedicated FAC aircraft have entered the service since the OV-10 (the OA-10 was reroled). The same thing happened after World War II and Korea, which is why we began Vietnam performing forward air control in O-1s. Will we need the airborne FAC again? Maybe. Even if sensors and snooping platforms become extremely sophisticated, getting current target information cranked through the intelligence "fusion" process will always be frustratingly slow. Nothing can replace the human "eyes of the fist" above the battlefield. The FAC experience is worth keeping alive; Harrison tells it like it really was.

Lt Col Dion W. Johnson, USAF
Camp H. M. Smith, Hawaii

One Day in a Long War: May 10, 1972, Air War, North Vietnam by Jeffrey Ethell and Alfred Price. New York 10022: Random House, 1989, 217 pages, $18.95.

One Day in a Long War is an airman's book. Recapitulating the events that happened in the air war over North Vietnam on 10 May 1972—the opening day of Linebacker I—this book supplies the tension and excitement that is missing from the official Air Force study (*The Tale of Two Bridges: The Battle for the Skies over North Vietnam*). The difference between the two books is the fact that *One Day* is based primarily on recorded cockpit conversations, diaries, and interviews.

Writing this book in a journalistic rather than an academic style makes it a "quick read." *One Day* is a chronological narrative of the events occurring on 10 May—from midnight to midnight—as viewed from the cockpit. This perspective gives it the excitement missing from the USAF publication, which was written from a more detached viewpoint. Also adding to the book's interest are the observations from French journalists and the British consul general, which provide the picture as seen from the ground in North Vietnam.

One Day is one of those rare books that can be appreciated by both the general reader as well as the experienced airman. On one level, it is a very basic book, taking pains to explain things to the general reader, such as the reason that the Paul Doumer Bridge presented a tough target and the differences between the various types of aircraft ordnance (electro-optically guided bombs and laser guided bombs). With this help from the authors, the person ignorant of air combat operations quickly "learns the lingo" and is able to follow the movement of the narrative without feeling overwhelmed by technical terms.

On another level, from the standpoint of the air tactician or the aircrew member, the cockpit chatter is invaluable in studying what works and what does not in air combat. The descriptions presented are of dogfights as seen from the cockpit, which are much different than the third-person accounts usually found in official histories. One comes away from this experience with the definite feeling that the aircrews were shortchanged by the reliance on air-to-air missiles to the exclusion of aircraft cannon. The conclusion presented by the authors is that, had the fighters been provided with cannon, their kill ratio would have been much higher in

encounters too close for the use of missiles or in those instances when the missiles turned out to be "duds" (particularly significant in light of the statistic showing a reliability rate for the missiles that ranges as low as 15 percent).

The authors succeed remarkably well in striking a balance between the Air Force and Navy flight operations on that day. In fact, one of the primary points made by the authors is that the Navy initiated training at its "Top Gun" school just prior to Linebacker, but its worth could not be assessed until large-scale air-to-air combat resumed—which it did in this operation. Their conclusion was that Top Gun did prove its worth, in terms of both lives and aircraft saved.

For this reader, the book had three high points. One, of course, was to be able to read the thoughts of the crews as they engaged in air combat. One can remember all the stock footage of air combat scenes in years of official Air Force news films, but with this book the reader can better experience the fear and anticipation in the cockpit. Another high point was the informal decision by some of the pilots to "alter" their egress plan from Hanoi in order to fly over the "Hanoi Hilton" and cut loose with sonic booms over the prison in order to let the POWs know they were not forgotten. (But it was disappointing to learn that the POWs did not hear the "sonics" over the din of battle.) Finally, one of the most emotionally moving highlights was the chapter devoted to Capt Roger Locher's 23 days on the ground in North Vietnam evading the enemy forces, and Gen John Vogt's humanitarian decision to pull 119 aircraft from their combat missions to rescue Captain Locher. A common theme in these latter two points is the strong sense of solidarity the reader senses between the members of that exclusive club of aircrew members—in particular, the esprit de corps among aircrews as a factor in maintaining morale. In fact, the supreme importance that General Vogt placed on morale was the guiding factor in his decision.

This book makes an outstanding contribution to the history of air power by making available to the reader a primary historical source—the participants' thoughts while engaged in combat. But its greatest value is its ability to leave the reader with a taste of what it felt like to be an aircrew member in "the most concentrated sky action ever fought over North Vietnam"—one day in a long war.

Ronald Callahan
Placerville, California

High Honor: Recollections by Men and Women of World War II Aviation by Stuart Leuthner and Oliver Jensen. Blue Ridge Summit, Pennsylvania 17294: Smithsonian Institution Press, 1989, 402 pages, $19.95.

Although 45 years have passed since the end of the Second World War, interest in this conflict seems to be stronger than ever—witness the steady stream of books on the subject. With so many new titles to choose from, it is natural to ask what makes *High Honor* by Stuart Leuthner and Oliver Jensen particularly deserving of the reader's time and energy. The best answer is that few books have so comprehensively captured the rich variety of American military aviation in World War II. Here the reader comes as close to experiencing it firsthand as one can without actually having been there.

In their own words, 28 men and women tell their stories—a little about their lives before the war, their role in aviation during the war, and the effect that their wartime experience had on them after the war. The planes they flew represent virtually every conceivable kind of aircraft—fighters, bombers, naval aircraft, and even transports and gliders.

Twenty-two of the 28 are aviators—pilots, navigators, bombardiers, gunners—but to paint a more complete picture, Leuthner and Jensen have also included the experience of a number of aviation support people whose essential role has often been overlooked. These include an aircraft carrier landing-signal officer, a crew chief, a flight surgeon, and an aircraft assembler. For the most part, the recollections are in chronological order. They are also helpfully grouped by branch of service and type of flying.

Leuthner and Jensen have succeeded admirably in accomplishing their stated goal: "to examine not the war itself but the memories of a handful of flyers who survived." These memories prove fascinating indeed. From Gerrit Roelofs we learn the intricacies of landing a torpedo plane on a tiny escort carrier rolling in heavy seas. Baldwin Smith, a carrier landing-signal officer, exemplifies the combination of athletic and acting ability needed to project landing instructions to pilots across hundreds of yards of ocean. Kenneth Carlson, a B-17 navigator, describes the sense of unreality he felt the first time he saw a plane shot down—"no sense of feeling or sound ... not really seeing the real thing." Later, while he was lying wounded in a hospital bed, his crew took a di-

rect hit with no survivors. He attributes his survival and their deaths to "the roll of the dice."

Compared with the ground war, life in the air could at times be comparatively easy. Robert Ramer, a B-29 pilot, mentions how important it was to plug in the plane's food warmer so the crew could eat dinner after completing their bomb run. Contrast the warm and comfortable life of a B-29 crew with the hair-raising lot of a fighter pilot. Edwards Park describes the thrill of flying his tricky P-39 Airacobra *Iron Dog*, a plane "as rotten as she was sexy," to its very limits. Realizing there was a limited future in flying like this, he decided one day he "might as well get killed in combat instead of just 'augering in' for fun."

Many common threads run through these recollections, among them a sense of high adventure and a feeling that these were once-in-a-lifetime experiences. One is also struck by the youth of these men and women, by their sense of purpose, and by their unawareness of their own mortality. Readers who flew in World War II will find at least a piece of their experience here. For those of us who did not, *High Honor* is about as close as we will ever get to being there.

Maj James C. Ruehrmund, Jr., USAFR
Richmond, Virginia

Moral Issues in Military Decision Making by Anthony E. Hartle. Lawrence, Kansas 66045: University Press of Kansas, 1989, 180 pages, $25.00.

Hartle is well qualified to write on this subject—no armchair ethicist is he. In addition to holding a PhD and serving on the faculty of the United States Military Academy at West Point, Colonel Hartle distinguished himself in Southeast Asia, where he was wounded and decorated for valor. As he acknowledges at the outset of the work, it is especially in war that members of the military encounter the severest "threat to consistent moral behavior" (1).

The author persuasively argues the need for a "workable guide" which systematically clarifies the rather abstract professional military ethic (PME). Satisfying this need is the expressed goal of the volume, and Hartle does a convincing job of reaching it.

The book is systematic in its approach. However, it is not suited to casual reading. Its measured content is better suited to the classroom or to individual (uninterrupted) reading and reflection. Nevertheless, the book should not be relegated simply to an academic realm. The subject it ably addresses is one crucial to all commissioned and noncommissioned officers (although Hartle intentionally directs it toward combat officers rather than "supporting specialists"). What the text may lack in easy readability, it compensates for in its thought-provoking value. In essence it is not a book to be read, so much as one to be studied.

Hartle begins with a fine synthesis and thoughtful analysis of previous studies pertinent to his own. He foregoes the use of potentially confusing classical ethical categories and terminology. Further, the author's masterful use of case studies draws the reader into direct application of the concepts he discusses. He wisely follows each with a "discussion," rather than a solution. (In his introduction he quotes a work of fiction: "'War is not a series of case studies that can be scrutinized with objectivity'" [3].) His analyses are perceptive. Rather than allowing us to flee to a relativism offering situational excuses for its variations, Hartle attempts to provoke the reflective development of a "consistent" military ethic. "Can we justifiably violate the laws of war in order to achieve specific ends?" he asks. If we do, "such situations, repeated with terrible frequency, corrode the soul and warp moral sensibilities" (3). If he is correct, all the more reason to understand and embrace our American PME.

Hartle readily acknowledges that in a pluralistic environment such as our own nation, "any discussion of social or national values . . . will suffer from oversimplification" (86). Nevertheless, he offers an argument for a fundamentally shared American value system. It includes several values thoroughly woven into the fabric of our national morality—commitment to freedom, equality, democracy, and individualism. By *individualism*, he refers to the value placed by Americans on personal freedom, autonomy, and human worth itself.

However, it is not the American value system alone which molds PME. As he traces the various factors, he queries, "Given such disparate influences, can the resulting ethic be one that makes logical sense? If the ethic is to be practically useful in providing moral guidance for action, its provisions must not contradict one another" (29).

Hartle sees three primary influences as the factors which have shaped the American professional military ethic. They are the "functional requirements of military service, the international laws of war, and the core values of

American society." He cites three essential functions of professional ethics in general: to "protect society from exploitation, enhance the image of the professional, and ... articulate a warrant for certain actions morally impermissible for a nonprofessional" (27). He contrasts the function of the Uniform Code of Military Justice, which "defines honorable conduct in a negative sense by establishing what members of the military will *not* do" with the PME, which "emphasizes ideals and positive aspects of conduct" (52).

Hartle isolates two underlying moral principles: (1) people deserve respect and (2) human suffering ought to be minimized. He contends that the former has priority, since the latter "invokes utilitarian considerations" (71). He cites a reference in a US Air Force pamphlet (AFP 110–31, *International Law—The Conduct of Armed Conflict and Air Operations*) to the "'principle of humanity, which forbids the infliction of suffering, injury or destruction not actually necessary for the accomplishment of legitimate military purposes'" (72) and argues that comprehending the proper relationship of these principles to the PME is essential, since the specific, codified "laws of war are incomplete, and will probably remain so" (77).

Hartle points out that although each branch of the service has various expressions of the basic PME and although all affirm our national commitment to the laws of war, "because the American PME is uncodified beyond [its elementary expressions in various military publications] the exact content of the ethic will be a subject of dispute within any group of military professionals" (53). Nevertheless, as a common bond between the services, "the oath and the commission provide the foundation for the traditional idealistic code of the United States armed forces—the code I have been calling the professional military ethic" (44).

His discussion of Duty, Honor, Country includes some timely reflections on the actions of Lt Col Oliver North and Adm John Poindexter. He notes that while "the political arena in which the two men operated is considerably removed from the normal range of activity of a military officer ... they were still presumably committed to the PME" (48). In a different context, he points out that "equating duty with obedience to orders is a common but serious failing of the officers corps" (121). Beyond these three foundational values—Duty, Honor, Country—he also mentions other traditional values, including professional competence, civilian control of the military, and the importance rightfully placed upon the "welfare of the individual soldier" (51).

Hartle emphasizes the moral responsibility of every military officer. He claims that each one must be willing—and able—to serve, should the need arise, as a "corrective within the chain of command." Without suggesting that every order should be challenged or postponed, he states that it is "precisely because of human fallibility [that] the moral judgment of each individual military officer must act as a check on the military system" (116).

He realistically assesses the situation when he states that "not all young soldiers or young officers give serious thought to the professional ethics they are taught. Most simply accept that 'the rules' are such and either attempt to abide by them or choose to violate them for reasons of their own." The problem is exacerbated when "those who make the military a career begin to identify themselves in terms of their role, which makes their objective analysis even more difficult and less frequent." Despite having the rules ingrained in his own psyche during his years as a student at West Point, Hartle encountered in Southeast Asia "numerous morally ambiguous situations" in which the "answers provided by the code as [he] understood it were sometimes incompatible with intuitions of conscience." In this situation, a "justification of the code itself became necessary" (36). Readers of this book may profit from Hartle's dilemma without having to undergo it themselves.

A major contention of Hartle's work is that the military profession is "partially [rather than] fully differentiated." In essence, this means that military officers are not exempt from the common American values and utterly free to operate with independent standards and norms, disregarding broader societal values.

> The military professional, in the preparation for and conduct of war, appropriately takes actions that would be morally impermissible outside the role. The function of the military would not be possible otherwise. Because of their special responsibility to society, however, military professionals must consider and weigh the significance of their actions in terms of the general moral principles which derive from the basic values of society. (118)

"The American soldier in his or her function as the defender of a free society" bears great responsibility, and a careful reading of this volume could be invaluable in better equipping

the career officer to more conscientiously "wield such authority" (119).

A valuable addition to officer training is Hartle's discussion of noblesse oblige—the idea that obligations to act honorably accompany a position of responsibility. He cites the example of the Israeli war hero Nahum Arieli, who ordered a retreat when his position was overrun by a much larger Arab force. Only a covering fire would allow any of the men to survive. His order: "All enlisted men are to withdraw; the officers will cover the retreat" (18).

One interesting historic insight is that "if we consider the rationale for the restraints imposed by the customs of warfare in the distant past ... we will indeed find little evidence of mercy or concern for human welfare. We do find considerable expediency and self-interest." In contrast, he argues that the contemporary "codified laws of war can be traced to underlying moral principles, though non-moral considerations are not to be ignored" (59).

Of particular interest to Air Force readers is the fact that "the incompleteness of the laws of war as a result of new means of conducting warfare is particularly evident with respect to air warfare and aerial bombardment." This situation only promises to grow worse, as in our nuclear age "technological advances have been so rapid and so dramatic that the slow process of achieving consensus through usage has not begun to keep pace" (65). Thus, we have all the more reason to strive to instill within every military officer the maturest possible military ethic. After all, "since no set of rules or laws can provide specific guidance for every eventuality, the 'spirit of the law' may be the deciding factor in those cases in which the letter of the law is not specific or not applicable" (56).

Hartle offers a helpful and concise epilog, summarizing his most important contentions. Using a similar technique to set a clearer course at the beginning of the book could aid readers in more effectively organizing the material in their minds as it is presented. For those who desire to pursue the subject further, he offers a comprehensive bibliography.

While we long for moral absolutes which will "simplify the moral universe" (119), we live in a world where decisions are rarely clear-cut and "certainty in moral judgment is seldom attained" (83). This truth makes Hartle's volume all the more crucial.

Moral Issues in Military Decision Making is a worthwhile book for all officers to read because, most assuredly, "understanding the nature of the professional military ethic and the normative context in which it is applied can make our military leaders more capable and more reliable" (154). Still, even as we ponder its message, we remain all too aware that "the PME and actual behavior are two separate areas of consideration" (45).

Chaplain, Capt, Robert C. Stroud, USAF
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Brats: Children of the American Military Speak Out by Mary R. Truscott. New York 10016: E. P. Dutton, 1989, 256 pages, $18.95.

Those of us in uniform are well aware of the demands which the military system places upon us. A casual reading of back issues of the *Air Force Times* reveals a number of them clearly—frequent moves, long hours, family separations, low pay, inadequate housing, poor promotion opportunities, and low status. What is not readily apparent, however, are the problems of a large subset of military members—dependents. Mary Truscott's *Brats* is an attempt to allow these "disenfranchised" members to tell their own stories about life in military families.

Interviewing 40 former dependents (23 from officers' families and 17 from enlisted families), Truscott—a third-generation military brat—sought a means to test her own experience against that of other people. What she found was a unique culture identified not only by frequent moves, but also by a military ethos shaped by the career of the military parent. The book, divided into 12 chapters, thematically portrays the impact of this culture upon military children.

The chapters, which follow the ebb and flow of the careers of the dependents' fathers, speak to the rituals and traditions which distinctly set the military culture apart from other American cultures. The showing of the ID card, standing at attention for the national anthem, or dealing with the different ways that officer and enlisted children treated each other, were part of a collective, ritual process that resulted in the evolution of a distinct worldview. Children living on base participated in an isolated, conservative experience whereby military dependents were separated from their civilian counterparts, not only by gate guards but also by the whims of a military bureaucracy, a caste system, and a rigorously disciplined family life.

Some of the best chapters deal with the effects of frequent migration on military families. The process of breaking with the past, adjusting to new surroundings, making new friends, and being consistently the new kid on the block is causally connected—according to Truscott and some of her respondents—to both healthy, adaptive behavior and dysfunctionalism. The fact that other families on base had gone or were going through the same experience significantly helped dependents through these various stages. Networks of military families were formed to sustain people in like circumstances.

As to dysfunctional behavior, many dependents whom Truscott interviewed find it extremely difficult to make long-term commitments, stay in one place long, keep in touch with old friends, or adjust to people with different backgrounds. Yet, it is not clear whether these effects are very different from those caused by life in modern societies where a high degree of geographic and occupational mobility is the norm. Because of the increased mobility in America since World War II, more than likely this transient culture was unique to military life prior to 1940. Undoubtedly, however, transiency wedded to a very insular institution forms an environment much different from the one that most Americans experience.

The book is not without its flaws—mainly omissions. Enamored with the idea that military brats were spawned from a homogeneous milieu, Truscott fails to ask whether or not the experience was different for minority families. Similarly, she purposely stays away from tough, controversial questions about alcoholism and abuse. Certainly, if these problems were as pervasive as she indicates in her introduction (alcoholism was three times as prevalent in the military than in other populations), they are subjects that must be dealt with, regardless of whether the respondents were reluctant to talk about them.

Serious interdisciplinary efforts are being made to study the isolated effects that migration, prolonged parental absence, and abusive behavior have on families in uniform. Only now, though, are scholars beginning to study the total culture engendered by military social-welfare systems. *Brats* addresses these timely issues in laymen's terms and for that reason is important reading for policymakers and military members alike.

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Washington, D.C.

Strike from the Sky: The History of Battlefield Air Attack, 1911–1945 by Richard P. Hallion. Blue Ridge Summit, Pennsylvania 17294: Smithsonian Institution Press, 1989, 323 pages, $24.95.

The debate over close air support/battlefield air interdiction (CAS/BAI) seems endless. Each watershed (e.g., the 1943 publication of Field Manual 100-20, *Command and Employment of Air Power*, and the 1948 Key West agreements) has simply ushered in a new round in the discussion. Air Vice-Marshal R. A. Mason, in the foreword to *Strike from the Sky*, says that "there is no shortage of evidence" to inform this debate (xii). So why can't everyone agree? Why is there so much heat and so little light in discussions about CAS/BAI?

Although a great deal of evidence exists, much of the most important material isn't widely available. For example, one of the best examinations of theater air power in all its roles is Wing Comdr John C. Slessor's *Air Power and Armies* (1936). One of the best studies of actual battlefield air operations is Gen Omar Bradley's *Effect of Air Power on Military Operations, Western Europe* (1945). Don't try to find these titles at your local bookstore; they've been out of print for 40 years. (Any reader who doubts the contemporary value of these books should read them. If you're still not convinced, compare them with the venerable TAC Manual 2–1, *Tactical Air Operations*, which is still officially "current.")

As Hallion points out, "Researchers have devoted far more attention to the air superiority war and to strategic bomber operations than they have to other topics" (129); consequently, this focus has created a big void in the study of CAS/BAI. Hallion has taken a tremendous stride toward filling in this gap by covering the subject so thoroughly that his book is bound to be a favorite reference for students of the history of air power as well as for professionals studying theater air operations. *Strike from the Sky* is an outstanding accomplishment.

The first half of the book covers two campaigns of the First World War and several campaigns in smaller wars prior to World War II. The Rif war (involving Rifis—Berber tribes) in Morocco and the Nomonhan incident (between Japan and the Soviet Union in 1939) are useful examples of effective, well-integrated air operations. A chapter covering the Spanish civil war is particularly effective at dispelling misconceptions about that war. A follow-up chapter, "The Spanish Legacy: Lessons Read and Mis-

read," is probably the most valuable part of the book. It shows how several nations developed diverse doctrines based on experiences from the Spanish civil war—doctrines which were tested in the fire of World War II.

The second half of the book covers several campaigns of World War II in a variety of theaters. Two major trends evident in these campaigns are (1) the emergence of increasingly sophisticated organizations for applying air power to the battlefield and (2) the need for air superiority to permit effective battlefield air support. Bracketing the historical analysis that makes up the bulk of this book are an introduction and an epilogue by the author, as well as Air Vice-Marshal Mason's insightful foreword.

Hallion has done a remarkable job of distilling what happened and why, using an impressive array of sources in six languages. The source notes are a gold mine for future researchers. They acquaint interested readers with major works, such as those of Slessor and Bradley, and highlight the most informative materials on specific areas of study. Among the most fascinating of the primary sources are attaché reports from the Spanish civil war.

The historical analysis is so comprehensive and balanced that it provides fuel for a variety of arguments. Hallion's epilogue contains 13 conclusions; I arrived at several others from my own reading. My conclusions (e.g., the value of using multiple methods to solve problems in battlefield air support, the tremendous cost of fratricide, and the advantages of simple command and control solutions) are supported by several examples, just as Hallion's are.

Another quality of *Strike from the Sky* is context: CAS and BAI are not simply ends in themselves. Hallion writes from a battle-and-campaign perspective, reaching down to the weapons, tactics, and engagements that create success, and demonstrating that air-attack campaigns are operational-level efforts that may decide strategic issues. The importance of doctrine, which determines how to best use air forces to support surface operations (and why), is also presented clearly.

Altogether, *Strike from the Sky* stands alone in its potential to inform the current phase of the CAS/BAI debate with relevant historical examples. Hallion's focus on events up to 1945 may trouble people who think that current technology and political circumstances are unique. Although circumstances are always unique, they are never unprecedented, and one of this book's major accomplishments is providing contemporary readers with a wealth of precedents in a single reference—a feat not duplicated by other sources.

Certainly, Hallion does not imply that he has simple, clear, ironclad answers. Reflecting on the lessons that several nations drew from the Spanish civil war (which became the doctrines that World War II would test), he writes,

> It is this aspect of the Spanish Civil War that is most interesting: intelligent, well-informed critics could reach often diametrically opposite conclusions, or, interpreting data correctly, nevertheless reach a flawed conclusion.... It might be said that critics took away from the Spanish war what they wished to believe, and they searched its lessons carefully to selectively acquire supporting data for their own particular viewpoint. (110)

So don't expect discussions of battlefield air support to end soon or to reach many bombproof conclusions. As *Strike from the Sky* shows, CAS/BAI has been a hot topic since World War I. But we can hope that the debate will be more informed because any reader of this book will better understand CAS/BAI in practice and theory.

If you are interested in air power, command and control, joint operations, doctrine, or military history, read *Strike from the Sky*. Better yet, get your own copy so you can underline and highlight, as well as scribble notes and dog-ear the book without feeling guilty. All libraries serving military audiences should obtain this book, but don't expect it to gather dust on the shelves.

Lt Col Charles M. Westenhoff, USAF
Maxwell AFB, Alabama

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Notices of upcoming conferences, seminars, and other professional events of a noncommercial nature should be sent to the Editor, Airpower Journal, Walker Hall, Bldg. 1400, Maxwell AFB AL 36112-5532. We reserve the right to edit material for length and editorial content.

Air University Review Index

The Air University Press has published a complete index of the *Air University Review* (1947–87). This reference work contains an author index, a title index, and a cross-referenced subject index. Any Air Force or other government organization, college or university library, or similar organization with a need for this index can be placed on distribution. Requests for distribution and other inquiries should be addressed to Maj M. A. Kirtland, AUCADRE/RI, Walker Hall, Bldg. 1400, Maxwell AFB AL 36112-5532. Major Kirtland can also be contacted at DSN 875-6629 or (205) 293-6629.

Army Aviation Convention

The Army Aviation Association of America will hold its annual convention from 10-14 April 1991 in Saint Louis, Missouri. For more information, contact AAAA, 49 Richmondville Avenue, Westport CT 06880-2000 or call (203) 226-8184.

USAFA Instructor Opportunities

The Military Studies Division at the United States Air Force Academy is seeking highly qualified captains for instructor duty in the summer of 1991 and beyond. This duty involves motivating and teaching cadets in university-level courses that stress air power, the art of war, military theory, doctrine, and force employment. Since its inception in 1980, the curriculum in professional military studies has evolved into one of the most interesting and demanding areas of study at the academy. A master's degree is required of all applicants. Preferred degrees for military studies instructors are in history, military history, political science, and international relations, or in area studies of the Soviet Union, Eastern Europe, or the Middle East. Experience in tactical or strategic operations or in operationally related specialties is highly desirable. The division can sponsor a few highly qualified applicants with the appropriate background for a master's degree through the Air Force Institute of Technology (AFIT), with a follow-on assignment to the Military Studies Division. Applicants should have three to seven years of commissioned service, an outstanding military record, and impeccable military bearing and appearance. Interested individuals should consult chapter 8 of AFR 36-20, *Officer Assignments*, for application procedures or write Capt Bob Angwin, Headquarters USAFA/CWIS, USAF Academy CO 80840-5421 or call DSN 259-3257/3248.

Naval History Symposium

The History Department of the United States Naval Academy will sponsor its 10th Naval History Symposium at Annapolis from 11–13 September 1991. Individuals who wish to propose a paper or a topic for panel discussion should submit an abstract of approximately 250 words to Dr Jack Sweetman, History Department, US Naval Academy, Annapolis MD 21402-5044. Deadline for proposals is 1 March 1991.

Uniformed Services Medical School Training

The Uniformed Services University of the Health Sciences is seeking students for its medical training and graduate medical-education programs. Medical students are commissioned as ensigns or second lieutenants and draw full military pay and benefits. There is no tuition, and all books and equipment are provided. At graduation, students are promoted to naval lieutenant or captain and have a seven-year service obligation. Both civilians and military personnel with a college degree may apply for the four-year medical program. Applicants must be no older than 27 (or 33 with prior military experience) when they enter school. The university also has a graduate program in basic medical sciences open to civilians and military. Civilians are not commissioned into the military. Graduate students serve as teaching and research assistants. For more information, contact the Office of Admissions, Attn: PAC, Uniformed Services University, 4301 Jones Bridge Road, Bethesda MD 20814-4799 or call (202) 295-3106.

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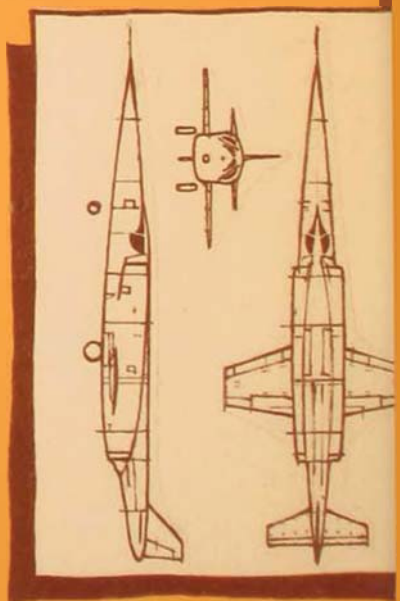
The Warrior

I've known fear and heard the battle's sound;
I've fought and spilled blood on hallowed ground.
On silver wings, I've flown through the air,
and daily I've trod where few will dare.
To some I'm a hero and freedom's defender;
to others I'm a monger of what war can render.
Both love and hate at times I've known,
and until time of war I'm no one's own.
So few understand my perspective and place,
for better than any I know war's ugly face.
I loathe battle and the destruction it brings,
but I know of war, there are worse things.
To fight and win conflicts has not been my best,
for to find and keep peace has been my real quest.

Capt John C. Orndorff



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