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AIR FORCE MAGAZINE

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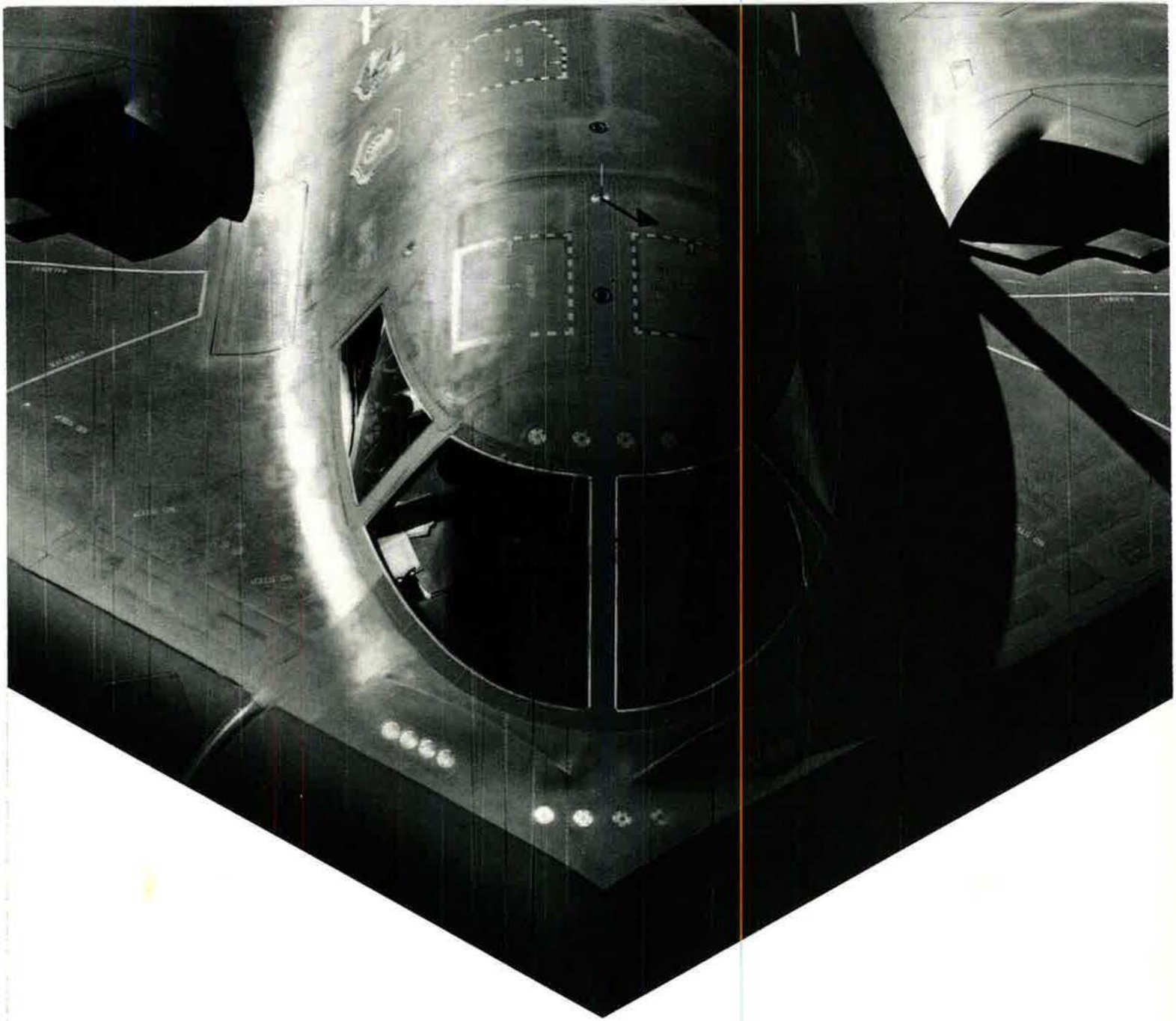
Electronic Storm

The War the Enemy Never Saw



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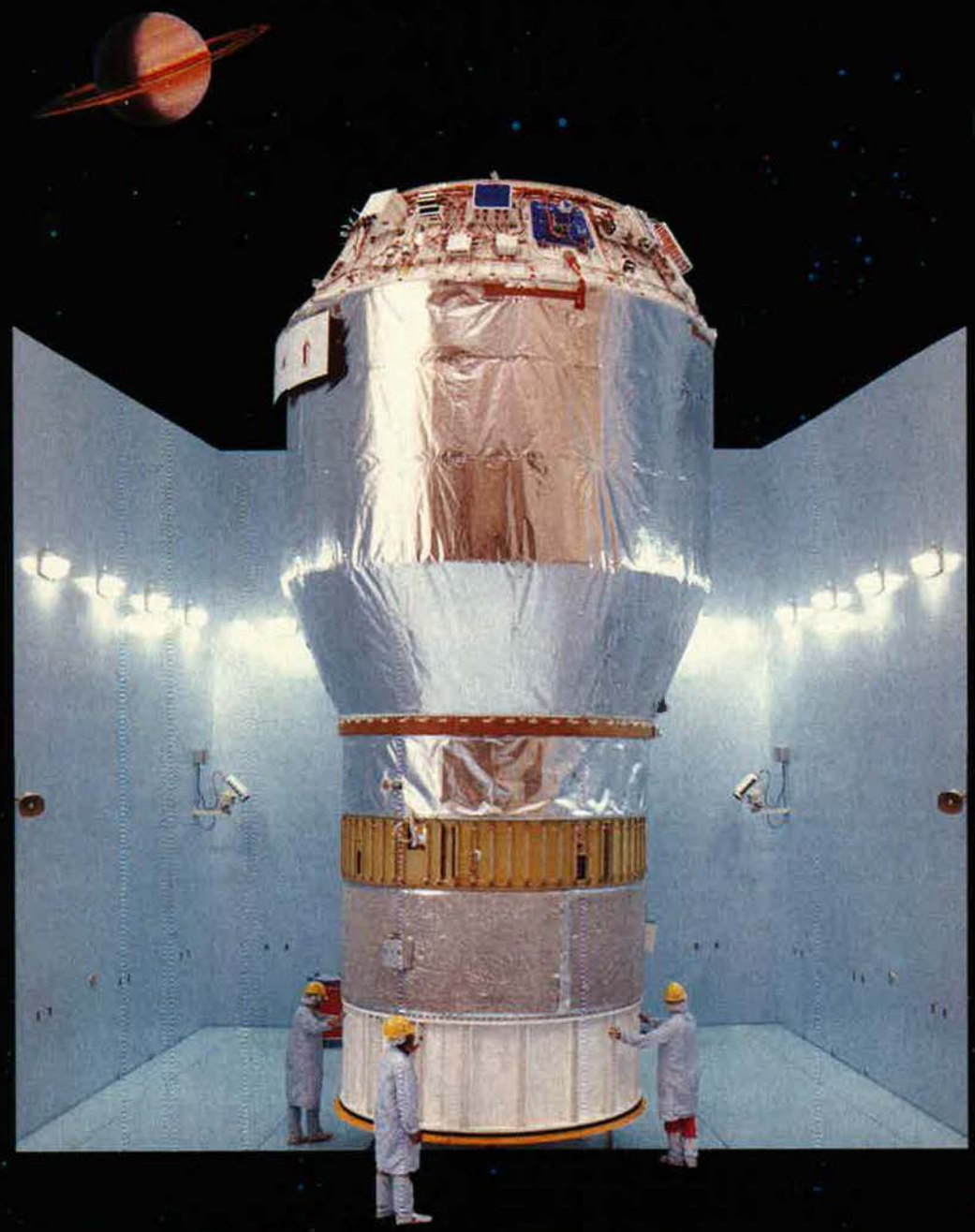

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June 1991, Vol. 74, No. 6

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Departments

About the cover: An F-117A Stealth fighter is refueled after a night mission over Iraq. During Desert Storm, F-117As demonstrated that eluding radar is just as important as destroying it. USAF photo by TSgt. Hans Deffner.

Electronic Storm: The War the Enemy Never Saw

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Editorial

By John T. Correll, Editor in Chief

The Measure of Affordability

THE Air Force cannot afford the Advanced Tactical Fighter program, the Congressional Budget Office told a Senate Armed Services subcommittee April 22. To pay for a full complement of these aircraft, the tactical air forces would have to sacrifice another ten—or perhaps another fourteen—wings from the reduced number already planned, CBO said.

In 1990, the Air Force fielded thirty-six fighter wings. It is scheduled to have twenty-six left in 1995. Eventually, a fourth of them are supposed to be equipped with the ATF air-superiority fighter.

According to CBO, buying the ATF would drop the affordable total to sixteen wings, and given "less favorable assumptions" about budgets and program cost, the force could further shrink to twelve wings. CBO proposed that Congress consider several alternatives, including a "silver bullet force," in which "a very few" ATFs would be supplemented by low-cost multirole fighters.

The Air Force says that CBO's method was faulty and its conclusions wrong, but, as usual, the prospect of cuts in a defense program drew a crowd of speculators anxious to see what they could make of it. CBO does not attack the requirement for the ATF. In fact, it acknowledges a strong case for the new fighter. The concern, it says, is affordability.

Undoubtedly so. Federal outlays in 1991 will equal 24.9 percent of the Gross National Product, the highest in almost fifty years. The government will collect 19.4 percent of GNP in revenues. The deficit is forecast at $308 billion. Even optimists do not believe it can be brought to heel by 1995.

There has been a redistribution of spending, not a reduction of it, and as the competition for available funding intensifies, we ought to get a few points straight about affordability.

Defense, which went down steadily while the deficit was going up, did not cause the deficit and is not perpetuating it. The trend lines finally crossed, and the deficit is now larger than the defense budget.

Adjusted for inflation, defense spending in 1995 will be thirty-four percent lower than in 1985. Air Force purchasing power takes an especially heavy hit, declining by about forty-five percent over the ten-year period.

Over the next five years, the armed forces will lose ships, divisions, air wings, and about 500,000 active-duty troops. The Air Force of 1995 will count itself lucky to field a strategic bomber fleet of 181 airplanes. By 1996 the defense program will account for 3.6 percent of GNP, the lowest level since 1939.

Incredibly, the myth persists that the Pentagon budget is lavish, growing, driving the deficit, and robbing resources from domestic and social programs. As with the ATF, we can expect every high-visibility defense program to be challenged on "affordability." Oddly, the question is almost never applied to nondefense programs, even those that paced the rise of the deficit.

CBO, in its January 1991 *Economic and Budget Outlook*, notes that defense's declining share of GNP indicates only "the relative burden" of spending. In the context of a rising GNP and the overall pattern of federal outlays, these percentages also tell us a great deal about priorities and affordability.

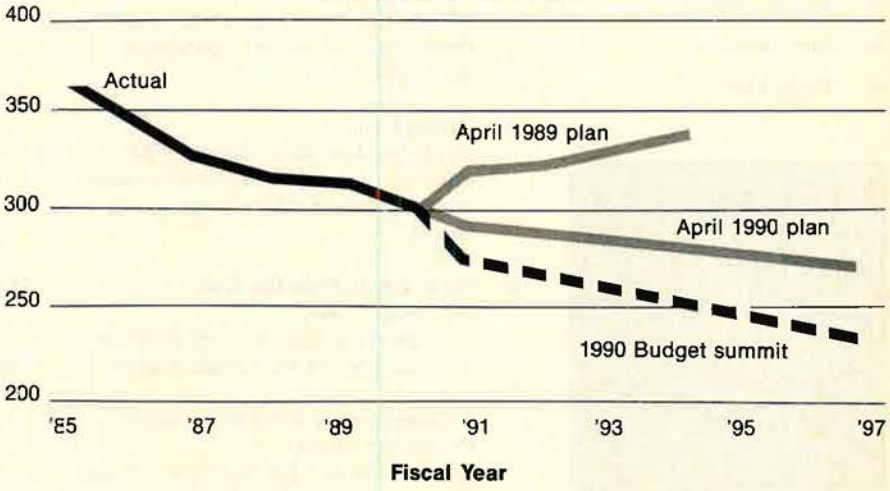
Suppose, for the sake of discussion, that CBO's findings on the ATF were correct. Does this mean that fielding a new air-superiority fighter almost thirty years after its predecessor went into service would wreck the economy?

Does it mean that after a decade of progressive reductions to the defense budget, massive cuts in personnel and force structure, cancellation and curtailment of weapon systems, withdrawals from overseas, base closures, and other such adjustments, the United States will be unable to scrape together enough money to pay for what's left of the defense program?

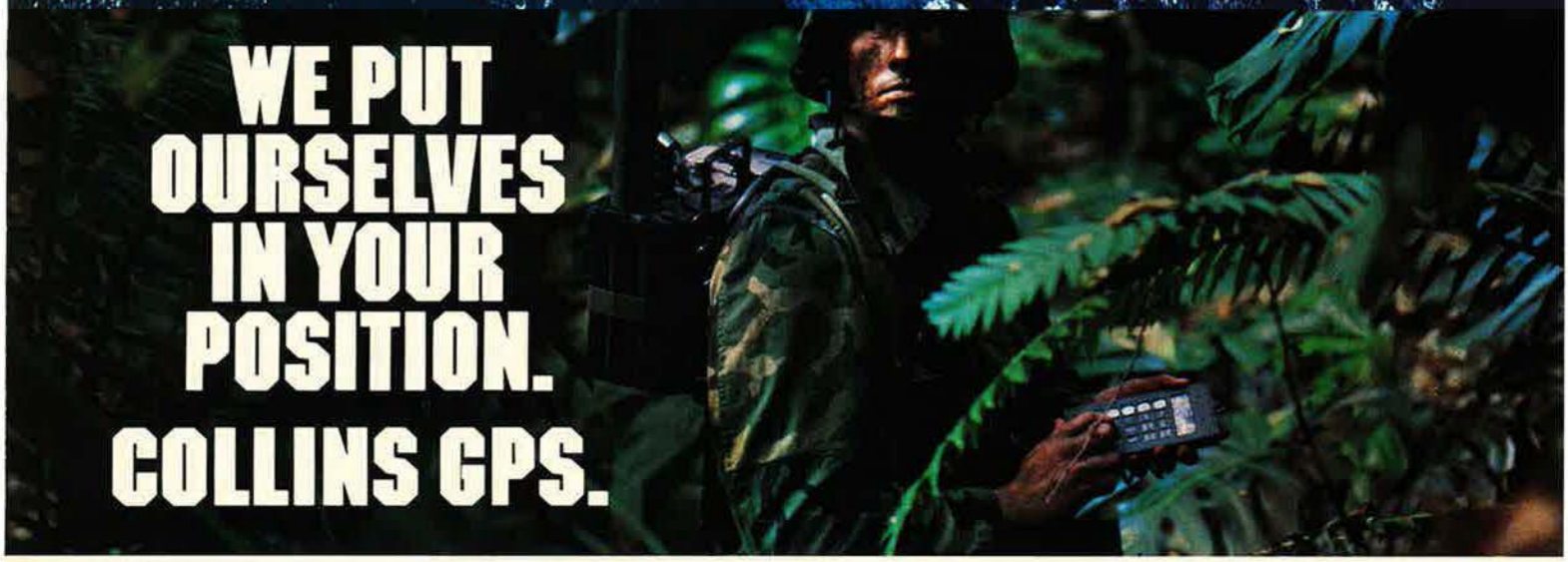
The nation may not *want* to spend more than 3.6 percent of GNP on defense, but to claim it cannot *afford* to do so is absurd. ■

Defense Budget Authority

FY 1991 Dollars in Billions



Fiscal Year



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Letters

Pilotless Marvels

As a onetime F-105 "Thud" driver who now works with, believes in, and spreads the gospel about robotic aircraft like Pioneer, Hunter, and Aerobot, it was a great pleasure to read Jim Canan's "Steady Course for Unmanned Aircraft." *[See March 1991 issue, p. 84.]*

The article signaled the reawakening of USAF interest in UAVs. Despite Air Force leaders' denial of "any institutional prejudice against unpiloted planes," Air Force decision-makers and policymakers have traditionally scorned any real support of tactically oriented UAV programs since the "Buffalo Hunter" era of Vietnam. Now, it seems, times are changing.

Since the widespread use of UAVs in Operation Desert Storm, parochial perceptions and fears that these unmanned hummers would someday replace piloted aircraft are giving way, begrudgingly, to an acknowledgment that they do have a valid, proven role in many mission areas. This is true now and will be more so in the future. As a consequence of the new thinking, such robotic systems as the operational Pioneer and downstream mid-, short-, and close-range programs are going to save the hides and improve the fortunes of a lot of pilots and grunts alike.

As the various UAVs destined for Air Force employment begin to appear in contingency planning and training exercises, even the staunchest hardline Air Force skeptics will find themselves solidly aligned with their Marine, Navy, and Army contemporaries in championing the virtues of these pilotless marvels.

John Jordan
San Clemente, Calif.

Military-Media Relations

I enjoyed your editorial "Nitwitness News." *[See April 1991 issue, p. 6.]* I agree that the military and the media distrust each other, but I do not agree that this relationship is inevitable or necessarily hopeless.

In 1972, at the Air War College, I wrote a professional study paper titled "Government and the Free Media: Clear National Policy in Harmony with Responsible Criticism." The study concluded that a proper relationship between the government and the media requires a two-way street—consistent facts in return for responsible reporting.

From my knothole, I would say that during the Gulf War reporters were provided with the essential facts but they wanted more—a natural tendency in a trade that depends on "scoops and exclusives" for ratings and celebrity. Given the promise of a new era of factual consistency, perhaps even a suspicious press will come to act more responsibly.

Brig. Gen. Kenneth H. Bell,
USAF (Ret.)
Monument, Colo.

I read with interest your editorial in the April 1991 issue, "Nitwitness News."

This direct quote from the July/August 1987 issue of *American Heritage* Magazine shows that poor military-media relations are not of recent vintage. "I am in battle and was pushed forward, catching all the path of the balls and bullets in front, and then the curses and malediction of the non-thinking herd behind. The newspapers declare me their inveterate enemy and openly say they will write me down. In writing me down are they not writing the Cause and the Country down?" Brig. Gen. William T. Sherman wrote those words on February 6, 1863.

The American military and the media have disliked each other since the Civil War. And why not? Both armies in that conflict paid the price many times for so-called "responsible journalism" and "First Amendment rights." Things did not change much until General Schwarzkopf entered the scene. For once, the press was put in its place by a brilliant general and the American public. It was refreshing to see.

Yes, the hostility is deep-rooted, as you say. It's had 130 years to get that way. The press has earned its low standing with the US military. Perhaps, if the press starts now, it can dig out of its deep hole within twenty to thirty years.

Eric C. Wuest
Santa Maria, Calif.

"Nitwitness News" hit the nail on the head and summed up what many of us have thought—we are being besieged by incompetent so-called newsmen.

It would be a nice gesture if it could be arranged so that Colman McCarthy, who wrote of "fearless warriors" in "a coward's air war," could strap on a high-performance aircraft, participate in a night refueling, and then go in at low level for a simulated attack. That might make him see what real risk is.

Lt. Col. William J. McCormick,
USAF (Ret.)
Albuquerque, N. M.

Forgotten Gunners

As one who was trained as an aerial gunner before being commissioned during World War II, I was delighted to read Bruce Callander's "The Aces That History Forgot." *[See April 1991 issue, p. 92.]* However, where did Mr. Callander get the idea that the Martin B-10 had a tail turret? It had a flexible gun firing aft from a dorsal enclosure in front of the tail, not a turret by any stretch of the imagination. Even the frontal gun position was not a true turret but simply an unpowered movable enclosure, which *Jane's All the World's Aircraft* for 1938 described as a cockpit "covered with a transparent cupola."

Maj. Gen. I. B. Holley, Jr.,
AFRES (Ret.)
Durham, N. C.

Do you have a comment about a current issue? Write to "Letters," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Letters should be concise, timely, and preferably typed. We cannot acknowledge receipt of letters. We reserve the right to condense letters as necessary. Unsigned letters are not acceptable. Photographs cannot be used or returned.—THE EDITORS

Many thanks for "The Aces That History Forgot." It certainly met with this dinosaur's approval.

On reflection, I would have to say—taking away the flak and the cold—that being a B-24 ball turret gunner was about the best and most satisfying job I ever had in either AAF or USAF.

At least in our bomb group victories were credited to individual gunners.

Lt. Col. Jim O'Brien,
USAF (Ret.)
Albuquerque, N. M.

Effectively Flattened?

The remarks by Secretary of Defense Cheney about "the enormous value of stealth" as demonstrated by the F-117 in the Gulf War *[see "The No-Frills Air Force," April 1991 issue, p. 75]* must have been said with tongue in cheek, considering that the Iraqi air defenses had been effectively flattened by UN coalition forces. There is no question other delivery systems could have (and did) accomplish target destruction with vehicles far less expensive than the F-117.

It would appear that the Secretary of Defense is trying to shore up the shaky position of the stealthy B-2 based on how the stealth of the F-117 made it so successful in Iraq. Congressional leaders, such as Sen. Sam Nunn, are not likely to be moved by the ploy.

Col. Peter Boyes,
USAF (Ret.)
Rancho Murieta, Calif.

A Real Pioneer

"Pioneers at High Altitude" *[see April 1991 issue, p. 88]* was especially interesting to me because I had a small part in some of those early flights as a mechanic in the Air Service at Wilbur Wright Field, which was located near the town of Fairfield (later Fairborn), Ohio.

Robert van Patten's article is very accurate, and I do not wish to engage in any nit-picking, but because I was there I wish to elaborate on one of the events described in the article.

Capt. Rudolph "Shorty" Schroeder's first attempt to establish an altitude record took place from Wilbur Wright Field on September 8, 1918. The airplane was a British-built Bristol Fighter P-30, powered by an experimental 300-horsepower Model H engine, built by the Wright-Martin Corp.

Another mechanic and I installed the oxygen system, which consisted of a small tank with two manually controlled valves within reach of the pilot. One valve controlled the oxygen to the carburetor air intake through a copper tube. The idea was that at high altitude, the oxygen-enriched air would sustain engine power. It did not. The other valve was attached to a rubber hose that fit into the mouth of the pilot, who could control the flow of oxygen by biting on the hose.

During the September 8 flight, Captain Schroeder, unaware that his oxygen supply was depleted, suffered from hypoxia and other symptoms of oxygen deficiency. The engine ran out of gas, and an emergency landing was made near Canton, damaging the propeller (as Mr. van Patten stated in the article). Although Captain Schroeder reached an altitude of 29,800 feet, a problem with the barograph prevented the record from becoming official.

I left the Air Service with an honorable discharge five months later (February 1919).

Blake Hobart
Atascadero, Calif.

Keep the B-52Hs

I was surprised to see two mentions in the April 1991 issue of the retirement of the B-52H *[see "Defense in*

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Letters

Four Packages," by Robert S. Dudney, p. 62, and "The Chart Page," p. 66]. Why would the Air Force retire the B-52H before the B-52G? I realize the B-52G is used for conventional ordnance; however, I understand both aircraft models have the same Offensive Avionics System.

The B-52H has safer (no water-injected takeoffs) and more efficient engines and probably has a longer airframe life. I can't understand the Air Force's logic.

Capt. Glenn D. Butler,
AFRES
Prattville, Ala.

One of Our MAWs is Missing

While reading your March 1991 issue *[see "The Forces of Desert Storm," p. 34],* I noted that the 443d Military Airlift Wing from Altus AFB, Okla., was not listed as one of the active-duty units from which Desert Shield and Desert Storm forces were drawn. Let me assure you that the 443d played an important and active role in the Middle East crisis. We deployed more than 400 highly trained men and women, who performed a variety of tasks—from fixing aircraft to providing ground security. Our strategic airlift crews and aircraft flew and continue to fly numerous sorties in and out of the Area of Operation. Also, as the Aerial Port of Embarkation for Fort Sill, we moved nearly 11,000 soldiers on more than 100 dedicated military and Civilian Reserve Aircraft Fleet flights. As their commander, I am extremely proud of each and every one of them and their accomplishments.

Col. Walter S. Hogle, Jr.,
USAF
Altus AFB, Okla.

• AIR FORCE *Magazine developed its list of major units that supplied forces to Desert Shield and Desert Storm from information provided by the Air Force and DoD. We regret the omission of 443d MAW and any other unit that directly participated in the operations but did not appear on the list.*
—THE EDITORS

Due Credit

[On behalf of the members of the] 2d Troop Carrier Squadron, in the China-Burma-India theater from 1943 to 1945, I take umbrage at "Flying the Hump." No mention whatsoever is made of the role played by the 2d TCS, even though at one time the squadron was carrying the greatest percentage of tonnage per airplane. For example, in May 1943, the squadron completed 368 trips over the Hump with just thirteen C-47s carrying 1,242 tons of material from India to China. During this period, there were enemy aircraft operations and the weather conditions were not suited for flying around mountains 5,000 feet higher than the ceiling of a C-47.

All units that were involved in the Hump operation deserve full credit. However, while ATC was in the process of setting up a big operation that received much publicity, the 2d TCS was busy hauling material over the Hump. The squadron eventually was awarded two Presidential Unit Citations. Not bad for an organization that was not mentioned in the article. Just once, recognition should be given where it is deserved.

Albert O. Wilkat
Plantation, Fla.

Searching for Sevareid

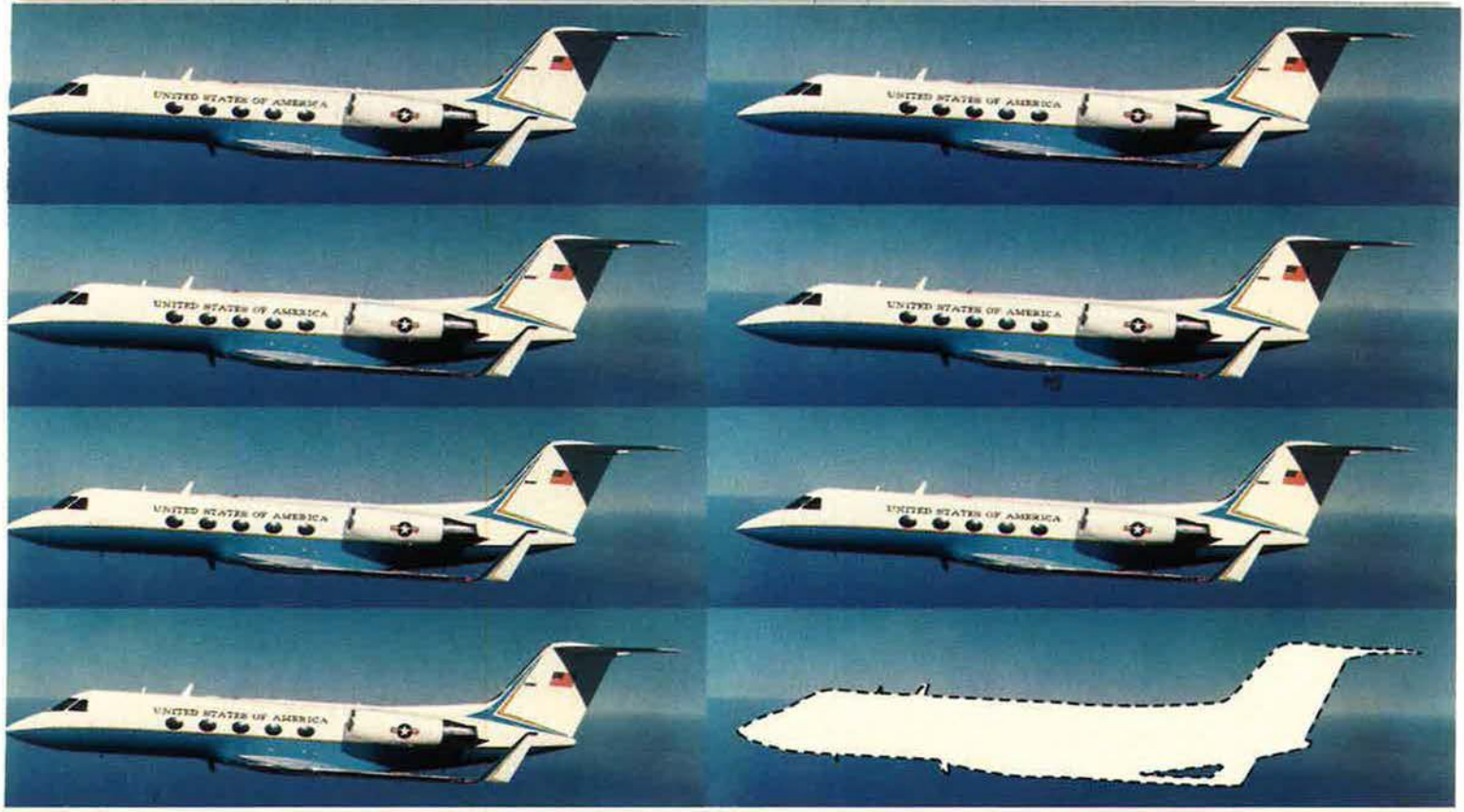
Your interesting article "Flying the Hump" *[see March 1991 issue, p. 102]* conveyed the impression that "Blackie's Gang" was primarily responsible for search-and-rescue missions in the early days of the Hump operation. Mr. Glines's article states, "One of the first of Blackie's rescue missions was a search for the twenty crew members and passengers, including CBS correspondent Eric Sevareid, who had bailed out of a C-46 in the Naga hill country of northern Burma."

Capt. "Blackie" Porter may have been one of the pilots in the search, but frankly I don't remember ever hearing the name during the whole operation. The man in charge of the operation was Richard "Dick" Kight, who in those early days was already a colonel. He had a well organized operation at Chabua. Brigadier General Alexander, in command of transport operations, and Brig. Gen. C. V. Haynes, commanding tactical operations, were kept informed on an hourly basis—but Dick Kight ran the rescue operation. . . .

Incidentally, it was decided that no more passengers would be taken over the Hump in C-46s. Even before the "Sevareid incident," there had been a rash of engine problems with the C-46s.

When the Air Force established the Air Rescue Service as a component of Military Air Transport Service, Dick Kight was selected to be its first commander. His experience in CBI was, no doubt, a big factor in that choice.

Col. Lee Baker,
USAF (Ret.)
Phoenix, Ariz.



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By Brian Green, Congressional Editor

The Silver Bullet Force

The Air Force rejects CBO's theory that buying more than a handful of ATFs would make the twenty-six-wing force unaffordable.

"After hundreds of hours of simulated engagements, both the F-15XX and the Falcon 21++ [a notional upgrade of the F-16] were shown to fall far short in their ability to ensure that we could attain the needed air superiority in future conflicts," Maj. Gen. Joseph W. Ralston, director of Tactical Programs at USAF headquarters, told the Senate Armed Services Committee in April. "Additionally, the study concluded [that] neither alternative aircraft is a low-cost answer for modernizing the air-to-air force."

The simulations were conducted in response to Congress's demand that the Air Force take a look at alternatives to the Advanced Tactical Fighter (ATF).

General Ralston's testimony is particularly significant in light of claims by the Congressional Budget Office (CBO) that Air Force budgets will not support planned acquisition of the new ATF. The Air Force intends to procure 648 new fighters.

According to Robert F. Hale, CBO's assistant director, the cost of two new airplanes—the ATF and a proposed Multirole Fighter (MRF) to succeed the F-16—will prevent the Air Force from maintaining its planned twenty-six-wing tactical air force at current budgetary levels. "To minimize long-term problems, the Administration should consider buying aircraft other than the Advanced Tactical Fighter or buying fewer of the new fighter; perhaps most important, the Administration must limit the costs of the Multirole Fighter," Mr. Hale said.

CBO, using what it considered reasonable assumptions about budget levels, cost, and force structure, argued that the tactical air forces would end up with only eighteen wings. If ATF or MRF costs went up, the Air Force budget went down, or the tactical air forces' share of the USAF budget declined, the Air Force could end up with as few as eleven or twelve wings, according to CBO testimony.

Secretary of the Air Force Donald B. Rice criticized the CBO study, maintaining that the structure of the study "almost drove their conclusion." He noted that the CBO analysis presumed that the defense budget would remain constant for thirty years beyond 1995, that the Air Force would spend a historically low percentage of its budget on tactical air forces, and that the next-generation Multirole Fighter would cost much more than its F-16 predecessor. These, he argued, were all "worst-case assumptions."

"If you modify those assumptions to more realistic ones, then the force structure fits," argued Secretary Rice.

The Air Force also believes that CBO assumes there will be unnecessary management inflexibility and ignores the fact that ATF procurement will be more affordable as B-2 and C-17 procurement declines in the years that the ATF is ramping up.

Mr. Hale argued that a small fleet of tactical aircraft "would probably be unable to carry out future missions such as those required in the Persian Gulf War." He also maintained that today, measured by quality and quantity, "the United States enjoys overwhelming advantages in tactical aircraft over many potential adversaries" such as Libya and Cuba and that US and NATO tactical aircraft are in "rough parity" with those of the Soviet Union.

If the Air Force does not produce the ATF, Mr. Hale conceded, Soviet aircraft will enjoy a substantial margin of superiority in the future, even if the Soviets comply with the terms of the recent conventional arms reduction treaty. He argued, however, that other factors, including defensive missions for "many" Soviet fighters, reduce the margin of advantage and that the Soviet Union may not remain a major threat to US security.

The Air Force, however, continues to emphasize the threats faced by US tactical air forces. "Air superiority is an absolute necessity to successfully prosecute any military operation. . . . The prospect for entirely new follow-ons to the [Soviet] Su-27 and MiG-29 some time after the turn of the century remains a concern," General Ralston testified.

Secretary Rice noted that "the key point is maintaining air superiority into the next century. . . . It takes a long time to field a new generation of aircraft. . . . Others will close the [air-superiority] gap on us, and the airplane quality is already in their hands to allow them to do that."

Mr. Hale suggested that, in light of affordability questions, "Congress might want to examine alternative [Air Force procurement] policies." These might include forgoing acquisition of the ATF and continuing the F-16 and F-15 programs; or canceling the ATF, but buying the Falcon 21++ and acquiring a "silver bullet fleet," ten percent of which would be ATFs, the remainder low-cost Falcon 21s. Each of these alternatives, he said, could support a twenty-six-wing tactical air force.

Secretary Rice said funding in the six-year defense plan will support the ATF development program in Fiscal Years 1992, 1993, 1994, and perhaps 1995. "The last couple of years or so of the program may require some additional funding beyond what we have in there," he said. "We think those amounts are within the capability of the Air Force to work within our overall budget allocations."

The Air Force reports that a Navy withdrawal from the program will not increase ATF costs, since costs, planning, and budgeting were calculated without assuming procurement of a Naval ATF.

Secretary Rice believes that the ATF to be built by the Lockheed/General Dynamics/Boeing airframe team and the Pratt & Whitney engine house "will result in a lower-cost program in the end than any of the other possibilities." General Ralston also argued that because the ATF prototypes demonstrated hardware and software capabilities, "the ATF no longer carries the higher risk of paper designs" such as the F-15XX and Falcon 21++. ■

Look of the Future in DF

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Aerospace World

★ Writing an end to one of history's more hotly contested aircraft competitions, the US Air Force chose Lockheed Corp. and Pratt & Whitney Co. to build the Advanced Tactical Fighter (ATF) that it wants to ensure American air superiority into the next century. The new jet, the F-22, will succeed the F-15.

Air Force Secretary Donald B. Rice announced the multibillion-dollar fighter airframe and engine decisions on April 23, closing out a five-year design and test-flight competition.

The Lockheed-led industrial team, which includes General Dynamics and Boeing, will take its prototype YF-22A fighter airframe into full-scale development (FSD) and, eventually, into series production. The P&W engine house likewise moves into FSD and then into production with its YF119-PW-100 ATF powerplant. The Air Force plans formally to award airframe and engine FSD contracts this summer.

The decision dashed the hopes of a second, Northrop-led, airframe team, which included McDonnell Douglas. This combination produced a strong ATF contender, the YF-23A. The second engine-maker, General Electric, produced a strong powerplant, the YF120-GE-100. Both entries fell short.

Secretary Rice maintained that he reached final decisions only the night before he announced the victors. Even so, the Air Force leader argued that the Lockheed YF-22 prototype had rated higher than Northrop's competing model in nearly all key criteria.

The Air Force in 1986 established that the ATF should be stealthy, highly maneuverable, fast, easily maintainable, and highly reliable and that it should possess great range. In the two prototypes, the Air Force faced a choice between substantially different planes. Experts speculated that the technological contest boiled down to the YF-23's superior speed vs. the YF-22's maneuverability.

Each prototype met the Air Force's technical requirements for the ATF, said Secretary Rice. He added, however, that the YF-22 was judged to offer better capability at a lower cost. "I would not describe it as a split decision," said the Secretary.

Lockheed, Boeing, and General Dynamics combined forces to win the hotly contested ATF competition with their F-22 entry. The fast, stealthy, and highly maneuverable fighter will be powered by Pratt & Whitney engines.

The Lockheed team and P&W are expected to reap the benefits of a production run of 648 ATFs over twenty-five years, which will cost $64 billion in current dollars. The contractors believe that by using the latest stealth technologies, supercruise capabilities, and ultrahigh-technology avionics, they will be able to come up with an overpowering, twenty-first century, air-to-air fighter. First squadrons would become operational around 2000.

Lockheed's YF-22 uses thrust-vectoring nozzles that help it fly at very high angles of attack. The P&W YF119 produces about 35,000 pounds of thrust and permits the plane to cruise at approximately Mach 1.5 without afterburner.

Secretary Rice left no doubt that he views ATF production as mandatory. He maintained that some Soviet and French fighter aircraft are aerodynamic equals of the fifteen-year-old F-15 and that USAF pilots have been able to hold their edge in the air primarily through better avionics and training. Potential adversaries, he said, will try to close the gap in the next decade, but the ATF would maintain that edge. "US forces have not had to fight without air superiority since 1942, and we intend to keep it that way," he said.

The tense, long-running ATF competition and prototype flight testing were modeled after the recommendations made by the Packard Commission in 1986, the year the ATF program's extensive demonstration and validation phase began. According to Secretary Rice, the ATF competition had one aspect that the Air Force will not repeat: the service's demand that the contractors accept a firm, fixed-price contract for a state-of-the-art development program.

Under such a contract, each airframe team invested some $750 million of company cash in its ATF entry. It is generally believed that the Northrop/McDonnell Douglas team has little chance to recoup any of its staggeringly large outlay.

"I don't think it was appropriate to have the contractors shoulder all that

Anniversaries

• *June 19, 1911:* The second Army plane arrives at College Park, Md., from the Wright factory.

• *June 18, 1916:* H. Clyde Balsey of the Lafayette Escadrille is shot down near Verdun, France, the first American-born aviator shot down in World War I.

• *June 11, 1926:* The prototype Ford 4-AT Trimotor flies for the first time. It is an eleven-passenger airliner.

• *June 23, 1931:* Wiley Post and Harold Gatty begin their around-the-world flight in the Lockheed Vega *Winnie Mae*. They complete the New York to New York trip July 1, having flown for eight days, fifteen hours, and fifty-one minutes.

• *June 20, 1941:* The United States Army Air Forces is formed, with Maj. Gen. H. H. Arnold as its Chief.

• *June 22, 1946:* Two USAAF Lockheed P-80 Shooting Star fighters carry the first US airmail to travel by turbojet-powered aircraft from Schenectady, N. Y., to Washington, D. C., and Chicago, Ill.

• *June 26, 1946:* The USAAF and the US Navy officially adopt the knot and nautical mile as standard aeronautical units of speed and distance.

• *June 28, 1946:* The first V-2 rocket is launched from White Sands Proving Grounds, N. M. It rises to an altitude of sixty-seven miles.

• *June 20, 1951:* First flight of two Bell X-5 research aircraft. Based on the Messerschmitt P.1101, they are used to investigate variable wing sweepback.

• *June 20, 1956:* The US Navy commissions its first helicopter assault carrier, USS *Thetis Bay*.

• *June 9, 1961:* The first Boeing C-135A Stratolifter is delivered to the Military Air Transport Service, marking the start of a modernization program to eliminate its all-propeller fleet of transports.

• *June 29, 1961:* The US Navy's Transit IV satellite is launched, the first known to carry a nuclear power source in the form of a radioisotope battery.

• *June 3, 1966:* NASA launches Gemini 9 with Lt. Col. Thomas Stafford, USAF, and Lt. Cmdr. Eugene Cernan, USN, on board. Commander Cernan performs a two-hour spacewalk during the three-day mission.

• *June 7, 1981:* Eight Israeli Air Force F-16s, escorted by F-15s, attack the Osirak nuclear reactor near Baghdad, Iraq, disabling its core. As a result, the US imposes a temporary embargo on the supply of new F-16s to Israel.

• *June 26, 1981:* The first production Grumman/General Dynamics EF-111A, a specially developed ECM tactical jamming aircraft, makes its first flight.

1990 Air Force Achievement Awards

Maintenance Effectiveness Awards

Award	Unit, Base
Organizational Maintenance	92d Organizational Maintenance Squadron, Fairchild AFB, Wash.
Field Maintenance	319th Field Maintenance Squadron, Grand Forks AFB, N. D.
Avionics Maintenance	3380th Avionics Maintenance Squadron, Keesler AFB, Miss.
Aircraft Generation	86th Aircraft Generation Squadron, Ramstein AB, Germany
Equipment Maintenance	4th Equipment Maintenance Squadron, Seymour Johnson AFB, N. C.
Component Repair	57th Component Repair Squadron, Nellis AFB, Nev.
Consolidated Aircraft Maintenance	655th Special Operations Maintenance Squadron, Eglin AFB, Fla.
Munitions Maintenance Activity	3096th Aviation Depot Squadron, Nellis AFB, Nev.
Ground-Launched Missile Maintenance	501st Tactical Missile Maintenance Squadron, RAF Greenham Common, UK
Large Communications-Electronics Maintenance Activity	1961st Communications Squadron, Clark AB, the Philippines
Small Communications-Electronics Maintenance Activity	2036th Communications Squadron, Mountain Home AFB, Idaho
Depot Maintenance	Ogden Air Logistics Center, Hill AFB, Utah

risk in an early phase of the development program," said Secretary Rice. "That approach has the potential to take substantial capital out of our industrial base, and we have to be concerned about that. At the same time, I don't see the Air Force paying back the money to those companies who didn't win. It was a fair competition, and they had their shot."

One day before the Secretary's announcement, the Air Force told Congress it would buy some 100 fewer ATFs than previously planned. Secretary Rice said the original number of ATFs—750—was chosen in the mid-1980s, at a time when the Air Force thought it would have a much larger force structure. Now, with the service expected to drop to twenty-six tactical fighter wings by the late 1990s, the number of ATFs can be cut, he explained.

First flight of an FSD ATF is planned for 1995, after which the aircraft will undergo four years of extensive flight tests. The contracting team is to build eleven developmental aircraft, with the first production contract due to be let in 1997.

★ Efforts to draw lessons from the Gulf War will continue for years, but in April the Air Force shed considerable light on the air campaign with a new white paper. The fifteen-page study, "Air Force Performance in Desert Storm," gives heretofore classified details on types of aircraft used, numbers of sorties flown, targets hit, and the mission capable rates of selected planes. While most of the news was positive, the paper cited several shortcomings for future consideration and correction.

In the white paper's presentation, the F-111 emerges as a workhorse of the campaign, flying 4,000 sorties against armored formations, bridges, C^3I sites, aircraft shelters, and weapons production facilities. The F-111s used precision guided GBU-12 glide bombs to destroy more than 150 armored vehicles per night in the first few weeks of the war. The F-111s' kill total came to more than 1,500 enemy armored vehicles. The aircraft had a mission capable rate of eighty-five percent.

Air Force B-52 bombers—in numbers that still are secret—operated across the theater, logging 1,624 missions and dropping 25,700 tons of munitions on Iraqi troop concentrations, storage areas, and factory complexes. The white paper notes that the B-52, "despite being over thirty years old," had a mission capable rate of

eighty-one percent—higher than its peacetime rate.

The Air Force deployed forty-eight F-15E dual-role fighters to the Gulf. They operated mainly at night, hunting Scud missile launchers and artillery sites with the help of Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) pods. In what amounted to its initial operational test and evaluation, the LANTIRN system in wartime achieved "spectacular results," according to the report.

The F-15E scored a 95.9 percent mission capable rate while logging 2,200 sorties and suffering only two losses.

In Scud-hunting, the F-15E is reported to have worked well in tandem with another developmental system that was rushed to the Gulf: the Joint STARS (Surveillance and Target Attack Radar System) plane. The two converted Boeing 707s carrying the Joint STARS multimode radar logged 535 hours spotting convoys, trucks, missile launchers, and even SAM sites for F-15s and F-16s. *[See "Joint STARS Does Its Stuff," p. 38.]*

Helping to clear the path for the planes in the initial air assault were EF-111A jamming planes and F-4G Wild Weasel defense suppression aircraft armed with AGM-88 high-speed antiradiation missiles (HARMs). The report says that Iraqi air defense operators were so wary of HARMs that they would often turn off their radars after launching a surface-to-air missile, leaving it unguided.

EF-111s flew 900 sorties and racked up a mission capable rate of 87.5 percent. F-4Gs flew 2,500 sorties with an eighty-seven percent mission capable rate.

In air-to-air combat, the F-15C Eagle led all fighters by a wide margin, accounting for thirty-four of the thirty-nine US air-to-air victories. Usually vectored to their targets by US Air Force or Saudi E-3A Airborne Warning and Control System (AWACS) planes, F-15Cs scored twenty-five kills with Sparrow radar-guided missiles and another eight kills with AIM-9 Sidewinder heat-seeking missiles. The remaining F-15C kill came when a MiG-29 "Fulcrum," chased by an Eagle, flew into the ground.

The 120 F-15Cs on station in the Gulf War engaged in more than 5,900 sorties, achieving a mission capable rate of ninety-four percent.

The aircraft type that accounted for the most sorties was the Air Force's F-16 multimission fighter. The 249 F-16s deployed to the Gulf flew a total of 13,500 sorties, with a total mission capable rate of 95.2 percent, or five percent better than their peacetime rate. The doughty F-16 was used to attack airfields, military production facilities, Scud missile sites, and a variety of other targets. Seventy-two F-16s carried LANTIRN navigation pods, according to the Air Force white paper.

The Air Force's A-10 close air support aircraft launched ninety percent of the Maverick missiles used in the Gulf War. Moreover, the A-10 scored the air war's only two air-to-air gun kills; two enemy helicopters were downed by its 30-mm gun. The A-10s flew 8,100 sorties, with a mission capable rate of 95.7 percent, five percent higher than their peacetime rate.

On the negative side of the Air Force's performance, the white paper says that acquisition of bomb-damage assessment was a problem. The report states that the videotape recorded by onboard cameras was not good enough to provide reliable bomb-damage assessment or to confirm even half of the air-to-air kills. According to the Air Force, installation on aircraft of new and improved vid-

eocassette recorders would solve the problem.

In addition, says the paper, Air Force units that deployed with secret, never-before-used weapons carried insufficient training munitions. Some of these unidentified systems "needed adjustments," but there were not enough training rounds for crews to practice with them prior to combat.

Field commanders were also said to have complained about delays in receiving tactical information. Not only was there a shortage of tactical reconnaissance assets, according to the report, but there was also an inability to quickly analyze and keep pace with post-mission data.

★ Pentagon force structure continues to absorb major blows. On March 31, the Air Force ended operations at Pease AFB, N. H., marking the official closure of the installation. Pease was one of eighty-six bases selected in 1989 by the Department of Defense and the official Commission on Base Closure and Realignment established by Congress.

On April 12, Secretary of Defense Dick Cheney announced a second round of base closings, providing a list of at-risk bases. The bipartisan commission will now review the list and may hold public hearings. If it determines that the Secretary deviated substantially from the force-structure plan or the criteria used to select the bases, it can change the list.

By July 1, the commission is to transmit its final recommendation to the President. He has until July 15 to approve the list and send it to Congress or disapprove it and send it back to the commission. If he chooses the latter, the commission has until August 15 to submit a new report. The deadline for the President to approve or disapprove the second report is September 1. If he disapproves, no closures will occur. In all, there will be three rounds of closings in the next six years, with different commissions overseeing the closing process in 1993 and 1995.

Air Force bases on Secretary Cheney's recently announced list include the following:

- Bergstrom AFB, Tex., which will close in 1993. Its RF-4C aircraft will be retired this year.
- Carswell AFB, Tex., which will also close by 1993. Its B-52H aircraft are slated for transfer to Barksdale AFB, La., and its KC-135A aircraft will be redistributed to other units.
- Eaker AFB, Ark., which will close in 1993. Its B-52Gs will begin to retire late this year. Its KC-135As will also be redistributed to other units.
- Castle AFB, Calif., which will close in 1995. Its B-52G aircraft will transfer to K. I. Sawyer AFB, Mich., and its KC-135 aircraft will be given to active-duty and Reserve units.
- England AFB, La., which will close in 1992. The A-10s located there are to be retired or redistributed.

Lt. Gen. Leo Marquez Awards

Award	Level	Individual, Base
Aircraft	Field Grade Manager	Lt. Col. Richard M. Bereit, Spangdahlem AB, Germany
	Company Grade Manager	Capt. Larry W. Hudson, Eglin AFB, Fla.
	Civilian Manager	William H. Draughn, Elmendorf AFB, Alaska
	Civilian Technician	Barton L. Stanton, Elmendorf AFB, Alaska
	Supervisor-Manager	SMSgt. Charles B. Aubrey, Misawa AB, Japan
	Technician-Supervisor	TSgt. Barbara R. Baum, Osan AB, South Korea
	Technician	Sgt. Kevin D. Sparks, Eglin AFB, Fla.
Communications/ Electronics	Field Grade Manager	Maj. Glenn F. Haller, Clark AB, the Philippines
	Company Grade Manager	Capt. Jean M. Fecteau, Offutt AFB, Neb.
	Civilian Manager	James M. Pinkerton, Eglin AFB, Fla.
	Civilian Technician	Harvey L. Board, RAF Uxbridge, England
	Supervisor-Manager	SMSgt. Albert D. Bowles, Patrick AFB, Fla.
	Technician-Supervisor	SSgt. Dwayne C. Caneen, Langley AFB, Va.
	Technician	A1C Jeremy D. Overton, Mountain Home AFB, Idaho
Missile Maintenance	Field Grade Manager	Maj. Charles Flint, RAF Greenham Common, UK
	Company Grade Manager	Capt. Jerry Browning, F. E. Warren AFB, Wyo.
	Civilian Manager	Kelcey P. Webb, F. E. Warren AFB, Wyo.
	Civilian Technician	Robert J. Jacques, F. E. Warren AFB, Wyo.
	Supervisor-Manager	MSgt. Douglas E. Washburn, Offutt AFB, Neb.
	Technician-Supervisor	SSgt. Richard H. Williams, Hill AFB, Utah
	Technician	SrA. Deborah A. Clark, Whiteman AFB, Mo.
Munitions Maintenance	Field Grade Manager	Maj. Dean R. Jansheski, K. I. Sawyer AFB, Mich.
	Company Grade Manager	Capt. David W. Morrell, Homestead AFB, Fla.
	Civilian Manager	David W. Bishop, McChord AFB, Wash.
	Civilian Technician	John R. Gaines, Luke AFB, Ariz.
	Supervisor-Manager	SMSgt. Kevin J. Jozwiak, Seymour Johnson AFB, N. C.
	Technician-Supervisor	SSgt. L. T. Lewis, McChord AFB, Wash.
	Technician	Sgt. Darold E. Fish, Barksdale AFB, La.

• Grissom AFB, Ind., which will close in 1994. The Air Force will redistribute its KC-135 aircraft, but the air refueling wing will remain as a Reserve unit unless local authorities convert the installation to a civil airport.

• Loring AFB, Me., which will close in 1994. Its B-52G aircraft will go to K. I. Sawyer AFB, Mich., and its KC-135Rs to various active-duty and Reserve units.

• Myrtle Beach AFB, S. C., which will close in 1993. Its A-10 aircraft will be retired or redistributed.

• Moody AFB, Ga., which will close in 1994. Its seventy-two F-16C/D aircraft will be redistributed.

• Williams AFB, Ariz., which will close in 1993. The 82d Flying Training Wing will deactivate at that time.

• Wurtsmith AFB, Mich., which will close in 1993. Its B-52Gs will be retired and its KC-135As will be redistributed to active-duty and Reserve units.

★ **NEWS NOTES**—The winner of one of the largest next-generation aircraft programs was decided on April 8 when **the Army selected Boeing-Sikorsky's Light Helicopter (LH) candidate** over that of McDonnell Douglas–Bell Helicopter Textron.

The decision was a blow to McDonnell Douglas, which earlier this year was rocked by Secretary Cheney's cancellation of the Navy A-12 Avenger attack aircraft and, two weeks later, lost the competition to build the ATF.

According to the Army, Boeing-Sikorsky ranked higher in operational suitability, reliability and maintenance, and affordability. The team came in with a cost quote of $2.7 billion for the development program, just under the Army's estimate of $2.8 billion. The teams were said to be very close in technology and production.

Only days later, the Boeing-Sikorsky team received the first $241 million increment of funding to cover the initial stages of a fifty-two-month extended demonstration/validation phase, which is to produce four prototype aircraft. The first prototype is to fly in 1994.

In a marked departure from other recent aircraft competitions, the Army says it will do all it can to help the losing companies find new business. Obviously concerned about the helicopter production base, the Army is considering an upgrade of older Apaches built by McDonnell Douglas Helicopters, as well as the Longbow radar upgrade that is expected to continue through 1995.

South Korea has reversed a nearly two-year-old decision to buy 120 McDonnell Douglas F/A-18 Hornets for

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the Korean Fighter Program, opting instead **to procure the General Dynamics F-16.**

The announcement by Korean Defense Minister Lee Jong-koo was made on March 29 following a months-long reevaluation of the F/A-18 program in the face of what he termed "alarming" cost growth.

According to Mr. Lee, costs of the program had risen from the $4 billion McDonnell Douglas proposed two years ago to $6.2 billion. By contrast, General Dynamics would sell 120 of its F-16 fighters for $5.2 billion, with first deliveries in 1994.

Because the F-16 package differs substantially from the proposal that General Dynamics worked out two years ago for the initial competition, the Bush Administration will need to get new approval from Congress. A number of congressional sources have been quoted as saying that the Administration can expect heavier scrutiny of the new deal, especially the provisions regarding transfer of technology and offset issues.

In the aftermath of a major reevaluation of naval aviation, **the Navy has sent an amended budget request** to Secretary Cheney. It provides for doubling and accelerating the program to rewing the aging A-6E Intruder carrier attack plane and for carrying out a much larger buy of F/A-18s than was previously planned.

The Navy wants to use money once earmarked for A-12 production—now deleted from the Navy's budget—to add $2.3 billion to the FY 1992–97 A-X development program outlined in the February budget. The new Naval aviation plan will require $1.8 billion more in funding in 1993–94 than had been planned. The Navy plans to offset it with cuts in funding for AEGIS support equipment, computer purchases, spare and repair parts, and sonobuoys.

The first full-scale test version of the Titan IV Solid Rocket Motor Upgrade (SRMU) was destroyed in an explosion two seconds into static firings during tests at Edwards AFB, Calif., on April 1. Early suspicions about the cause of the explosion center on the lightweight filament-wound casings. Those casings give the upgrade its twenty-five percent improvement in lift capacity. The accident is expected to delay introduction of the more powerful boosters to the Air Force's flight program for an undetermined period.

After hairline fractures on a number of US shuttles caused frustrating delays and major modifications of NASA's launch schedule, the agency got partially back on track with the **successful flight in April of *Atlantis.*** During the mission, astronaut Jerry Ross, an Air Force lieutenant colonel, and civilian physicist Jay Apt spent a total of ten and a half hours in extravehicular activity. Outside the shuttle, they studied a variety of possible techniques for assembling the planned space station. After bad weather at the landing site postponed the return of *Atlantis* by one day, the shuttle landed at Edwards AFB, Calif., on April 11.

★ **PURCHASES**—The Air Force awarded **Boeing Defense and Space Group's Aerospace & Electronics Division** a $748 million cost-plus contract to restart **basing structure studies for the Midgetman Small ICBM.**

Security Police Awards

Award	Individual, Base
Billy Jack Carter Award	1st Lt. Laddie K. Hancock, Clark AB, the Philippines
Active-Duty Outstanding Field Grade Officer	Maj. James E. Brown, Mather AFB, Calif.
Active-Duty Outstanding Company Grade Officer	Capt. Gregory E. Ditzler, Buchel AB, Germany
Active-Duty Outstanding Senior NCO	SMSgt. Gary J. Kelly, Ramstein AB, Germany
Active-Duty Outstanding NCO, Security	TSgt. Harold L. Clark, Jr., RAF Greenham Common, UK
Active-Duty Outstanding NCO, Law Enforcement	SSgt. Richard L. May II, Clark AB, the Philippines
Active-Duty Outstanding First-Term Airman, Security	SrA. Coretta Bawn, Osan AB, South Korea
Active-Duty Outstanding First-Term Airman, Law Enforcement	SrA. Kevin J. Keaney, Kadena AB, Japan
Outstanding DoD Civilian Employee	Shuji Ajiro, Yokota AB, Japan
Reserve Component Outstanding Officer	Maj. Ronald D. Brooks, Jacksonville IAP, Fla.
Reserve Component Outstanding Senior NCO	SMSgt. Jimmie L. Deal, Youngstown Municipal Airport, Ohio
Reserve Component Outstanding Airman, Law Enforcement	SSgt. Donald H. Green, Richards-Gebaur AFB, Mo.
Reserve Component Outstanding DoD Civilian Employee	Sandra L. Smith, Buckley ANGB, Colo.
Outstanding IMA Officer	Capt. Gary E. Nelson, Robins AFB, Ga.
Outstanding IMA Enlisted	MSgt. Robert D. Gilmartin, Davis-Monthan AFB, Ariz.

Combat Arms Training & Maintenance Awards

Award	Individual, Base
Active Component Outstanding Manager	MSgt. William J. Pisel, Jr., Tyndall AFB, Fla.
Active Component Outstanding Specialist-Technician	SSgt. Barton P. Newton, Langley AFB, Va.
Reserve Component Outstanding Manager	MSgt. Wayne D. Hurley, Dover AFB, Del.
Reserve Component Outstanding Specialist-Technician	TSgt. Carlton R. Tobias, Dover AFB, Del.
Active Component Outstanding First-Term Airman	SrA. Brian A. Tebon, Ramstein AB, Germany

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The Pampa 2000 is a team effort from LTV and Fabrica Militar de Aviones (FMA) of Argentina. LTV has more than 70 years' experience in aviation, making history with aircraft like the F4U Corsair and the A-7 Corsair II. FMA has been building military aircraft for more than 60 years. Since 1988, the Pampa has proven itself with a flawless record in the Argentine Air Force. Together, LTV and FMA are making the Pampa 2000 a world-class JPATS contender.

Watch for the Pampa trainer as it makes a U.S. flight demonstration tour this year.

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L T V : L O O K I N G A H E A D

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AMRAAM's first ground test launch confirms laboratory analysis and simulations of the missile's performance when fired with zero initial velocity. In the tests, a next-generation Advanced Medium-Range Air-to-Air Missile (AMRAAM) was fired from a standard F-16 aircraft missile rail launcher mounted at a 30-degree elevation from the ground. The Hughes Aircraft Company-built AMRAAMs, combined with the TPQ-36A three-dimensional radar, are part of a joint program with Norsk Forsvarsteknologi of Norway to help the Royal Norwegian Air Force create a totally new Advanced Surface-to-Air Missile capability.

A new navigational aid will help pilots flying the night attack version of the U.S. Navy's and Marine Corps' F/A-18 Hornet aircraft see through smoke, haze, darkness and adverse weather. The main element of the Hornet's night attack system is a forward-looking infrared (FLIR) sensor, called a Thermal Imaging Navigation set (TINS). The TINS, made by Hughes and designated AN/AAR-50, generates a daytime, TV-like image of the dark world ahead of the aircraft and presents this image on an improved "raster" head-up display (HUD). The improved HUD and TINS systems will allow passive low-level navigational and - along with a targeting FLIR - help pilots locate, identify and attack ground targets at night.

A single aircraft will serve as a "generic" testbed for testing radars in realistic airborne environments. The Advanced Radar Test Bed program is being conducted by Hughes under contract from Lockheed Aeronautical Systems Company for the U.S. Air Force. It will modify and equip a C-141A Starlifter cargo jet to serve as the testing platform for Hughes F-15 APG-63/70 and other Air Force radars. The radar systems will have more extensive instrumentation than is possible in their operational aircraft, allowing extensive real-time monitoring and analysis capability. The result will be more efficient development and evaluation, particularly of ECCM capabilities, without the necessity of operational aircraft usage.

A new onboard signal processing chip can increase the efficiency of communications satellites. The Hughes-designed very large scale integrated (VLSI) circuit will allow satellites to sort and arrange simultaneously received signals and retransmit them in a single "downlink." Normally, a satellite returns signals to Earth in multiple downlinks, in the same configuration as the signals are received. This splits the satellite's power among the various transmissions and requires a large ground station. A single downlink enables the use of small, simplified ground stations. Without these new VLSI circuits, the electronics to perform these functions would be the size of a filing cabinet.

A new hydrogen maser "atomic clock" combines a compact size suitable for space applications with the highest long-term stability ever reported for this type of device. Developed and built by Hughes for the U.S. Navy, the fully automated frequency standard is about 10 times more stable than currently-used cesium beam devices. Atomic clocks use the resonance frequency of an atom to provide a precise measurement of time, but use of hydrogen maser clocks in space has been limited due to their bulkiness. Other Hughes-built atomic clocks were developed for the Defense Department's NAVSTAR Global Positioning System.

For more information write to: P.O. Box 45068, Los Angeles, CA 90045-0068

HUGHES

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Air Force officials said that if Midgetman development ensures the mobility of the missile, there is no need to decide immediately whether it should be mobile or silo-based.

Rockwell Space Operations Co. received a $2.3 billion contract extension from NASA to continue **shuttle operations activities at Johnson Space Center** through 1999. The extension brings the total value of the contract for shuttle operations, plus award fee, to $4.8 billion.

The Army awarded **Northrop's Electronics Systems Division** a $5 million, two-year contract to develop a **sensor system to warn helicopter pilots of obstacles while flying at low altitudes.** The Obstacle Avoidance System will use a laser radar and data processor to detect obstacles at night or during the day and will trigger a voice warning if necessary.

LTV Aerospace and Defense Co. received an $8.4 million contract to produce **stationkeeping equipment for Air National Guard C-130H aircraft.** Stationkeeping equipment enables aircraft to locate and identify each other and maintain relative positions in formation regardless of visibility.

Under a four-year, $91 million Air Force contract, **Hughes Aircraft Co.** will implement the first phase of a **preplanned improvement program for the Advanced Medium-Range Air-to-Air Missile** (AMRAAM). Work under the contract will improve the missile's aerodynamics, aircraft carriage, and signal processing.

Grumman received a $155 million, five-year contract to develop, install, and test an **upgrade of the EF-111A's AN/ALQ-99E tactical jamming system** by 1995. After a prototype of the upgraded system is flight-tested, it is expected to be installed throughout the EF-111A fleet.

The **Smithsonian Astrophysical Observatory** in Cambridge, Mass., has been selected by NASA to develop and operate a **science support center for the space-based Advanced X-ray Astrophysics Facility** (AXAF). The science center is expected to develop and oversee an observation program for the X-ray telescope and to manage reception and distribution of its data. The AXAF is scheduled for launch in 1998, and the contract is expected to bring the Smithsonian $86.7 million over a ten-year period.

★ **MILESTONES**—In a certification submitted to the House and Senate Armed Services and Appropriations Committees, the Defense Department stated that the **B-2 Stealth bomber has passed Block 2 low-observable flight tests** with "no significant technical or operational problems." The certification is required before B-2 funds can be released and obligated.

The second flight test of the Air Force's Small ICBM was conducted successfully on April 18. The missile flew 4,000 miles from Vandenberg AFB, Calif., to an assigned target area at the Army's Kwajalein Missile Range in the Pacific Ocean. The test was one of a series to be conducted in the full-scale development phase. During its first flight, in May 1989, the SICBM was destroyed seventy seconds after launch because of problems with the exit nozzle cone of the second stage.

The final Air Force Ground-Launched Cruise Missile was removed from Comiso AB, Italy, on March 26, fulfilling US obligations under the Intermediate Nuclear Forces Treaty. The Treaty calls for the last of 433 missiles covered under the agreement to be destroyed by May 31.

The Air Force, in an April 12 presentation to the Defense Acquisition Board (DAB), argued that it had a total requirement for **only 1,000 stealthy Advanced Cruise Missiles,** significantly fewer than had originally been planned. General Dynamics is currently under contract to build 360 of the strategic cruise missiles. McDonnell Douglas is about to receive a contract to produce 100. Along with its total requirement, the Air Force submitted an acquisition plan to the DAB under which it would "buy out" the contract with a final order for 455 missiles placed with one of the companies. Some missiles have already been produced and delivered.

The **Royal Air Force** on March 26 received the first of its seven **E-3 Airborne Warning and Control System (AWACS) planes,** built by Boeing. The other six are to be delivered during the next ten months. France, which ordered four AWACS aircraft in conjunction with the British deal, was to receive its first AWACS last month.

Air Force Systems Command's Aeronautical Systems Division (ASD) completed the **first phase of field tests of a Silent Attack Warning System** (SAWS), a passive, infrared missile warning receiver designed to alert pilots to incoming missiles and aircraft. During the tests, forty-seven AIM-4G IR missiles were fired from an F-4 and eleven Chaparral IR missiles were fired from the ground at a hardened manned test site housing the SAWS hardware.

The **66th Air Rescue Squadron,** the newest rescue squadron in Military Airlift Command, has been activated

Information Security Awards

Award	Individual, Base
Active-Duty Outstanding Manager	TSgt. Donald L. Hyde, Vance AFB, Okla.
Active-Duty Outstanding Specialist	SSgt. Jonathan C. Hummer, Charleston AFB, S. C.

Intelligence Awards

Award	Individual, Unit, Base
Outstanding Headquarters Officer	Capt. Larry K. Grundhauser, 548th Reconnaissance Technical Group, Hickam AFB, Hawaii
Outstanding Unit Officer	Capt. Jesse M. Morimoto, 10th Tactical Fighter Wing, RAF Alconbury, UK
Outstanding Headquarters Senior NCO	MSgt. Arthur G. Riles, 36th Tactical Intelligence Squadron, Langley AFB, Va.
Outstanding Unit Senior NCO	MSgt. Neil P. Ahern, 1605th Military Airlift Support Wing, Lajes Field, Azores
Outstanding Headquarters NCO	TSgt. David P. Lamar, 7451st TIS, Hahn AB, Germany
Outstanding Unit NCO	TSgt. Albert C. Saulnier, Detachment 11, European Special Activities Area, McGraw Kaserne, Germany
Outstanding Headquarters Airman	A1C Carlton E. Bowen, 36th TIS, Langley AFB, Va.
Outstanding Unit Airman	SrA. Charles R. Smith, 20th TFW, RAF Upper Heyford, UK
Outstanding Contributor, Officer	Capt. Paul M. Vavra, 376th Strategic Wing, Kadena AB, Japan
Outstanding Contributor, Enlisted	SMSgt. Bill Burgess, Hq. Strategic Air Command, Offutt AFB, Neb.
Outstanding Contributor, Civilian	Cathleen C. Byram, Hq. Foreign Technology Division, Wright-Patterson AFB, Ohio
Outstanding Senior Civilian	John B. Tidwell, FTD, Wright-Patterson AFB, Ohio
Outstanding Intermediate Civilian	Grant A. Marler, 36th TIS, Langley AFB, Va.
Outstanding Reserve Officer	Capt. Lewis D. Hill, Det. 9, Air Force Intelligence Agency, Hickam AFB, Hawaii
Outstanding Reserve Senior NCO	SMSgt. Edward C. Osborne, 482d TFW, Homestead AFB, Fla.
Outstanding Reserve NCO	SSgt. Craig A. Ritchie, 317th Tactical Airlift Wing, Pope AFB, N. C.
Outstanding Reserve Airman	SrA. Danny L. Hice, 184th Tactical Fighter Squadron, Fort Smith Municipal Airport, Ark.

at Nellis AFB, Nev. The 66th is slated to become the Air Force's first US-based active-duty squadron to fly the MH-60G Pave Hawk helicopter in a combat rescue role.

The Grumman **X-29 Advanced Technology Demonstrator** this spring completed the high angle of attack phase of its flight testing at Edwards AFB, Calif. A joint effort by the Air Force and NASA, the X-29 demonstrated its ability to fly at a sixty-seven-degree angle of attack.

British Aerospace's **North Sea Air Combat Maneuvering Range** is now fully operational and has already been used for air combat training by Royal Air Force Tornado crews. Negotiations are reportedly under way between USAFE and British Aerospace for use of the range.

★ **HONORS**—The Air Force announced the winners of the 1990 **Maintenance Effectiveness Awards** and the **Lt. Gen. Leo Marquez Outstanding Maintenance Personnel Awards,** both presented annually to units and personnel displaying the highest professionalism and outstanding achievement in Air Force maintenance. General Marquez, the awards' namesake, served as deputy chief of staff for Logistics and Engineering from September 1983 until his retirement in 1987. Also announced were the 1990 winners of the **Security Police Awards, Combat Arms Training and Maintenance Awards, Information Security Awards,** and **Intelligence Awards.** *[See boxes on pp. 14, 16, and 18 and at left for a list of recipients.]*

The 1st Special Operations Wing, Hurlburt Field, Fla., was chosen 1990 winner of the Air Force's **Daedalian Maintenance Award,** presented each year to the unit displaying the highest degree of professionalism in the maintenance field. The 1st SOW is also one of the Air Force's nominees for the Phoenix Award, the top maintenance award in DoD.

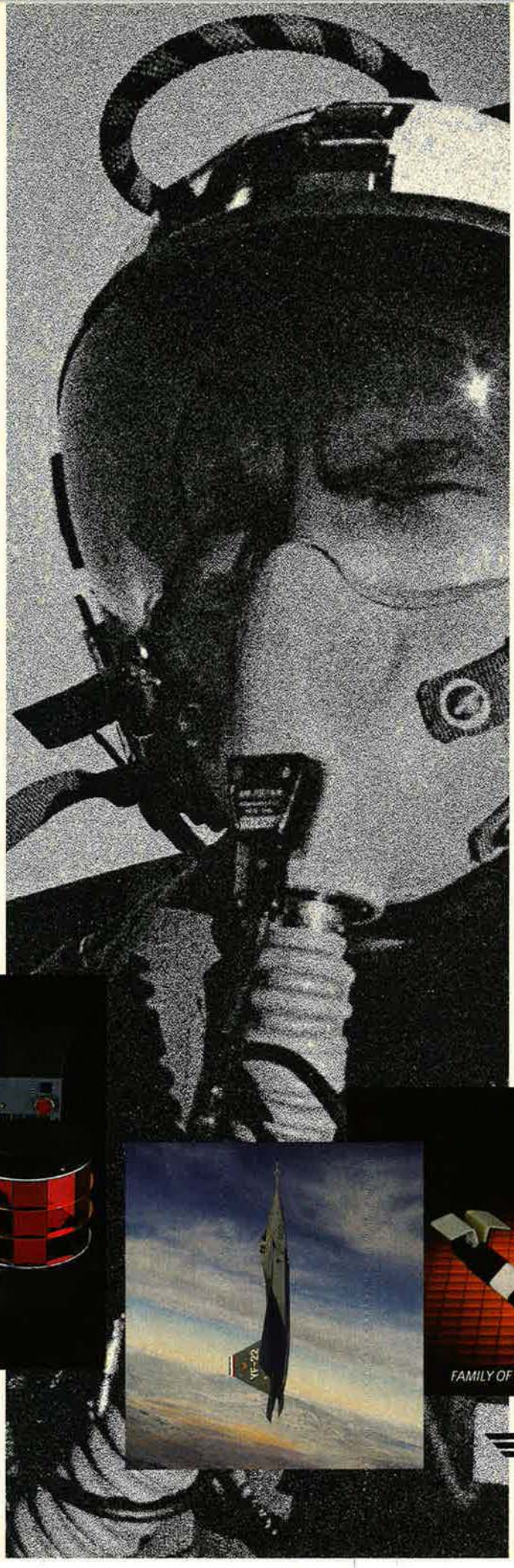
MSgt. Kenneth A. Beears, Jr., a member of the 512th Military Airlift Wing at Dover AFB, Del., was named the **Air Force Reserve First Sergeant of the Year** for 1991.

Norman R. Augustine, chairman and chief operating officer of Martin Marietta Corp., received the **1991 Robert H. Goddard Memorial Trophy** awarded by the National Space Club. Mr. Augustine, who last year chaired the Advisory Committee on the Future of the US Space Program, was cited for his "outstanding leadership and intuitive ability to penetrate complex issues and translate them into clearly defined goals." On April 4, he also received the National Engineering Award from the American Association of Engineering Societies.

★ **DIED—John Tower,** former Republican senator from Texas, on April 5, in the crash of a commuter airplane, which also took the life of his daughter Marian and twenty-one other persons. He was sixty-five. A four-term senator, he was the first elected Texas Republican Senator since Reconstruction. Chairman of the Armed Services Committee from January 1981 until he retired from the Senate in January 1985, Tower also served as chief US negotiator at the Geneva START talks and headed a three-member presidential commission that in 1986–87 investigated the Iran-contra affair. In 1989, President Bush nominated him for Secretary of Defense, but his confirmation was derailed by allegations of personal impropriety. Tower always maintained that the charges were political in nature and either highly exaggerated or false.

Aviation pioneer **Robert L. Hall,** of undisclosed causes on February 24 at

"Tiger 1.
Fulcrum.
010, 10 high.
40 miles,
1500 closing.
No missile
threat."



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ALQ-126, 156 AND 144
COUNTERMEASURE SYSTEMS.

FAMILY OF EXPENDABLE DECOYS.

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a hospital in Newport, R. I. He was eighty-five. While at Grumman Aircraft during World War II, he helped design and test a series of fighters that proved a major force in the air war, including the F-4F Wildcat, F-6 Hellcat, F-8F Bearcat, and F-7F Tigercat. He was instrumental in the design of several jet fighters and the Gulfstream I executive aircraft. He retired from Grumman Aircraft Engineering Corp. in 1970 after serving as the company's chief engineer and vice president.

Clifford E. Charlesworth, former NASA flight director, of a heart attack at his home in Friendsworth, Tex. He was fifty-nine. As flight director of the Manned Spacecraft Center at Houston from 1962 to 1970, he directed several Gemini and Apollo missions, including Apollo 11, which landed the first men on the moon in 1969. He was also flight director for Apollo 8, a moon-orbit mission, and for Gemini 12, which included a two-hour space walk by Maj. Edwin E. Aldrin, Jr. ■

Senior Staff Changes

RETIREMENTS: L/G Donald O. **Aldridge;** B/G Stuart R. **Boyd;** L/G Donald L. **Cromer;** M/G John R. **Farrington;** L/G Ellie G. **Shuler,** Jr.

PROMOTIONS: To be **Lieutenant General:** Edward P. **Barry,** Jr.; Billy J. **Boles;** Vernon J. **Kondra;** Martin J. **Ryan,** Jr.; Charles J. **Searock,** Jr.; Alexander M. **Sloan;** Donald **Snyder;** Richard J. **Trzaskoma.**

To be **Major General:** Lawrence E. **Boese;** Phillip E. **Bracher;** Robert A. **Buethe,** Jr.; Hiram H. **Burr,** Jr.; Michael J. **Butchko,** Jr.; Lewis E. **Curtis** III; Brett M. **Dula;** Marvin S. **Ervin;** James A. **Fain,** Jr.

Lawrence P. **Farrell,** Jr.; Bruce L. **Fister;** Charles E. **Franklin;** Buster C. **Glosson;** Thomas R. **Griffith;** Kenneth L. **Hagemann,** Sr.; Larry L. **Henry;** James F. **Hinkel;** James M. **Hurley.**

John P. **Jumper;** John G. **Lorber;** James E. **McCarthy;** John F. **Phillips;** Joseph J. **Redden;** Ervin J. **Rokke;** Donald B. **Smith;** Edwin E. **Tenoso;** Thad A. **Wolfe.**

To be **ANG Major General:** James W. **Chapman;** Adolph P. **Hearon;** Raymond E. **Moorman;** James T. **Whitehead.**

To be **ANG Brigadier General:** Eugene R. **Andreotti;** Donald W. **Armington;** Robert W. **Barrow;** Michael J. **Bowers;** John D. **Broman;** James F. **Brown;** John H. **Fenimore;** Gene A. **Katke.**

Harold E. **Keistler;** Phillip L. **Latham;** Allen J. **Newcomb;** Ronald L. **Seely;** Lonnie J. **Slauson,** Jr.; Preston M. **Taylor;** William A. **Treu;** Joseph N. **Waller.**

CHANGES: L/G Thomas A. Baker, from Vice Cmdr., Hq. TAC, and Vice CINC, USAFLANT, USLANTCOM, Langley AFB, Va., to Cmdr., 12th Air Force, TAC, and Cmdr., US Southern Command Southern Air Forces, replacing retired Peter T. Kempf . . . **M/G (L/G selectee) Edward P. Barry, Jr.,** from PEO, Tactical and Airlift Prgms., AFPEO, Hq. USAF, Washington, D. C., to Cmdr., Space Sys. Div., AFSC, Los Angeles AFB, Calif., replacing retired L/G Donald L. Cromer . . . **B/G Richard C. Bethurem,** from Cmdr., 831st AD, TAC, George AFB, Calif., to IG, Hq. TAC, Langley AFB, Va., replacing B/G Ralph E. Eberhart . . . **M/G (L/G selectee) Billy J. Boles,** from Cmdr., AFMPC, and Ass't DCS/Pers. for Mil. Pers., Randolph AFB, Tex., to DCS/Pers., Hq. USAF, Washington, D. C., replacing L/G Thomas J. Hickey . . . **B/G Sebastian F. Coglitore,** from Cmd. Dir., NORAD Combat Ops. Staff, J-31, Hq. NORAD, Cheyenne Mountain AFB, Colo., to Cmdr., Western Space and Missile Center, AFSPACECOM, Vandenberg AFB, Calif. . . . **B/G James L. Cole, Jr.,** from Ass't DCS/Ops., Hq. MAC, Scott AFB, Ill., to Chief of Safety, Hq. USAF, Washington, D. C. . . . **B/G William E. Collins,** from Ass't for R&M, Manufacturing, and Quality, DCS/Acquisition, Hq. USAF, Washington, D. C., to Cmd. Dir., NORAD Combat Ops. Staff, J-31, Hq. NORAD, Cheyenne Mountain AFB, Colo., replacing B/G Sebastian F. Coglitore.

M/G Robert E. Dempsey, from Vice Cmdr., 8th AF, SAC, Barksdale AFB, La., to Cmdr., 3d AD, SAC, Hickam AFB, Hawaii, replacing M/G David J. Pederson . . . **B/G (M/G selectee) Brett M. Dula,** from Dir., Leg. Liaison, OSAF, and Dir., Air Force Issues Team, Hq. USAF, Washington, D. C., to Vice Cmdr., 8th AF, SAC, Barksdale AFB, La., replacing M/G Robert E. Dempsey . . . **M/G Thomas E. Eggers,** from Cmdr., Hq. AFSOC, and Cmdr., Air Force Comp. Cmd., USSOCOM, Hurlburt Field, Fla., to Dep. CINC, Hq. USSOC, MacDill AFB, Fla., replacing M/G (L/G selectee) Donald Snyder . . . **B/G (M/G selectee) Bruce L. Fister,** from Dep. Commanding Gen., Joint Spec. Ops. Cmd., USSOCOM, Fort Bragg, N. C., to Cmdr., Hq. AFSOC, and Cmdr., Air Force Comp. Cmd., USSOCOM, Hurlburt Field, Fla., replacing M/G Thomas E. Eggers . . . **B/G Buster C. Glosson,** from Cmdr., 14th AD Provisional, USCENTCOM, Saudi Arabia, to Dir., Leg. Liaison, OSAF, and Dir., Air Force Issues Team, Hq. USAF, Washington, D. C., replacing B/G (M/G selectee) Brett M. Dula . . . **B/G Gerald E. Hahn,** from Dep. Auditor General, OSAF, and Cmdr., AFAA, Norton AFB, Calif., to Dep. for Policy and Network Mgmt., Defense Finance and Accounting Service, Lowry AFB, Colo. . . . **L/G Trevor A. Hammond,** from Vice Cmdr., Hq. AFLC, Wright-Patterson AFB, Ohio, to DCS/Log., Hq. USAF, replacing L/G Henry Viccellio, Jr.

L/G Bradley C. Hosmer, from IG, Hq. USAF, OSAF, Washington, D. C., to Superintendent, US Air Force Academy, Colo., replacing retiring L/G Charles R. Hamm . . . **B/G Thomas C. Hruskocy,** from Dir. for Materiel Mgmt., Oklahoma City ALC, AFLC, Tinker AFB, Okla., to DCS/Log., and Dep. Dir., Log., STRACOS, Hq. SAC, Offutt AFB, Neb., replacing M/G (L/G selectee) Charles J. Searock, Jr. . . . **M/G John E. Jackson, Jr.,** from Dir., Personnel Prgms., Hq. USAF, Washington, D. C., to Cmdr., AFMPC, Randolph AFB, Tex., replacing M/G (L/G selectee) Billy J. Boles . . . **M/G (L/G selectee) Vernon J. Kondra,** from DCS/Ops., Hq. MAC, Scott AFB, Ill., to Cmdr., 21st AF, MAC, McGuire AFB, N. J., replacing M/G Paul E. Landers, Jr. . . . **M/G Paul E. Landers, Jr.,** from Cmdr., 21st AF, MAC, McGuire AFB, N. J., to DCS/Ops., Hq. MAC, Scott AFB, Ill., replacing M/G (L/G selectee) Vernon J. Kondra . . . **M/G James W. Meier,** from Dep. Dir., Ops., NMCS, J-3, Joint Staff., Washington, D. C., to Vice Cmdr., 15th Air Force, SAC, March AFB, Calif., replacing retired M/G John R. Farrington . . . **M/G David C. Morehouse,** from Dep. JAG, Hq. USAF, Washington, D. C., to The Judge Advocate General, Hq. USAF, Washington, D. C., replacing retired M/G Keithe E. Nelson.

M/G David J. Pederson, from Cmdr., 3d AD, SAC, Hickam AFB, Hawaii, to Dep. Dir., Ops., NMCS, J-3, Jt. Staff., Washington, D. C., replacing M/G James W. Meier . . . **B/G Everett H. Pratt, Jr.,** from Ass't DCS/Ops. and Ass't Dep. Dir., Ops., TACOS, Hq. TAC, Langley AFB, Va., to DCS/Ops. and Readiness, Hq. ATC, Randolph AFB, Tex., replacing retiring M/G Sam W. Westbrook III . . . **L/G Robert L. Rutherford,** from DCS/P&P, Hq. USAF, Washington, D. C., to Vice CINC, Hq. MAC, Scott AFB, Ill., replacing retired L/G Anthony J. Burshnick . . . **M/G (L/G selectee) Martin J. Ryan, Jr.,** from Dep. CINC and C/S, USLANTCOM, Langley AFB, Va., to Cmdr., 8th AF, SAC, Barksdale AFB, La., replacing retired Ellie G. Shuler, Jr. . . . **M/G (L/G selectee) Charles J. Searock, Jr.,** from DCS/Log. and Dep. Dir., Log., STRACOS, Hq. SAC, Offutt AFB, Neb., to Vice Cmdr., Hq. AFLC, Wright-Patterson AFB, Ohio, replacing L/G Trevor A. Hammond . . . **B/G Nolan Sklute,** from Staff Judge Advocate and Cmdr., Air Force Contract Law Center, Hq. AFLC, Wright-Patterson AFB, Ohio, to Dep. JAG, Hq. USAF, Washington, D. C., replacing M/G David C. Morehouse . . . **M/G (L/G selectee) Alexander M. Sloan,** from Command Surgeon, Hq. USEUCOM, Vaihingen, Germany, to Surgeon General of the Air Force, Hq. USAF, Washington, D. C., replacing retiring L/G Monte B. Miller . . . **M/G (L/G selectee) Donald Snyder,** from Dep. CINC, Hq. USSOC, MacDill AFB, Fla., to Vice Cmdr., TAC and Vice CINC, USAFLANT, USLANTCOM, Langley AFB, Va., replacing L/G Thomas A. Baker.

SENIOR EXECUTIVE SERVICE (SES) CHANGES: James F. Bair, from Dep., Engineering, Munitions Systems, ASD, AFSC, Eglin AFB, Fla., to Dep. Dir., Wright Laboratory, ASD, AFSC, Wright-Patterson AFB, Ohio, replacing Gary L. Denman . . . **Robert L. Baugh,** from Ass't Auditor General (Financial and Support Audits), AFAA, Norton AFB, Calif., to Assistant Auditor General (Operations), AFAA, Norton AFB, Calif., replacing Kenneth E. Seifert . . . **William L. Gifford** to Spec. Ass't to the Sec'y for External Affairs, OSAF, Washington, D. C. . . . **Theodore S. Haddad,** to Associate Dep. Ass't Sec'y for Communications and Computers, Hq. USAF, Washington, D. C. . . . **Anthony J. Pansza,** from Ass't to the Cmdr., Log. Ops. Ctr., Hq. AFLC, Wright-Patterson AFB, Ohio, to Principal Dep. to the Cmdr., Acquisition Log. Div., Hq. AFLC, Wright-Patterson AFB, Ohio, replacing Arthur G. Atkins.

Philip P. Panzarella, from Principal Ass't for Science, Technology, and Engineering, Hq. AFLC, Wright-Patterson AFB, Ohio, to DCS/Engineering and Technical Mgmt., Hq. AFSC, Andrews AFB, Md. . . . **William A. Ratcliff,** to Spec. Ass't for Total Quality Mgmt., Hq. USAF, Washington, D. C. . . . **Kenneth E. Seifert,** from Ass't Auditor General (Operations), AFAA, Norton AFB, Calif., to Ass't Auditor General (Financial and Support Audits), AFAA, Norton AFB, Calif., replacing Robert L. Baugh . . . **Walter J. Senus,** from Tech. Dir., Intel. and Recon., Rome Laboratory, AFSC, Griffiss AFB, N. Y., to Dir., Plans, Rome Laboratory, AFSC, Griffiss AFB, N. Y., replacing Carlo P. Crocetti . . . **Charles R. Wallace,** from Ass't to the Cmdr., Air Force Electronic Combat Office, Wright-Patterson AFB, Ohio, to Dir., Financial Mgmt., Warner-Robins ALC, AFLC, Robins AFB, Ga. ■

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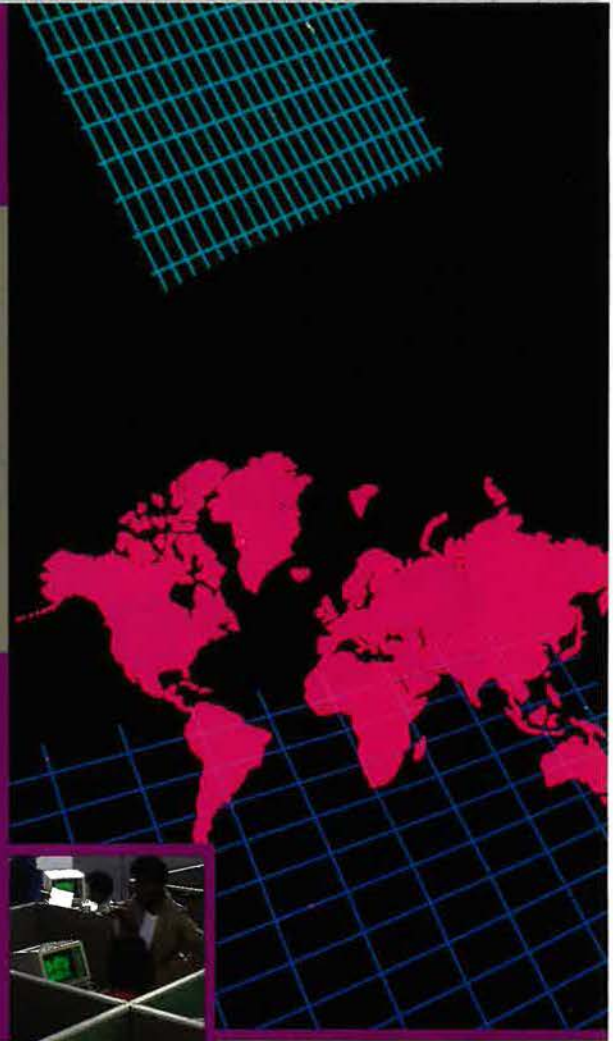

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LTOC LORAL

Not long ago, they called EW "a disaster area," but, as Operation Desert Storm demonstrated, things change.

The Electronic Storm

—USAF photo by MSgt. Bill Thompson

By James W. Canan, Senior Editor

SUPREMACY in electronic warfare from start to finish was a big reason—maybe the biggest reason—for the stunning success of the allied coalition's air campaign against Iraq. EW, waged in every imaginable way, enabled allied air forces to confound Iraqi air defenses throughout the six-week war. It cleared the way for allied aircraft and protected them to near-perfection.

US Air Force Lt. Gen. Charles A. Horner, architect of the allied air campaign, gave EW great credit for its triumphant outcome. In an interview with AIR FORCE Magazine *[see p. 57]* at his headquarters in Riyadh, Saudi Arabia, the Central Air Forces Commander in Chief was asked to appraise the "results of your electronic countermeasures" (ECM).

He replied, "I would have to say it's one of the highlights of the war, especially if you look at the number of sorties we flew and the intensity of the air defenses."

The CENTAF CINC noted that "our losses to surface-to-air missiles were something like ten planes," even though the enemy "fired thousands and thousands of surface-to-air missiles." This, he said, "would tell you automatically that the combination of electronic countermeasures and the Wild Weasel operation was certainly effective.

"In fact," he continued, "the only kills [the enemy] got were probably flukes. We know of many cases where they just shot the missiles in the air. In one case, they spun one off, and it hit an airplane. The airplane got back okay, but [with] some holes in it."

Countermeasures were only part of allied air forces' electromagnetic arsenals. Led by USAF, those air forces used just about every conceivable electronic asset in the fight. Iraqi air defenses and communications were crushed or rendered confused and chaotic by jamming, decoys, and attacks with missiles and bombs.

Air Force F-117A Stealth fighters, exemplars of contemporary electronic combat, were first to hit Iraqi air defense radars, which never saw them coming. Then, surging through the radar gaps opened up by the F-117As, came wave after

F-4G Wild Weasels from wings in the US and Europe fly formation over Bahrain during Operation Desert Storm. Carrying ALQ-131 and ALQ-184 electronic countermeasures pods and armed with radar-busting HARMs, Wild Weasels waged electronic warfare, with stunning results.

wave of allied "strike packages" spearheaded by USAF's nonstealthy Wild Weasels and fighter-bombers.

The F-117As showed the world, to say nothing of Iraq, that modern electronic warfare relies as much on mystifying enemy radars as it does on disrupting and destroying them.

At the height of Operation Desert Storm, Brig. Gen. Richard B. Myers, Tactical Air Command's deputy chief of staff for Requirements, described "the entire spectrum of electronic combat that we try to defeat —from enemy detection through identification, acquisition, whatever kind of track mechanism, missile launch, guidance, and then, eventually [missile] fuzing."

Addressing an Air Force Association symposium in Orlando, Fla., General Myers went on to explain that "our electronic combat is tasked to work with parts of that spectrum in various ways," from the EF-111 standoff jammer "against the front end of [enemy] detection and identification" radars to "systems hanging on our [individual] aircraft that work on the other end of the spectrum [against enemy] missile guidance and fuzing."

He declared, "Overlaying all of that, in addition to those systems, is stealth."

Just in Time

Aside from the F-117A Stealth fighters, there was nothing especially exotic about the ECM equipment that made it possible for Air Force fighters and bombers to survive the war in such remarkable numbers. Some of that equipment showed up just in time, though, and its fortuitous availability for combat is now regarded as a tribute to EW acquisition as practiced by the Air Force in recent years.

Desert Storm's spectacular results are seen as vindication of the Air Force's EW acquisition community. It had come under fire in recent years for failures of several key EW systems in development or in operation. Desert Storm showed the other side of the story—the successes.

In the opinion of Air Force Col. Robert Walsh, a top EW official in the office of the Assistant Secretary of the Air Force for Acquisition, Desert Storm demonstrated under difficult circumstances that "our EW systems are better than we ever expected them to be. We knew they were good, but we couldn't prove it in a court of law. Desert Storm was our confirmation."

An Air Force EC-130 Compass Call aircraft takes on fuel for a communications jamming mission in the Gulf War. Disruption of communications necessary for centralized command and control threw Iraqi forces into disarray.

In his interview with AIR FORCE, General Horner described allied EW assets and their employment in Desert Storm as follows:

- Countermeasures pods on airplanes to "provide terminal protection" by jamming enemy missile-guidance radars and misleading them with chaff and by shooting off flares to fool heat-seeking missiles.
- Air Force F-4Gs and Navy F/A-18s in the Wild Weasel role firing high-speed antiradiation missiles (HARMs) at enemy ground radars, making it dangerous for their operators to keep them turned on long enough to "put [air target] information into the missile guidance system and guide the missile to the target."

Up against Wild Weasels, an enemy radar operator knows all too well that "if he stays on longer than a few seconds, he dies," the General declared. "What he has to do is like shooting a rifle by closing his eyes and blinking them open. That was nearly impossible."

- Area-jamming aircraft "like the Air Force EF-111 and the Navy EA-6B, which pour electrons into [the enemy's] target-acquisition radars so he just doesn't know where you're coming from." This technique cloaks the attacking aircraft and has the effect of making all of them stealthy, whether or not they are built that way.

Allied electronic combat involved other key elements as well. General Myers noted, for example, the vital role of the Air Force's EC-130 Compass Call aircraft in disrupting Iraqi military communications at strategic and tactical levels.

"We have seen what technology can do over there in terms of weapons," he told his AFA symposium audience. "Some of that makes for good video. . . . What we don't see are the technologies that are enabling us to use those smart weapons."

Those technologies do their stuff in "the mostly invisible world of electronic combat," the General said. "I can guarantee you that Iraq understands electronic combat and has a very real and very intense defense." He noted that ECM suites on all Air Force aircraft were "working very, very well" under fire.

Who would have believed it? Only a few years ago, the Air Force was in a funk about electronic warfare. Big problems plagued several key programs in development or in operation, such as the defensive avionics suite aboard the B-1B bomber, the airborne self-protection jammer (ASPJ), the upgrade of the area-jamming gear aboard the EF-111, and an "advanced capability" jamming pod for a wide variety of aircraft.

Disaster Area

Beset by such failures, top uniformed and civilian leaders in the Air Force's operational and acquisition communities called EW a disaster area for the service. Much of the blame was laid on the EW acquisition strategy conceived by the Defense Department in the name of all the services in the early 1980s. That strategy was criticized for having overreached itself in setting unrealistic expectations for excessively capable EW systems. It was sound in other respects, though, and this became apparent in the Gulf War. The EW strategy had been largely pegged to pushing new EW systems through development and into production much more quickly and efficiently than had been the norm. It put a premium on "quick reaction" development of jammers and warning systems for a wide range of combat aircraft.

Several such systems did their stuff in Desert Storm and helped mightily to save the day. Thanks to the EW acquisition game plan, some had come through several years of development and production just in time to be installed on Air Force fighters deployed to the Gulf. The timing was uncanny. By all accounts, the new systems made a big difference once the shooting started.

One was the ALQ-184 ECM pod. The Air Force contracted with Raytheon in 1982 to develop it for a wide range of aircraft. A problem with one part of the system cropped up during operational testing, which was not completed to the Air Force's full satisfaction until near the end of last year.

Meanwhile, the Air Force made a decision that would turn out to have been opportune indeed. Convinced that the problem could and would be fixed, USAF put the ALQ-184 system into low-rate production almost two years before the testing would run its course. As a result, a goodly number of Air Force fighters were able to go to war with ALQ-184 pods slung underneath.

The ALQ-184 did a great job of bamboozling enemy radar-guided missiles. It gets much of the credit for the Air Force's astonishingly low losses.

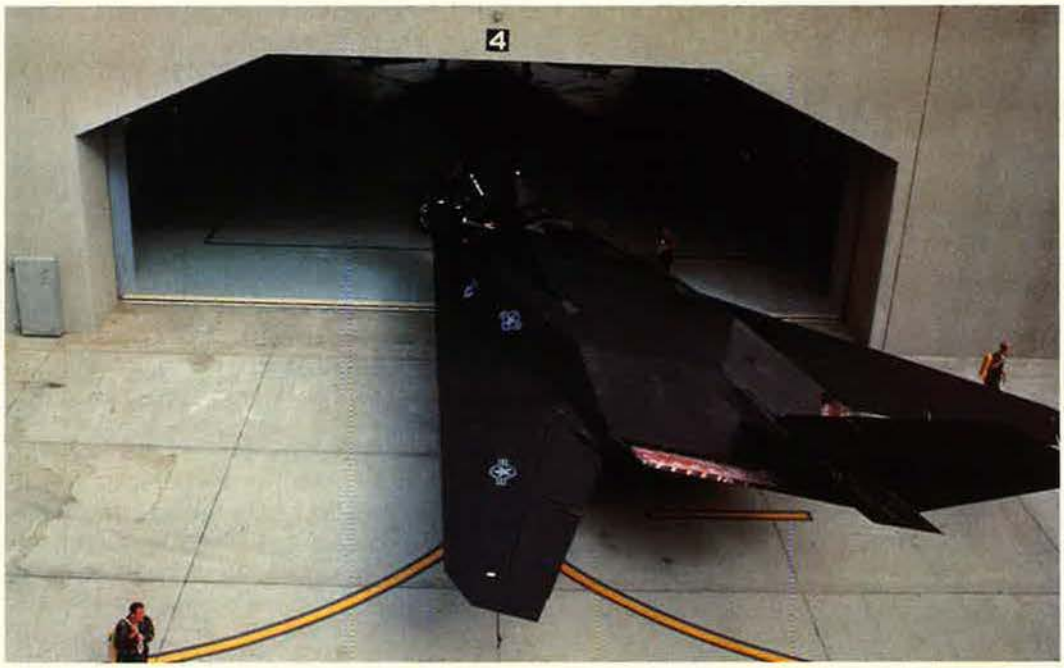
The ALQ-184 story makes a telling point: Had the Air Force been purist about putting off production until testing was all done, the ALQ-184 would have missed the war, with sorry consequences, in all likelihood, for at least some Air Force fighters that carried it into combat. Production would not even have begun until last January, just about the time that those very fighters first came under fire over Iraq and Kuwait.

Why did the Air Force conclude that there was no risk in going to war with ECM pods still being tested? Because, in effect, the testing was tougher on the pod than the war was expected to be.

The problem discovered during operational testing of the ALQ-184 was caused by a single part. The Air Force decided that the system did not need that part in order to do good work in the air war around the Gulf.

Colonel Walsh describes the part as "an auxiliary receiver that gives the system an increased capability against specific threats." Those threats "were irrelevant to Desert Storm," and, in any case, "the auxiliary receiver would not have been installed" in the ALQ-184 pods that were deployed to the Gulf.

ALQ-184 pods, each costing about $900,000, will eventually replace Westinghouse ALQ-119 pods aboard a wide range of Air Force fighter and attack aircraft. The ALQ-119 did yeoman work for many years but is based on outdated ECM technology of the 1970s and has seen its day. The ALQ-184 outperforms and outlasts it by far. All ALQ-119s in the inventory are now being transformed into ALQ-184s.



An Air Force F-117A takes cover in a hardened shelter. Epitomizing modern electronic combat, stealthy F-117A attack fighters escaped detection in the Gulf War and went unmolested while taking out top-priority targets.

Tough Pod

The ALQ-184 has shown its toughness too. It tested out at eighty hours mean time between failures (MTBF) in the field and actually did a little better than that under the heavy stress of combat sorties ga-

lore around the Gulf. The best the ALQ-119 could ever manage by way of reliability was twenty hours MTBF.

Colonel Walsh claims that the ALQ-184's performance, reliability, and maintainability are "all very important in terms of our having a highly deployable Air Force," one that will remain capable of fulfilling USAF's "Global Reach, Global Power" responsibilities. He also predicts that the system "will get even better over time" in all respects.

The ALQ-135, an internal jammer that Northrop began developing for the Air Force in 1983, also sprang from the Pentagon's EW acquisition strategy and performed for USAF on short notice in Desert Storm. It had been installed in the squadron of F-15C air-superiority fighters from the 33d Tactical Fighter Wing at Eglin AFB, Fla., in plenty of time for that squadron to go into combat—and claim the lion's share of all Air Force air-to-air victories—in Desert Storm.

The most up-to-date models of the ALQ-135 jammers did not emerge from production and go into operational service until last June. Even as Iraq invaded Kuwait less than two months later, those jammers were being installed on F-15Es of the 4th Tactical Fighter Wing at Seymour Johnson AFB, N. C.

Two squadrons of Air Force F-15Es went to war in Desert Storm. They belonged to the 4th TFW, and they racked up big scores against all sorts of targets all over Iraq and Kuwait. They were also, and hardly by chance, the very F-15Es equipped with upgraded ALQ-135s. Through days and nights of seemingly endless sorties, only one was shot down, most likely by a lucky shot from an antiaircraft gun.

The EW success story in Desert Storm was not about new systems alone. Most Air Force planes in that war carried older-generation, external ECM systems, such as the Westinghouse ALQ-119s and ALQ-131s. All did the job.

—USAF photo by TSgt. Perry Heimer

An F-16C returns from a Desert Storm mission with its bomb racks empty and an ALQ-119 ECM pod slung on its centerline. Air Force planes used assorted pods and internal jammers to great effect in fending off missiles and keeping losses very low.

Each plane went to war with the pods it already had. As a rule, ECM systems were not switched around at the last minute. "We don't just take the best pods we have and move them around from plane to plane or base to base," Colonel Walsh explains. "Aircrews aren't used to flying with them. Maintenance crews aren't used to fixing them."

Operation Desert Storm also showed that the Air Force had made sound decisions through the 1980s in developing new radar warning receivers for its top-line fighters. One such RWR, the Loral ALR-56C, was carried by all F-15Es and by many F-15Cs used in that war. Other F-15Cs were equipped with the first model of the line, the ALR-56A.

The solid performance of its ECM systems under fire does not mean that the Air Force can leave well enough alone. Improvements are always in order. Says Colonel Walsh, "We have to keep looking into the future, judging what the threat environment is going to be, and deciding which upgrades we will need to make to counter it."

Upgrading ECM is much easier than it used to be, thanks to reprogrammable computers. Most of the Air Force's modern radar warning

—USAF photo by MSgt. Bill Thompson

The ALQ-131 jammer pod is conspicuous on this F-4G Wild Weasel being readied for wartime action. The ALQ-131, which has been around for a while, did the job in Desert Storm. The technology in newer jammers, such as the ALQ-184, allows them to do more and hold up better. Some older pods are being upgraded.

receivers embody such computers. If the planes carrying those RWRs run up against new or different radars and missiles, or if intelligence sources see such menaces in the making, squadrons can reprogram their RWRs with new software that will attune them to the changing threats.

Air Force ECM software specialists did that sort of thing on nearly all ECM systems throughout Desert Shield and Desert Storm. As combat aircrews and intelligence analysts caught on to new or modified characteristics of enemy missile radars, the relevant ECM components were reprogrammed, flight tested, and installed on flight lines.

What this demonstrates, declares Colonel Walsh, is that "we have truly made monumental gains in our ability to reconfigure EW systems, which gives us great flexibility."

—USAF photo by SSgt. Charles M. Reger

EF-111s make ready for electronic combat. These area-jamming Ravens were crucial to the allied victory in the Gulf War, pouring electrons into enemy target-acquisition radars and rendering them useless.

Not By Chance

The Air Force's turn to reprogrammable RWRs and other ECM systems was not happenstance. "The Air Force made the decision to do it—to make the necessary investment—as part of the [EW] acquisition strategy of the early 1980s," Colonel Walsh explains. "There was no doubt at the time that it would become increasingly difficult to rebuild and reinsert hardware components of computers to adjust to new threats and that software would have to be the answer."

It also appears easier to keep readily reprogrammable ECM systems in shape to stay the course of combat. TAC's General Myers told the AFA symposium in Orlando that the trend to digital programmable computers through the 1980s "helped us a lot" in maintaining ECM systems. He said, for example, that in 1980, it took two and a half hours to reprogram an ECM pod. The pod had to be removed from the airplane, taken to the ECM "pod shop," reprogrammed there, and put back on the plane.

"Today we can do that same job in seven minutes because we can do it on the aircraft," General Myers declared.

With radar warning systems seemingly well in hand, the Air Force has begun attending to the development of missile warning systems to complement the RWRs on combat aircraft. An RWR is sensitive only to the approach of a radar-guided missile. An MWS, on the other hand, is designed to detect all kinds of missiles, including those using infrared and electro-optical sensors to seek their prey.

Missile warning systems are currently carried by limited numbers and types of Air Force aircraft, including B-52 and F-111 bombers and special operations planes, such as fixed-wing gunships. Now USAF is looking at missile warning systems for such planes as C-5, C-141, and C-130 transports and F-15 and F-16 fighters and attack aircraft. The F-111 may need a new MWS.

The Air Force is feeling pressure at the Defense Department level to get cracking on an MWS for the F-16. Last year, the Defense Acquisition Board approved USAF's controversial, much-debated plan to assign the F/A-16 to the close air support (CAS) mission as successor to the A-10 and assign it to the longer-range battlefield air interdiction (BAI) mission as well.

There was one caveat. The DAB ruled that the Air Force must put a missile warning system on the fighter.

The Air Force moved to comply. Its Tactical Air Warfare Center at Eglin AFB, Fla., examined the technology of missile warning systems already on "heavies," with an eye to its suitability for fighters. MWS contractors converged on Eglin for flight tests of their technologies on drones.

The testing resulted in "fairly high confidence that the technology was there and ready to make the transition to the fighter force," and "gave us just what we were looking for," General Myers said.

He predicted that more such expeditious testing of ECM technologies and systems will take place in the future. Why? Because the Air Force is intent on "streamlining" its ECM acquisition process, and "rapid prototyping and flight demos" like those at Eglin are in keeping with that.

Meanwhile, the Air Force is assured of having more than enough individual ECM systems for its fighter force, he said, "not because we are buying more ECM pods or radar warning receivers, but because our force structure is drawing down, and we are able to take pods that were flying on A-7s, for example, and move them to the [fighters] that are left."

General Myers emphasized that the Air Force will continue to "need ECM systems that are effective, timely, and affordable—a blend of stand-alone, bolt-on systems and fully integrated [internal] systems"—plus a continuation of top-notch training in their use. Otherwise, he warned, the impressive record racked up in Desert Storm electronic warfare may not be duplicated the next time around. ■

Avionic Systems | SUNDSTRAND AEROSPACE

REDMOND, WASHINGTON 98073 Sundstrand Corporation

A Checklist of Major Electronic Systems

Electronic works in progress at the Air Force's Major Program Offices, Electronic Systems Division, Hanscom AFB, Mass., and Rome Laboratory, Griffiss AFB, N. Y.

Airborne Warning and Control System Program Office

Airborne Battlefield Command and Control Center III
A C-130-based, automated, airborne command and control system for TAC use in forward battle areas and with special operations forces. **Contractor:** Unisys. **Status:** Production.

Airborne Warning and Control System (E-3)
A major upgrade program for the AWACS surveillance and battle management aircraft. Includes additional sensors, antijam communications, and radar systems upgrades to keep the plane in service into the next century. **Contractors:** Boeing, Logicon, Westinghouse. **Status:** Full-scale development, production.

NATO AWACS Program
Development, production, and enhancement of NATO's eighteen AWACS Sentry planes; installation of a major upgrade, Electronic Support Measures, to provide a passive sensor system as a complement to active radar sensors. **Contractor:** Boeing. **Status:** Deployment.

Saudi Arabian AWACS
Program to acquire and outfit five US-built AWACS E-3 aircraft for the Royal Saudi Air Force. **Contractor:** Boeing. **Status:** Deployment.

Air Base Decision System Program Office

AI-Derived Technologies
Program to develop three knowledge-based planning and scheduling systems for MAC and AFSPACECOM. **Contractor:** MITRE. **Status:** Validation.

Air Force Electronic Security Equipment Program
Procurement of physical security equipment for deployment to seventy USAF bases and 210 sites overseas. **Contractor:** None. **Status:** Deployment.

Air Force Shelter Technology Office
Program to provide program management and engineering support for shelter programs throughout the Air Force and to improve design, manufacturing techniques, and materials. **Contractors:** Spectrum 39, Advanced Composite Tech. **Status:** Full-scale development.

Air Force Worldwide Military Command and Control Information System
The C^3 systems planning and engineering center for USAF elements of the Defense-wide system. **Contractors:** Computer Engineering Associates. **Status:** Full-scale development.

Air Logistics Centers Local Area Network
Provides for development, installation, testing, and integration of a local communications system connecting the five Air Logistics Centers. **Contractor:** TRW. **Status:** Deployment.

Automated Weather Distribution System
Program to enhance the Air Weather Service's meteorological support for the Army and Air Force by using advanced computer technology and graphic presentation software. **Contractors:** Unisys, Contel, Federal Electric. **Status:** Production.

Automated Weather Distribution System P^3I
Preplanned Product Improvement to AWDS, focused on improved graphics, interoperability, and communications. **Contractor:** None. **Status:** Concept definition.

Avionics Intermediate Shop Mobile Facility
Program provides for developing shelter systems for F-15, F-16, A-10, and F/EF-111 avionics maintenance. **Contractor:** American Development Corp. **Status:** Production.

Battlefield Weather Observation and Forecast System/ Prestrike Surveillance Reconnaissance System
A tactical decision-aids system for providing weather observation from enemy areas and other inaccessible areas. **Contractor:** None. **Status:** Full-scale development.

Battlefield Weather Observation and Forecast System/ Tactical Decision Aids
Program to provide decision aids in assessing weather effects on various weapon systems in specific battle situations. **Contractor:** None. **Status:** Conceptual.

Command Center Evaluation System
Program to provide central facility to evaluate technologies that might meet needs of USAF command centers. **Contractor:** None. **Status:** Conceptual.

Computer Resource Management Technology
Engineering development program to translate the software advances of industry, university, and laboratory into use in USAF weapon systems dependent on computer resources. **Contractor:** HH Aerospace. **Status:** Full-scale development.

Deployable Strategic Mission Data Preparation System Shelter Group
Program to provide SAC with capability to transport computer system able to create Mission Planning Data Transfer Unit Cartridges for B-52, B-1, B-2, ALCMs, and ACMs. **Contractor:** Sacramento ALC. **Status:** Full-scale development, production.

DoD Base and Installation Security System
RDT&E program to develop physical security equipment for DoD sites worldwide. **Contractor:** None. **Status:** Full-scale development.

DoD Software Engineering Institute
Program to develop and disperse technology and means to improve quality of software in mission-critical computer systems. **Contractor:** Carnegie-Mellon U. **Status:** Full-scale development.

Information Processing System
Provides automated support for command and control functions at the top six MAC command echelons. **Contractor:** Computer Science Corp. **Status:** Full-scale development.

Joint WWMCCS Information Systems
Development of system to replace and modernize current WWMCCS automatic data processing. **Contractors:** GTE, IBM. **Status:** Full-scale development.

Logistics Information Management System
A program to produce logistics information architecture and recommendations for helping to keep USAF weapons in a high state of readiness. **Contractor:** Transportation System Center. **Status:** Concept definition.

Scope Shield Phase I
Program to create a security police communications system that will replace radios currently used by USAF security police in air base defense, weapon system security, and law enforcement. **Contractor:** Magnavox. **Status:** Production.

Scope Shield Phase II
Program to provide better communications for USAF security police and other forces. **Contractor:** None. **Status:** Production.

Security Pro
A security products program to design and develop secure computing systems able to meet war-planning, intelligence, and force-management requirements generated by SAC. **Contractor:** None. **Status:** Validation.

STARS
Software Technology for Adaptable, Reliable Systems pursues DoD goal of dramatic improvements in weapon software quality while reducing costs. **Contractors:** Boeing, IBM, Unisys. **Status:** Full-scale development.

Survivable Base Communication System
Program aimed at dramatically reducing the time required to assess damage and direct efforts of air base recovery teams; combines communications equipment and computers for effective command of recovery personnel. **Contractor:** Sumariq. **Status:** Full-scale development.

Technical On-Site Inspection
Program to investigate technologies and concepts for on-site inspections of international arms-control agreements; procurement of prototype for continuous monitoring system supporting this goal. **Contractors:** Sandia Laboratory, Hughes. **Status:** Full-scale development, deployment.

UHF Satellite Terminal System
Development of a deployable, multiple-access communications system based on a single UHF satellite channel for MAC and DoD users. **Contractor:** M/A-COM Government Systems. **Status:** Full-scale development.

Unified Local Area Network Architecture Phase I
Program to develop standard local area networking components used to create data communications networks on USAF bases. **Contractors:** EDS, TRW. **Status:** Ongoing.

USTRANSCOM C^2 Study
Development support for US Transportation Command's effort to deploy new command and control systems linking various parts of its structure. **Contractor:** None. **Status:** Conceptual.

Weapons Storage and Security System
Research effort to determine new ways to provide dispersed, unattended tactical weapons storage using hardened vaults beneath the floors of aircraft shelters. **Contractor:** Bechtel National. **Status:** Production.

Airspace Management System Program Office

Digital Brite
System that will replace the existing Brite display system with more reliable equipment displaying alphanumeric beacon data. **Contractor:** Unisys. **Status:** Deployment.

FAA/Air Force Radar Replacement
Joint effort to replace 1950s-vintage surveillance and height-finding radars with modern three-dimension radars. **Contractor:** Westinghouse. **Status:** Production.

Have Quick II/IIA
An upgrade to the Have Quick antijam UHF voice communications radio. **Contractors:** Many. **Status:** Full-scale development, production.

Have Sync
Development of a single-channel ground and airborne radio system (SINCGARS) for antijam, secure voice VHF/FM/AM communications to replace the AN/ARC-186 radio. **Contractor:** Cincinnati Electronics. **Status:** Full-scale development.

Microwave Landing System
A four-part DoD program to develop and produce landing systems to replace existing Instrument Landing System and Precision Approach Radars. **Contractors:** Many. **Status:** Full-scale development.

New Mobile Rapcon
Program to acquire new approach-control radar systems to replace aging mobile AN/MPN-14 systems. **Contractors:** Unisys (Radar AN/TPS-73), Aydin Computer System (NMR OPS). **Status:** Production (Radar AN/TPS-73), validation (NMR OPS).

Tower Restoral Vehicle/Surveillance Restoral Vehicle
Program to provide highly mobile, rapid restoral equipment for air traffic control towers and radar approach controls. **Contractor:** Airspace Technology Corp. **Status:** Full-scale development.

Battle Management System Program Office

Air Situation Display System
Procurement of system composed of six operator display positions used at Allied Tactical Operations Center at Sembach AB, Germany. **Contractor:** COMPTEK Research. **Status:** Production.

Caribbean Basin Radar Network
Program to upgrade US air surveillance in the Caribbean via transmission of radar data via satellite and land links to US C^3 centers. **Contractor:** Westinghouse. **Status:** Production.

Combat Communications Access for Support Elements
Program to develop system for transfer of logistic information within battle areas and between battle areas. **Contractor:** BBN Communications Corp. **Status:** Production.

Combat Identification System/Indirect Subsystem
Program to develop and deploy NATO-compatible system for accurate and timely target identification to battle commanders. **Contractor:** None. **Status:** Full-scale development.

Computer-Aided Mission Planning at Air Base Level
Program to provide an automated mission planning system for European Participating Air Forces. **Contractor:** General Dynamics. **Status:** Full-scale development, production.

Digital European Backbone
Incremental upgrade to portions of the European Defense Communications system from insecure analog systems to secure digital systems. **Contractors:** GTE, Gould, TRW. **Status:** Production, deployment.

EIFEL
Program to develop follow-on telecommunications and automated data-processing capabilities to the EIFEL I system at the ATOC, Sembach AB, Germany, and at associated bases. Common undertaking of the US, Germany, Belgium, the Netherlands, and the UK. **Contractor:** Dornier Systems. **Status:** Full-scale development.

Ground Mobile Forces SATCOM Terminals
Program to produce highly mobile satellite communications terminals for the tactical air forces and others. **Contractors:** GE, Harris. **Status:** Production, deployment.

Modular Control Equipment
Development of a transportable, modular, automated air command and control system. **Contractor:** Litton Data Systems. **Status:** Production.

Modular Control Equipment P^3I
Design development, fabrication, integration, and test of improvements to the MCE components. **Contractor:** Litton Data Systems. **Status:** Full-scale development.

NATO Air Base SATCOM Terminal Program
Development of survivable terminals for wartime communications between NATO Air Operations Centers and allied airfields. **Contractors:** Harris, Ford. **Status:** Production, deployment.

Puerto Rico Operations Center
Program to establish performance, integration, and verification requirements for Puerto Rico Operations Center, to be procured by the Puerto Rico ANG. **Contractor:** To be determined. **Status:** Production.

Seek Screen Arm Decoy
Program to build a decoy that would protect the AN/TPS-43 radar from destruction by incoming antiradiation missiles. **Contractors:** Many. **Status:** Full-scale development.

Seek Screen Ultra-Low Sidelobe Antenna
Development of modification kit to provide enhanced electronic counter-countermeasures and performance for the AN/TPS-43E tactical radar. Kit will make it more resistant to enemy aircraft's jamming, increase its range and sensitivity, and make it more survivable. **Contractor:** Westinghouse. **Status:** Production.

Special Operations Forces Automated Mission Planning System
Development, procurement, and deployment of a third-generation AMPS to replace minicamp hardware and to enhance existing minicamps. **Contractor:** To be determined. **Status:** Full-scale development.

Tactical Battle Management Integration
Program to identify options to satisfy future tactical C^3 needs identified by users. **Contractor:** Not announced. **Status:** Not announced.

Tactical Air Forces Mission Support System
Program to automate aircrew mission planning and provide a data-transfer cartridge to initialize aircraft avionics programs. Program will support all combat-coded and training squadrons of F-16, F-15, F/RF-4, F/EF-111, A-7, and A-10 tactical aircraft. **Contractor:** To be determined. **Status:** Full-scale development.

TRI-TAC AN/TRC-170
Development and production of digital troposcatter radio terminals for use by tactical forces; provides secure transmission of messages; performs analog and digital voice transmission and transmission of digital data over a range of up to 200 miles. **Contractors:** Raytheon, Unisys. **Status:** Production, deployment.

TRI-TAC Communications Nodal Control Element
CNCE program to enhance technical assessment and control of tactical communications; capability to monitor performance, restore essential communications rapidly after failures, and reconfigure communications rapidly to meet changing circumstances. **Contractor:** Martin Marietta. **Status:** Production, deployment.

TRI-TAC Joint Tactical Communications
Program to investigate and acquire new ground-based tactical digital communications equipment for multiservice use. **Contractors:** Many. **Status:** Production, deployment.

Intelligence, C³CM System Program Office

Automated Message Handling System
Program to provide an intelligence analyst with capabilities for local electronic message handling and access to databases. **Contractor:** None. **Status:** Full-scale development.

Cobra Dane Modernization
Upgrade to replace aging computers and software and improve processing of land-based, phased-array radar at Shemya AFB, Alaska. **Contractor:** None. **Status:** Production.

Comfy Sword
Program to develop a jamming and deception system for training aircrews to operate in an electronic environment. **Contractor:** Tracor Flight Systems. **Status:** Deployment.

Constant Source
Development of means to correlate and display intelligence information to unit-level forces. **Contractor:** None. **Status:** Conceptual.

Have Stare
Program to develop what the Air Force calls a "one-of-a-kind radar system." Details are classified. **Contractor:** Not announced. **Status:** Full-scale development.

High-Power Microwave
Program to develop a tactical, point-defense, high-power microwave for protection of C³I assets. **Contractor:** MITRE. **Status:** Conceptual.

Intelligence Communications Architecture
Program to support development of an intelligence communications architecture and to monitor related efforts. **Contractors:** Many. **Status:** Conceptual/delivery.

Intelligence Work Station
Joint ESD/Rome Laboratory project to replace standard intelligence terminals with modular, stand-alone stations. **Contractor:** Contel Federal Systems. **Status:** Production.

Intratheater Imagery Transmission System
Program to develop a hard-copy image dissemination system to allow the tactical air forces to transmit photographs and other intelligence information swiftly by electronic means. **Contractor:** GE. **Status:** Full-scale development, production.

Joint Intelligence Center
Program to develop and implement a wartime protected theater intelligence system to support unified and specified commands. **Contractor:** None. **Status:** Concept definition.

Joint Services Imagery Processing System
Development of a ground station to receive, process, and disseminate national, strategic, or tactical imagery to combat commanders. **Contractor:** E-Systems. **Status:** Full-scale development.

Joint Tactical Fusion Program
An evolutionary program to develop the Air Force's Enemy Situation Correlation Element and the Army's All-Source Analysis System, two programs that use data from numerous sources to create a picture of the battlefield. **Contractors:** NASA, JPL. **Status:** Full-scale development.

Networking Capabilities
Program to provide wide-range support to various local area networks and network-associated systems. **Contractor:** None. **Status:** Concept definition.

NORAD Tactical Intelligence Cell
Project to establish an around-the-clock, all-source, antidrug Tactical Air Intelligence Fusion Center. **Contractor:** SAIC. **Status:** Deployment.

PACAF Interim National Exploitation Segment
Program aimed at providing an interim soft-copy exploitation capability. **Contractor:** Hughes. **Status:** Deployment/program management responsibility transfer.

Red Mission Analysis
Program to improve the scientific and technical intelligence base for computer modeling and simulation, in order to create digital models of various kinds of threats. **Contractor:** To be determined. **Status:** Dem/val.

Sentinel Aspen Phase I
Fabrication of a general-imagery intelligence training system for ATC. The system uses computer-aided instruction in preparing imagery analysts for operational systems. **Contractor:** Loral. **Status:** Full-scale development.

Sentinel Aspen Phase II
Program to modernize the Air Intelligence, Targeting Indications, and Warning and Fusion Training conducted by Goodfellow Technical Training Center. **Contractor:** None. **Status:** Full-scale development, production.

Sentinel Aspen Expansion
Program to provide three more classrooms' worth of hard-copy imagery workstations, single soft-copy workstation for Sentinel Aspen General Imagery Intelligence Training System, and soft-copy workstation system for US Army Intelligence Center & School. **Contractor:** Not announced. **Status:** Full-scale development, production.

Sentinel Bright I
Development and acquisition of a voice-processing training system with 460 workstations for the training of cryptologic linguists. **Contractor:** Engineering Research Co. **Status:** Deployment.

Sentinel Bright II
Design, development, and acquisition of a classified training system with 275 workstations and an unclassified training system with 113 workstations; used to train operators, analysts, and maintenance technicians for modern crypto systems. **Contractor:** American Systems Corp. **Status:** Full-scale development, production.

Sentinel Byte
Program to provide unit-level intelligence support system focused on automated use of data in tactical air force units. **Contractor:** Infotec Development. **Status:** Deployment.

Soft-Copy Exploitation System
Development of a common family of workstations for exploitation of digital imagery; a DoD program managed by ESD. **Contractor:** Classified. **Status:** Production.

Special Project II
Classified project. **Contractor:** None. **Status:** Full-scale development.

Tactical Digital Facsimile
System to receive transmission of and reproduce photographs, maps, fingerprint replicas, and other forms of hard-copy images; compatible with standard modems. **Contractors:** Litton, Amecon. **Status:** Production.

316 F
Development, procurement, and deployment of data-collection radar. **Contractor:** General Electric. **Status:** Deployment.

International System Program Office

AWACS Interface System
Program to provide Royal Saudi Air Force with interface to its E-3 AWACS Sentry aircraft. **Contractor:** Boeing. **Status:** Deployment.

Base Air Defense Ground Environment
Program to provide engineering technical support to the Japan ASDF for a BADGE upgrade. **Contractor:** MITRE. **Status:** Deployment.

Canadian Patrol Frigate
Program to provide software analysis and technical support to Canada in its development of software for a new warship. **Contractor:** MITRE. **Status:** Not announced.

Egyptian Encryption Acquisition
Acquisition of commercial digital encryption devices to link Egyptian E-2C aircraft and the ground-based air defense system. **Contractor:** Rockwell. **Status:** Deployment.

Egyptian E-2C/776 Interoperability
Technical assistance to Egypt on how to coordinate the E-2C Hawkeye aircraft and the 776 Ground System. **Contractor:** Hughes. **Status:** Deployment.

Egyptian Radar Repair and Upgrade
Provides Egypt with capability to repair, reengineer, and refurbish air defense radars. **Contractor:** EG&G. **Status:** Production.

Peace Shield
Development and acquisition of a ground-based C³ system for the Royal Saudi Air Force; includes equipment, facilities, and support units that will link up with existing Saudi tactical radars, Saudi AWACS planes, and elements of other Saudi military forces. **Contractor:** Boeing. **Status:** Full-scale development.

Royal Thai Air Defense Systems
Program aimed at upgrading and automating existing Royal Thai Air Defense System and expanding its long-haul communications network. **Contractor:** Unisys. **Status:** Full-scale development.

TRI-TAC United Arab Emirates
Program to modify and develop an AN/TRC-170 troposcatter radio set with support equipment for the UAE Hawk missile program. **Contractor:** Raytheon. **Status:** Production.

Joint STARS System Program Office

Joint Surveillance and Target Attack Radar System
A joint USAF-Army program to develop the primary sensor needed to carry out the AirLand Battle doctrine; integrates a sensitive, side-looking multimode radar into an E-8A platform to create a targeting system able to detect ground-based objects, whether stationary or moving. **Contractor:** Grumman. **Status:** Full-scale development.

JTIDS System Program Office

Air Force JINTACCS
USAF input to a program for joint interoperability of tactical command and control systems, designed to ensure that Air Force standards are included in the program. **Contractors:** JTC^{3}A, Martin Marietta. **Status:** Full-scale development.

Joint Tactical Information Distribution System
A program to develop a high-capacity, jam-resistant, secure digital information system that will permit the distribution of intelligence data among fighter aircraft, surveillance aircraft, ground air defense units, and naval vessels. **Contractors:** Plessey, Hughes, IBM, Rockwell. **Status:** Full-scale development, low-rate initial production.

JTIDS Multifunctional Information Distribution System
Low-volume terminal program to provide a highly jam-resistant, secure digital information distribution system for US and NATO aircraft. **Contractor:** Plessey. **Status:** Conceptual.

Milstar Terminals System Program Office

Milstar Satellite Terminals
Development of reliable, antijam, and survivable EHF satellite communications terminals for strategic and tactical use among all services. **Contractor:** Raytheon. **Status:** Full-scale development.

North Warning & North Atlantic Defense System Program Office

North Atlantic Defense System
Program to provide four long-range radars to enhance ability of Air Forces Iceland to perform NATO missions. **Contractors:** GE, TechDyn Systems, Hughes Aircraft, Whittaker Electronic Systems. **Status:** Deployment.

North Warning System
A program to develop new long- and short-range radars that will replace the aging Distant Early Warning (DEW) Line and provide continuous coverage from the northern slopes of Alaska across Canada and down the east coast of Labrador. **Contractors:** Unisys, GE. **Status:** Full-scale development, production.

OTH-B Radar System Program Office

Over-the-Horizon Backscatter Radar
Program to develop and deploy a series of four radar systems for long-range detection, early warning, and attack assessment of bomber and cruise-missile threats. **Contractor:** GE. **Status:** Full-scale development, production.

Space & Missile Warning System Program Office

Acquisition Integration Office
Provides a "system of systems" quality assurance function for AFSC. Responsibilities include interface assessment, transition planning, and engineering analysis for 800 series programs in Missile Warning, Atmospheric Warning, and Space Warning mission areas. **Contractor:** None. **Status:** Ongoing.

BMEWS Modernization Program
Program to upgrade the Ballistic Missile Early Warning System radars in Greenland and the UK, plus modernization of BMEWS radar in Alaska. **Contractor:** Raytheon. **Status:** Full-scale development, production.

Cheyenne Mountain Upgrade Programs
Integrated management of five existing upgrades to Integrated Tactical Warning/Attack Assessment system of systems. **Contractor:** None. **Status:** Ongoing.

Command Center Processing and Display System Replacement
A replacement system, part of the ballistic missile warning network, to receive warning information from sensors and produce integrated warning and attack assessment displays for Cheyenne Mountain AFB and SAC headquarters. **Contractor:** TRW. **Status:** Full-scale development, production.

Communications System Segment Replacement
A replacement system to improve the reliability, capacity, and flexibility of Cheyenne Mountain communications processing. **Contractor:** GTE. **Status:** Full-scale development, production.

Deep Space Surveillance Radar
Program to develop radars that will gather surveillance and warning information on critical synchronous-altitude space assets; expected to be an integral part of US Deep Space Surveillance Network. **Contractor:** None. **Status:** Concept definition.

GEODSS
A ground-based, electro-optical, deep space surveillance system that will extend AFSPACECOM's spacetrack capabilities involving objects up to 20,000 miles in space. **Contractor:** TRW. **Status:** Deployment.

Granite Sentry
Program to replace the current NORAD computer system and modular display system and to upgrade command post, air defense operations center, battle staff support center, and weather support unit in Cheyenne Mountain. **Contractors:** AFSPACECOM & DEC. **Status:** Full-scale development.

Integrated Tactical Warning and Assessment System
Acquisition of new systems and upgrade of existing systems of the Integrated Tactical Warning and Assessment System. **Contractor:** None. **Status:** Not announced.

Pave Paws
A program to develop and deploy advanced, large-scale, phased-array radar systems to provide precise early warning and attack characterization of enemy sea-launched ballistic missiles from all directions. **Contractor:** Raytheon. **Status:** Full-scale development, production.

Space Defense Operations Center
Program to develop new SPADOC at Cheyenne Mountain AFB; central C^{3}I element of the Space Defense Command and Control System to be used to collect and distribute information on space status and warning. **Contractor:** Ford. **Status:** Full-scale development.

Survivable Communications Integration System
Development of a multimedia management and control system for sending missile warning data between sensor sites and command authorities. **Contractor:** E-Systems. **Status:** Full-scale development.

Strategic C^3 System Program Office

Advanced VLF Receiver
Program to provide B-2 bomber force with highly survivable capability to receive NCA directives. **Contractor:** None. **Status:** Full-scale development.

Aircraft Alerting Communications Upgrade
An electromagnetic pulse upgrade program designed to provide assured communication from CINCSAC to alert aircraft squads, secure from effects of EMP. **Contractor:** BDM Corp. **Status:** Full-scale development, production.

Conventional Mission Planning Preparation Software
Project to develop and provide software to Strategic Mission Data Preparation System, which performs conventional mission planning for B-52 aircraft weapons. **Contractor:** Boeing. **Status:** Full-scale development.

Diversity Reception Equipment
System to improve low-frequency communications for the Worldwide Airborne Command Post fleet. **Contractor:** Sonicraft Corp. **Status:** Full-scale development.

Dual-Frequency MEECN Receiver
Program to build receiver that will allow C^3 reception in VLF/LF band to strategic launch control centers, despite high-altitude nuclear detonations. **Contractor:** Westinghouse. **Status:** Full-scale development.

Ground Wave Emergency Network
C^3 program to provide US strategic forces with long-range communications that can continue to function in the presence of electromagnetic pulse. **Contractors:** GE, Contel. **Status:** Full-scale development, production.

Miniature Receive Terminal
A program to develop survivable, low-frequency terminals to upgrade communications among NCA, SAC, and SAC bombers; terminals will be designed to work even in a nuclear environment. **Contractor:** Rockwell. **Status:** Full-scale development, production.

Rapid Execution and Combat Targeting
Program to modify Minuteman and Peacekeeper launch-control centers. **Contractor:** GTE. **Status:** Full-scale development.

Strategic Mission Data Preparation System
Program to provide interface management and IV&V support to SAC for all strategic mission planning. **Contractor:** Boeing. **Status:** Full-scale development.

Rome Laboratory

Advanced Terminal Technology
Program to reduce the overall weight, size, and power requirements of airborne terminal systems and to increase survivability of satellite communications. **Contractor:** None. **Status:** Ongoing.

B-52 Infrared Camera
Program to provide the bomber with the capability passively to detect, track, and identify advanced atmospheric and space-based threats, with sufficient fidelity to provide positive threat assessment. **Contractor:** None. **Status:** Ongoing.

Conformal Array Radar Demonstration
Development and integration of sensors operating at multiple frequencies to provide high-confidence detection, tracking, classification, and identification of low-observable threats. **Contractor:** Raytheon. **Status:** Ongoing.

Digital Beam-Forming (Mainbeam ECCM)
Program to develop sensor systems with sufficient stability, adaptability, and sensitivity to handle small targets in a severe ECM environment. **Contractor:** General Electric. **Status:** Ongoing.

Integral C^3I Optical Processor
Effort to develop a hybrid opto-electronic processor capable of achieving processing speeds of one tera operation (10^{12} single operations) per second. **Contractor:** None. **Status:** Ongoing.

Knowledge-Based System Architecture Concept
Program to develop systems to support decision and analysis tasks in planning, intelligence, battle management, training, and logistics and to assist in the maintenance of these various AI-based systems. **Contractors:** Many. **Status:** Ongoing.

Natural Language
Program to investigate and develop advanced technology that will assist in the functional processes of an intelligence center and emulate the cooperation and interaction that occurs between expert, intelligent analysts. **Contractor:** None. **Status:** Ongoing.

NCTR Multisensor
Development of techniques to detect, store, and process unusual signals across wide bandwidths at higher frequencies and under new transmission schemes. **Contractor:** None. **Status:** Conceptual.

Secure Communications
Program to design and develop interoperable, multiservice, survivable, and secure communications among geographically separate functional units. **Contractors:** Many. **Status:** Ongoing.

Software Life Cycle Support Environment
Program to develop software engineering tools, methods, and integrated software development/support capabilities that will replace or reduce today's labor-intensive techniques. **Contractor:** None. **Status:** Ongoing.

Survivable Adaptive Planning Experiment
Seeks ways to improve the capability and timeliness of the current strategic nuclear C^2 planning and problem-solving system and to produce rapid responses to new threats and to relocatable targets. **Contractor:** McDonnell Douglas. **Status:** Ongoing.

Survivable Tactical Communications
Program to develop a single communications network that can integrate all multilevel-secure functions (voice, data, message) and reduce equipment requirements by fifty percent. **Contractor:** None. **Status:** Conceptual.

TACS Force Level Replanning
Program to provide the tactical air forces with an active battle management system, based on integrated situation-assessment and decision-support systems. **Contractor:** None. **Status:** Ongoing.

Tactical Infrared Communications
Effort to develop and test a variety of optical communications concepts in order to evaluate performance relative to various mission applications. **Contractor:** None. **Status:** Conceptual.

Tactical Multimode, Multiband Radio
Program to develop an AI-based, programmable radio with the capability to operate with similar programmable radios and other systems. **Contractor:** Hazeltine. **Status:** Ongoing.

Tactical Optical Disk
Program to develop an integrated optical processor, with special emphasis on optical memory and optical interconnections that will help achieve high processing speeds. **Contractor:** General Electric. **Status:** Ongoing.

Deputate for Engineering and Program Management

Get Price
Program to reduce cost of USAF electronic C^3 systems via advanced manufacturing technologies. **Contractors:** Westinghouse, Electronic Systems & Data Communications, Rockwell, Raytheon, GE, Boeing, Grumman. **Status:** Production.

Deputate for Plans & Advanced Programs

Advanced Air Traffic Control
Program to examine emerging technologies that can be used to meet anticipated requirements for air traffic control. System concept would automate air traffic control for high sortie rates, decrease dependence on radar, and use secure data links. **Contractor:** Transportation Systems Center. **Status:** Conceptual.

Air Defense Initiative
Definition, development, and demonstration of new technologies required for future construction of comprehensive active air defense system. Emphasis is on technologies for surveillance, battle management, and C^3I against advanced air vehicles. **Contractors:** Many. **Status:** Concept definition.

Automated Tactical Aircraft Launch and Recovery Systems
Development of a system to automate air traffic control and to integrate aircraft systems. Would control independent landing locations and integrate the battle management systems. **Contractor:** Transportation Systems. **Status:** Concept definition.

C^3I Concept for SOF Airlift Operations
Program to assess command, control, and communications requirements for SOF operations across a broad spectrum of potential uses. **Contractors:** MITRE, RJO. **Status:** Conceptual.

First Order Cost Estimating Model for Radars
Project to develop model able to quickly predict acquisition costs of radars during the conceptual phase, when there are little or no engineering design data available. **Contractor:** Tecolote. **Status:** Conceptual.

High-Frequency Master Acquisition Plan
Project to examine and develop action plan for meeting the Air Force's near-term and long-term high-frequency modernization requirements. **Contractor:** MITRE. **Status:** Conceptual.

International Cooperative Research & Development
Focal point office for processing information on ESD activities that might be of broader international interest and for identifying emerging technologies in the US. **Contractor:** None. **Status:** Ongoing.

Joint Service Antisatellite Program
Project that calls on ESD to develop battle management/C^3 system to support antisatellite capability, provide a surveillance support network, and integrate these elements with current and future antisatellite weapons. **Contractor:** Not announced. **Status:** Conceptual.

NATO ACCS/MCE Compatibility Study
Program that supports USAFE in its evaluation of the Modular Control Element for application in the NATO Air Command and Control System and to conduct engineering evaluation of the MCE. **Contractor:** MITRE. **Status:** Conceptual.

Small Business Innovative Research
Program to stimulate technological innovation in private research and technological firms. **Contractors:** Many. **Status:** Ongoing.

Space-Based Wide-Area Surveillance
Program in conjuction with Space Systems Division effort to develop land-based C^3 architectures to get space-based radar data to worldwide users. **Contractor:** Not announced. **Status:** Conceptual.

Strategic Defense Initiative Planning
Analysis of and experimentation with promising concepts and technologies for C^3 and battle management of a future strategic defense system. An experimental version of Strategic Battle Manager will be used. **Contractor:** Not announced. **Status:** Demonstration-validation.

Ultrawideband Radar
Program to develop improved surveillance sensor and communications for DoD and to permit "silent" radar surveillance and very-low-probability-of-intercept communications. **Contractor:** Not announced. **Status:** Concept definition.

Unmanned Air Vehicle
Program to support DoD UAV Joint Program Office with data links, data distribution capability, mission planning, and ground stations. **Contractor:** MITRE. **Status:** Concept definition. ■

Six years before its official deployment date, the E-8A made a spectacular combat debut in the Gulf War.

Joint STARS Does Its Stuff

By Peter Grier

ONE OF the more unlikely heroes of Operation Desert Storm was a powerful radar system that flew in an ex-civilian aircraft, arrived in Saudi Arabia only hours before the start of the war, and faces six more years of development and tests before it reaches its "official" deployment date.

It is the Joint Surveillance and Target Attack Radar System (Joint STARS), designed to detect and target Soviet armor columns in Europe. The Air Force sent this special sensor to the Persian Gulf at the request of Gen. H. Norman Schwarzkopf, Commander in Chief of US Central Command.

Every night throughout the Gulf conflict, one of the Air Force's two development E-8A Joint STARS planes flew a ten- to twelve-hour orbit. Its systems beamed back real-time data on everything from the movement of mobile Scud missile launchers to the location of concertina-wire barriers and traffic on previously undetected military roads.

The Air Force's tactical fighter units grew increasingly eager to acquire Joint STARS target information. CENTCOM headquarters came to view the F-15E fighter, with its deep-strike, nighttime capability, as an especially effective stablemate.

The Air Force, to hear US military men tell it, has fought its last war without bringing with it a Joint STARS–type aircraft. Lt. Gen. Gordon Fornell, commander of Air Force Systems Command's Electronic Systems Division (ESD) at Hanscom AFB, Mass., notes that Joint STARS gave commanders something they have never had before, what he calls "this real-time, god's-eye view of the battle."

In one of the more startling of Joint STARS's Desert Storm exploits, specially equipped radar aircraft detected an Iraqi convoy carrying free rocket over ground (FROG), surface-to-surface missiles fitted with chemical munitions, according to General Fornell. US officers immediately targeted the convoy; it was destroyed by cluster bombs dropped from F-16s.

US officials say that, during the battle for the Saudi border town of Khafji early in the war, Joint STARS crew members informed allied forces that no Iraqi units were com-

Every night of the Gulf War, one of the Air Force's two E-8A Joint STARS aircraft, still in development, flew a wide-area surveillance and targeting mission lasting ten to twelve hours. Having reaped the benefits of the powerful system, the Air Force may never fight in another conflict without a Joint STARS aircraft or something like it.

ing to support their comrades who had entered the town. Armed with this information, allied commanders launched an immediate and highly effective counterattack.

At one point, a Joint STARS airplane on a surveillance mission aided in recovering a downed F-16 pilot. It reported that there was no enemy activity in the area and that the way was clear for a rescue. Joint STARS also helped Army artillerymen target enemy positions. A US VII Corps Multiple Launch Rocket System battery used real-time Joint STARS radar information to target and destroy an emplacement of Iraqi radar-guided, SA-8 surface-to-air missiles.

Joint STARS flights spotted targets throughout the Kuwaiti theater of operations. Operators learned to differentiate between Scud launchers, air defense sites, tank columns, and other Iraqi units by the way they were arrayed on the ground.

"Every place they went, Joint STARS saw them," says Col. Mendel Solomon, Army Joint STARS program manager and deputy director of the USAF-Army Joint STARS effort.

Tying Weapons Together

The aircraft that provided this battlefield vision is the product of a joint USAF-Army program to provide an AWACS (Airborne Warning and Control System) of the ground war, a surveillance and battle management aircraft that looks deep behind enemy lines and provides US commanders with instantaneous information about the forces arrayed against them.

From its beginning, the Joint STARS concept fit naturally into the developing US AirLand Battle Doctrine of fighting fast and fluidly, from the front lines to the enemy's rear echelons. Joint STARS promised to help tie together a new generation of weapons, from the Air Force's F-117A Stealth fighter to the Army's Tactical Missile System (ATACMS).

Grumman, the Joint STARS prime contractor, serves as system integrator. It produced two prototypes under a $657 million full-scale development contract awarded in 1985 and is working on system enhancements. A third plane will be produced under a $523 million contract awarded last fall.

The Joint STARS platform is the Boeing 707, which was bought used, modified to military specifications, and dubbed the E-8A. Using old planes saves money on an admittedly expensive program, and Air Force officials maintain that the 707s are workhorses, engineered to be tougher than today's airliners, and are thus fully capable of withstanding the stresses of Joint STARS service.

The radar technology at the heart of Joint STARS was developed under a 1970s USAF-DARPA program called "Pave Mover." Housed in a twenty-six-foot-long canoe underneath the E-8A's forward fuselage, the Joint STARS radar can operate in several modes.

Its basic mode is wide-area surveillance, designed to find and identify slow-moving targets, such as convoys. Powerful signal processors, used with the Doppler radar mode, promise to sort signals, distinguishing wheeled vehicles from higher-value tracked armor.

Fixed targets are identified in a high-resolution synthetic aperture mode, which produces a map of ground regions. Bridges, airports,

and buildings show up as if in reconnaissance photographs *[see p. 41]*.

A secure and high-capacity data link beams this radar information to Ground Station Modules (GSMs). These truck-borne receiving stations can process their own raw radar data and are intended to serve as Joint STARS's direct link to the command and control structure.

Impressive "Deep Strike"

Though Joint STARS is not scheduled to be up and running in the operational Air Force until 1997, an exercise in Europe last fall, Operation Deep Strike, proved to be the turning point that led to the system's deployment in Saudi Arabia.

Deep Strike simulated a large "Soviet" ground force attack against NATO forces. At one crucial point, Lt. Gen. Frederick Franks, the Army VII Corps commander, used Joint STARS data to identify and counterattack an onrushing "Soviet" armor column, played by a Canadian tank convoy. The engagement resulted in some fifty-one tank "kills."

General Franks became a convert and later raved about the Joint STARS capability to General Schwarzkopf. Gen. John Galvin, Supreme Allied Commander, Europe, also expressed his admiration. Early last December, a Joint STARS team traveled to Riyadh to brief General Schwarzkopf's staff, and on December 18 the order came to prepare the two prototype E-8As for Desert Shield service.

The order came none too soon. Grumman was one day away from shutting down its Joint STARS operation in Melbourne, Fla., for a two-week Christmas break. The company mounted a three-week effort to get the two prototype Joint STARS E-8As ready for desert deployment.

The first priority was to get the hardware and software in both aircraft back into identical configurations. With Joint STARS in the middle of full-scale development testing, Grumman's technicians working on the program leapfrogged the airplanes, flying one while pulling the other's equipment for upgrades, then vice versa.

The second priority was to find the proper people. "There was no pool of ready operating personnel," Colonel Solomon says. Two cockpit crews had been formed as part of the flight test program. To augment the contractor employees who would be deployed with the airplanes, thirty Army and forty Air Force operators had to be trained quickly in the operation of E-8 communications and radar consoles. In some cases, privates training as technicians were taken out of basic training for the Joint STARS program, according to Colonel Solomon.

Planned technical enhancements were hurriedly installed. Long-range data communications were improved, as was the synthetic aperture radar. A simple electronic warfare self-defense suite, very much of the "quick-fix" variety, was added. In fewer than ten days, Joint Tactical Information Distribution System (JTIDS) linkups were installed and tested so that the Joint STARS airplanes could receive the air picture from US E-3 AWACS planes. This was done even though JTIDS wasn't scheduled to begin flight tests in the system until 1992.

The New Concept Emerges

Even the Joint STARS concept of operations was altered. Plans had called for a radar management officer to be an on-board conductor, parceling out ground requests for various types of radar pictures to console operators. But program managers anticipated that, against Iraq, Joint STARS would find itself taking a much more active role in directing airpower against targets.

The E-8A interior configuration was changed to make room for an air command element (ACE). Most ACE officers were senior Air Force colonels well versed in tactical air combat operations. All came from Stateside units, some of which had deployed to Saudi Arabia.

ACE officers "were integrated into our training program in Melbourne," says Col. Harry Heimple, Joint STARS program director. "It was important that they understood the capabilities of the system, the time lines of the radar, and so forth."

Finally, Tactical Air Command had to create a new unit, the 4411th Joint STARS Squadron. On January 11, the squadron's two aircraft departed Grumman's Florida facility for the Middle East, just days before Desert Shield was to be transformed into Desert Storm.

The first Joint STARS mission over Saudi Arabia took place on January 14. It was flown at night, as were all the aircraft's subsequent missions. Program managers made it clear before they went to the Middle East that they didn't have enough planes or manpower to provide round-the-clock coverage.

From the start, Joint STARS fit in well with the high-volume airpower plan presided over by Central Command air chief Lt. Gen. Charles A.

The heart of Joint STARS is its radar system, checked out above by technician Larry Mull in Grumman Corp.'s anechoic chamber in Melbourne, Fla. The radar was tested extensively in the chamber before being installed in the E-8A.

Horner. It took a few sorties for everyone to figure out just how much data the E-8As produced. "The more the air component and ground component commanders became familiar with our products, the more effectively they tasked and used us," says Colonel Heimple.

Usually the Joint STARS plane received an assigned mission orbit from the massive Air Tasking Order that was produced by Central Command and revised every night, says Colonel Heimple. Often it flew in the same general behind-the-lines area as AWACS aircraft.

The Joint STARS aircraft took off from its central Saudi Arabian base with orders to begin its night by looking at a large specific area of the Kuwaiti theater of operations, using its radar in wide-area surveillance mode, to track Iraqi moving targets. The crew carried a list of TAC targeting priorities that they executed during the mission, looking intensely at smaller areas with both the moving-target mode and the stationary-target synthetic aperture radar mode.

The Cue for Specific Targets

This preset part of the mission was only its framework. Throughout the night, crews used information from other intelligence sources to cue Joint STARS for specific target information. "Certainly, the system was often real-time-requested," Colonel Heimple says.

The main receivers of Joint STARS radar data were the six truck-mounted GSMs sent along with the 4411th Joint STARS Squadron. Central Command Air Force headquarters in Riyadh had one, as did Marine Headquarters. Central Command Army had two—one for the rear echelon and one to send forward. US VII Corps had its own GSM, as did the Army's 18th Airborne Corps.

Joint STARS crews communicated directly with airborne tactical command centers and individual fighter aircraft via secure voice links. TAC leaders want future fighters to be able to see the Joint STARS radar picture via JTIDS, but procurement of JTIDS for insertion into fighters has been a casualty of budget wars of recent years.

The Joint STARS final total of fifty-four missions added up to more than 600 hours of flight time. One of the E-8As was in the air every night of the war.

Joint STARS revealed the location of previously unknown military roads. This transmission shows Iraqi traffic backed up at blocked bridges and causeways and flowing back to Basra (where lines intersect at right) along several routes.

Says Colonel Heimple, "To take a system that has six years to go until IOC [initial operational capability], throw it into a war with no parts provisioning, no spares pipeline, and have it meet 100 percent mission tasking is pretty amazing."

Fortuitous development decisions helped. Much prototype hardware had already been built with the extra-robust connectors and other details required by military specifications.

The Air Force could not have kept Joint STARS planes flying without using contractor personnel. Four out of eighteen crew members aboard every Joint STARS flight were Grumman employees. Though all radar and communications consoles were manned by Army or Air Force officers, the contractors were the Ph.Ds. who got the system up and kept it up, according to Air Force officers. GSM contractor Motorola sent one maintenance technician along with each GSM, no matter where it went. "They did indeed get themselves into harm's way," says the Army's Colonel Solomon.

The performance of Joint STARS in its trial by combat gives the program a needed boost on the way to deployment, in the view of the Air Force. Congress has worried about cost overruns and schedule slippages in the program. With the easing of the Soviet threat in Europe, Joint STARS seemed to some critics to have lost its reason for existence. Why, they asked, should the Air Force buy a system designed to detect rear-echelon armor columns when conventional arms-control measures would eliminate most of those columns anyway?

"The Magic Number"

Before Desert Storm, few observers felt the Air Force would get its full complement of twenty production Joint STARS aircraft. The betting in Washington now is that the number is assured. Adding in the three prototype aircraft, "the magic number around here is twenty-three," one Air Force official says.

Army plans currently call for production of around seventy-five GSMs. A typical deployment would be about fifteen GSMs per Army corps, says Colonel Solomon.

Given the success of the system in Operation Desert Storm, allocation of seats on the plane may become a contentious issue. Most console operators will be Air Force officers. Right now, the Army gets three consoles. The Marines and even the Navy may now want to be on board, however.

The existing E-8A prototypes have ten operations consoles and two communications stations. The E-8B production version will have eighteen consoles, any two of which

Joint STARS faces six more years of development and tests before its "official" deployment date. Components to come include a full-capability self-defense suite, mission and flight simulators, and an integrated software support facility.

can be used for communications, and will have space to carry two entire mission crews. "Everybody will want a seat," says Colonel Solomon.

One of the lessons program managers learned from the deployment during Desert Storm was the value of Joint STARS in locating stationary targets. Though designed originally to handle the task of tracking "movers" such as tank columns, Joint STARS's synthetic aperture radar mode turned out a lot of valuable information about infrastructure in a theater of operations less thoroughly mapped than central Europe.

Ironically, even the wide-area surveillance/moving-target indicator mode helped in this regard. Concertina wire blowing in the wind turned up on the WAS/MTI picture. Convoys moving repeatedly over the same areas of desert revealed unmapped roads, built in Kuwait by Iraqi military engineers.

Combat experience pointed out some flaws in management of Joint STARS communications. Before Desert Storm, much effort was expended on the development of radar and data links. Operational missions found Joint STARS at full communications capacity—an area that had received less attention. With a system designed to handle sixteen radios operating simultaneously, there were inevitable delays in frequency management.

"We hadn't put a lot of stress on the system with lots of operators doing different things," says Colonel Heimple.

Some minor problems with man-machine interfaces also surfaced. Operators pointed out areas where they would like different tagging methods on-screen and different uses of color.

No Need to Hurry

There is still plenty of time to deal with these issues before Joint STARS deployment. Program managers say that Desert Storm will not cut any time off the march toward their major milestones. The decision on advance purchase of long-lead items is set for January 1992. A decision on whether to proceed into low-rate production is currently scheduled for January 1993. Full operational capability is not expected until 1997.

Colonel Heimple estimates that twenty-five percent of the program's total development work still needs to be done. Software has not been written for such features as built-in tests. A full-capability self-defense suite will begin flying on the third prototype plane in 1994. Repair manuals have to be written and production drawings made. Mission and flight simulators have yet to be finished, and a maintenance trainer and an integrated software support facility must be completed.

The man in the street may not understand why a system that performs well in real combat still needs six years before it is officially deployed. Colonel Heimple replies that it takes time to move from a plane that needs to carry contractors on board for repairs to one entirely under the control of uniformed personnel.

"Once you've mastered the miracle of the technology, it's critical to complete the process of engineering and development documentation to create a maintainable, reliable system that will produce these results over the long term," says Colonel Heimple.

For the future—beyond IOC—the US might upgrade the E-8 by adding a weapons data link so Joint STARS could provide targeting information to unmanned, precision guided weapons. This capability was part of the original USAF-Army requirements package. It was deleted to save money.

The Joint STARS radar sensor was actually built with a weapons link in mind. What is needed now is development of an interface unit that would enable cruise missiles or ATACMS to plug into the system.

As a nonintrusive monitor of ground activity, Joint STARS could have a future in treaty verification, drug interdiction, and peacekeeping missions by the UN and other international organizations, say defense officials. It could eventually be the precursor of a much more capable system. AFSC is examining the possibility of combining AWACS and Joint STARS characteristics in one radar aircraft.

AFSC Commander Gen. Ronald Yates told an Armed Forces Communications and Electronics Association luncheon audience in February that the Air Force's goal "is to have a 1,000 percent improvement in our ability to detect air and ground targets over wide areas." ■

Peter Grier is the Washington defense correspondent for the Christian Science Monitor *and a regular contributor to* Air Force *Magazine. His most recent article, "The New and Improved But Not Yet Perfect Procurement Process," appeared in the April 1991 issue.*

- SHINPADS
- SHINMACS
- JOINT STARS
- WWABNCP/ADP
- AAMS
- MTRE
- CAMS-II
- S3A
- MPD
- MNS
- TAS
- P3C UPDATE IV
- MINEHUNTER
- AN/SPS-48E
- AWADS
- GWEN
- F-5 COCKPIT DISPLAYS
- AN/SQQ-89I
- JSIPS
- MK86 GFC
- OTC IXS
- ADLIPS
- BULLDOG
- SEEKSCORE
- AN/USC-28
- MARC
- PENGUIN
- SEA SPARROW
- SIMULATOR STATION
- SACDIN
- STARLAB
- SPACE LAB
- SPECKLED TROUT
- F-18 AFTA
- F-15 GTS
- WALRUS
- DDG-51
- BURSTCOM
- PTARMIGAN
- LINK-11
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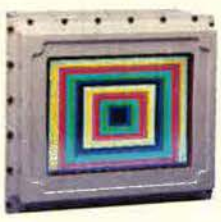

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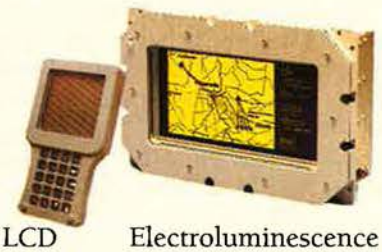

LCD Electroluminescence

INTERSTATE ELECTRONICS CORPORATION
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Electronic combat planning must avoid twin dangers: excessive cost and single-point failure.

Mixing It Up

—Staff photo by Guy Aceto

By Lt. Col. Michall C. Sheen, USAF

DEVELOPMENT of electronic combat capabilities always has been a seesaw battle of measure against countermeasure, a contest reminiscent of *Mad* Magazine's "Spy vs. Spy" cartoons. With the fielding of each new threat system, Western spies and scientists scrambled to gather as much data about it as possible. Engineers developed a picture of how it worked and what could be done to defeat it. In time, the US fielded a prototype countermeasure. The other side then added enhancements to its system, and the US in turn modified the countermeasure.

In the past, this spy-vs.-spy approach was appropriate, since the USSR's primitive data-processing capability severely limited its power to "harden" its systems against the Air Force's high-technology countermeasures. That, however, is no longer the case. As Soviet processing and compression technologies have advanced, the forces of the USSR and its clients have fielded some highly jam-resistant equipment. It might be wiser to take on such problems incrementally, because a pure "systems" solution, though feasible, would be too expensive, too risky, or both.

One significant advance, for example, was deployment of monopulse radar, which radiates short pulses of energy. Monopulse uses four overlapping beams—two for azimuth, two for elevation—with circuitry so arranged that, when the target is at center, output voltage vanishes. This pulse is difficult to suppress and is able to gather large volumes of information. In the Soviet Union's huge Integrated Air Defense System, newer surface-to-air missiles are controlled by frequency-hopping monopulse radar, which reads both range and direction from a single return.

The monopulse radar problem has been around for years. It continues to occupy the attention of US electronic combat specialists. In the gallery of technological challenges to US aircraft, it is the best known and most widely understood. Monopulse radar is not the only serious challenge that confronts US forces in the highly classified world of electronic warfare.

Such advances considerably magnify the Air Force's problem of

A ground Modular Threat Emitter at the 392d Electronic Combat Squadron, Mountain Home AFB, Idaho, mimics enemy surface-to-air signals in order to test and train pilots and equipment. The spy-vs.-spy method of developing equipment may not be effective in the future.

developing countermeasures for fighters. Continued use of spy-vs.-spy techniques at this level of technology would result in a countermeasure that resembles the target radar (or other system) in complexity and sophistication. This may look ideal, but US equipment may be becoming excessively specialized.

Dissecting the Pulse

The current trend in active jamming countermeasures seems to be to dissect the threat radar pulse train into smaller and smaller pieces, which requires increasingly sophisticated processing techniques. Having analyzed the pulse, the processor reproduces it and inserts information into the copy before the energy returns to a radar receiver. When this works, the radar gets an ambiguous reply to its electronic inquiry.

As years go by, however, the tendency is to get further and further into the details of the radar pulse. This process takes the engineer and developer of new systems into extraordinarily minute electronic detail. A number of perplexing problems immediately present themselves.

The first and most visible is the high, frequently exorbitant, cost of creating electronic combat systems capable of carrying out these operations. Hardware and software development become increasingly expensive as more levels of detail and sophistication are added to their mission.

As manifold unique processing and transmission requirements are levied on a single piece of equipment, there is a higher probability that unexpected interactions or simple overloading of functions will occur within the device itself. As a result, processing speed declines and the costs of developing and testing the system skyrocket.

Problems with a number of recent EW systems show how costs can escalate very quickly in ambitious, technologically risky efforts. These include the B-1B bomber's electronic warfare suite, the joint-service Airborne Self-Protection Jammer (ASPJ) system for fighter aircraft, and the upgrade of the EF-111 Raven area-jammer aircraft. The high expense of such programs predictably generated extra scrutiny from the military services, Congress, and the press, and in many cases they have been found wanting.

In the effort to develop and bring to maturity such complex, precise technology, Air Force technologists frequently encounter a second, equally serious problem: failure of the new system to perform as anticipated.

If the Air Force goes to the trouble to produce a detailed, tailored, sophisticated jamming technique to counter one specific radar, it expects to see dramatic results compared to an older, less sophisticated system.

An Insidious Problem

Unfortunately, as technological detail is added to a new system, an insidious problem begins to arise: The slightest inaccuracy in the matching of countermeasures to target radars can cause *complete* failure of a countermeasure.

When older countermeasures were used against older radars, such small inaccuracies were less critical. The countermeasure's result degraded gracefully, and the system achieved at least partial success. Modern, highly sophisticated techniques tend to produce an all-or-nothing result.

Yet the prospects of total success have never seemed less bright. In order to achieve the level of detail necessary to develop such precisely matched electronic combat systems, engineers need much more information than in the past about the threat system they are trying to defeat.

Simple signal analysis, the staple of the past, is no longer sufficient. Detailed knowledge of the system's inner workings is required. It is not sufficient to know what a signal looks like. It is necessary to know how it was generated and even how and when it will be processed.

These requirements mandate collection of intelligence on systems to be countered. At the other end of the development cycle, the same requirements create a need for expensive test equipment and simulators, so that Air Force technologists can accurately challenge, assess, and adjust the newly developed countermeasure equipment.

As the level of detail increases in both areas, the cost of collecting information and producing test equipment rises significantly. The Air Force encounters rapidly rising production costs, on the one hand, and, on the other, a higher probability of technical failure.

The Two-Track Approach

These realities do not add up to an argument against developing high-technology countermeasures. Without question, the Air Force still needs to seek and develop powerful, advanced, technological solutions to specific problems in electronic warfare. How should the Air Force adjust its approach to electronic combat problems?

First, everyone—developers, engineers, requirements writers, fighter pilots—should resist the temptation to focus on a specific threat system and take a broader look at what the Air Force wants to accomplish with its electronic warfare effort.

In all areas and at all levels of the Air Force and in its contractor base, there are times when individuals are tempted to focus immediately on defeating a particular type of threat system because it is perceived as the greatest current problem for American aircraft. However, focusing on one or two systems is too narrow an approach.

The goal of EC for tactical aircraft is to greatly reduce losses to enemy fire by deceiving, confusing, delaying, denying, or decoying enemy systems as Air Force aircraft penetrate hostile airspace.

In this regard, the service should consider the total environment and enemy network structure in which threat equipment is used. This may lead to a better idea for defeating the enemy's system or produce a simple way to reduce to acceptable levels its capability to challenge aircraft.

Analysts at all levels should ask —and answer—such questions as: Where does the initial targeting information come from? How is that information transmitted? How is it processed and fed to the tracking radar? How is the weapon system guided and fuzed? Perhaps most important, which critical areas require human interaction and decisions?

One or more of these areas may be more vulnerable to countermeasures than others. Identifying and

attacking several of the weak links in a system may produce the same overall result as defeating the fire-control radar, but at much lower cost and with less complexity. Environmental limitations may also be exploited with great effect. In the face of terrain travel limitations or specific types of weather, a change in tactics or ingress route might be the only countermeasure needed to defeat a system.

The second part of the new approach entails building on and exploiting synergies in electronic combat. By designing systems from the beginning to work in conjunction with other EC techniques, the Air Force can benefit. To begin with, by simultaneously working against several phases of a weapons engagement, the cumulative effects of small degradations will achieve major degradation of the enemy's effectiveness. In this respect, no individual technique needs to display perfect or overpowering effectiveness in order to achieve the desired result for the total system. Failure of a specific component in your own system will not result in failure to achieve at least some level of electronic protection.

A focus on the total EC environment would also change the way some in the Air Force evaluate EC system performance. In the past, the service has usually focused on how a piece of equipment performed in isolation.

Air Force officials and engineers still need the baseline performance measurements that are now produced. However, if the Air Force is to get a true picture of how well or poorly a system performs, it must evaluate the equipment in the context of its companion pieces.

Heterodoxy and Heresy

In the Air Force's efforts to improve the development of its EC equipment and techniques, it will also have to overcome another obstacle: the "not invented here" syndrome.

That syndrome certainly is not unique to those who work on electronic combat operations, or to the defense industry, or even to the military establishment. However, to develop systems that work together, engineers and operators need to develop a tolerance for ideas drawn from heterodox, even heretical, sources. They need to recognize that one solution may not be the only solution.

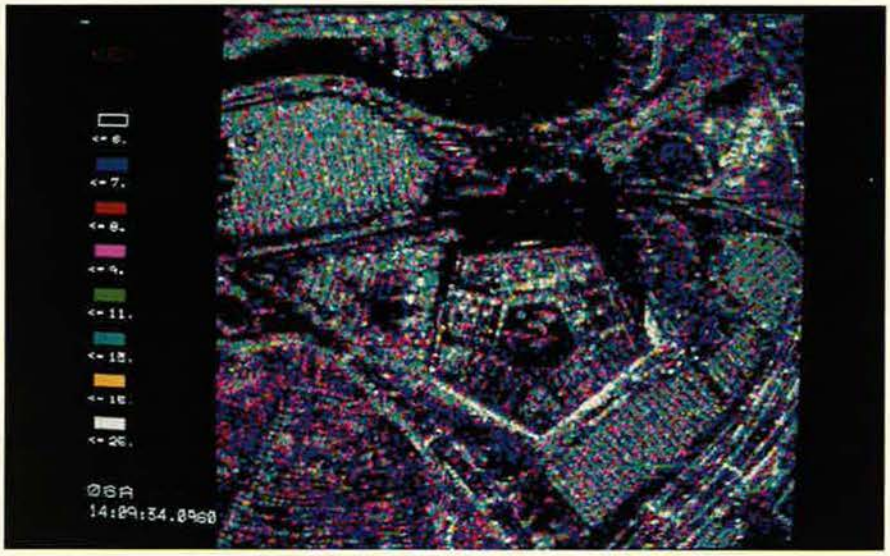
Another advance would be to moderate the Air Force's tendency to pit one EC idea against another in a winner-take-all competition. It may be more profitable and effective to pursue two or more solutions in combination and, in the process, reduce cost and complexity by pursuing a number of adequate systems rather than a single, "perfect" system.

Predisposition to a particular approach or solution can only stifle the very result that everyone should be trying to achieve—capitalizing on EC interactions.

Closely related to the not-invented-here syndrome is the "we tried that before, and it didn't work" syndrome. This syndrome fails to account for the development of technology, capabilities, and manufacturing techniques that may surmount limitations that caused previous experiments to fail.

For example, with the advent of high-speed mathematical processors, highly complex problems with multiple independent variables, too lengthy to solve by hand, could be solved quickly by relatively small computers. This allowed use of statistical analysis techniques, previously unworkable, to explore such problems as sequences of air-to-air combat or the interactions of EC equipment in surface-attack scenarios.

In general, the Air Force would be well advised to embrace these principles and move away from the spy-vs.-spy approach. Perhaps then it can avoid the twin dangers of skyrocketing equipment costs and single-point failure. ■



In electronic combat, the best solution to countering an enemy's advance in detection ability is not always a corresponding increase in US jamming ability. An upgrade like the APQ-164 radar, which recorded this image and allows the B-1B to fly low enough to avoid enemy radar, may be the optimum response.

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Here's another helping of vignettes from the Gulf War, recounted by the troops who fought it.

—USAF photo by TSgt. Hans Deffner

More Voices From the War

By Stewart M. Powell

THE first big turning point in Operation Desert Storm came when the Iraqi pilots began to flee rather than fight. Before the war was two weeks old, Iraq's Soviet- and French-trained flyers began to decamp to Iran, eventually taking 150 fighters and transports with them. It was the best—maybe the only—way to survive the allies' punishing, shelter-by-shelter bombing campaign.

At first, American pilots trained in the ways of Soviet-bloc pilots were wary about pursuing the fleeing Iraqi aircraft. "When we start to see the opposition go away from us, the natural instinct of an American fighter pilot is to say, 'He's trying to trick me,'" said Lt. Col. Mike Scott, a pilot of "aggressor" aircraft and former commanding officer of an F-16 aggressor squadron at Nellis AFB, Nev. "You've always got to watch for the decoy."

A pair of F-15 fighters chased an Iraqi jet fleeing to Iran. When the US planes broke off the engagement and turned around, they encountered four Iraqi warplanes—three MiG-23s and one Mirage F1. The Americans downed all four.

Above, a Wild Weasel's ground crew at a Gulf air base advises its pilots. Opposite, the backseater of an F-15E shows the same spirit as the Eagle's crew sets forth on Scud patrol, though frequent cloudy weather made Scud hunting frustrating.

The Great Scud Hunt

For crew members of the F-15E squadrons assigned to the nightly "Scud Patrol," nothing was more frustrating than knowing Iraqi missile crews were hiding beneath cloudy weather.

Iraqi missile crews often skipped clear nights, waiting for bad weather to roll in before making their next launches.

"One missile almost hit one of our guys," recalled Air Force Lt. Col. Steve Turner, commander of the 336th Tactical Fighter Squadron. "It came rocketing up through the clouds."

"The weather precludes us from seeing where they actually launch the Scuds," said Col. Dave Baker, deputy commander for air operations at the largest air base in Saudi Arabia. "That is really frustrating for the guys who go on station out there."

The better to locate Scud launchers, F-15Es often flew beneath cloud cover in a maneuver that exposed the fighters to antiaircraft artillery fire. For two F-15E squadrons that played a part in dousing the Scud threat, the mission was fulfilling. "It's frustrating until you find something," said Colonel Baker. "Then it's very rewarding, like fishing and getting a big strike."

Scud Patrol videotape became a featured attraction for the crews of the F-15E dual-role fighters. A favorite of pilots, weapon systems officers, and ground crews were the tapes of the "Chief's Greatest Hits" —named for Lt. Col. Steve "Chief" Pringle. "When guys have been getting good film, we splice [shots] together," said Colonel Pringle. The footage captured the drama of the darkened cockpit with the pilot handling the aircraft while his "wizzo" (weapon systems officer, or WSO) tracked targets on TV-like displays and navigated with a moving electronic map.

Highlights from one tape showed an F-15E moving in on a collection of Scuds and transporter-erector-launchers (TELs), the tractor-trailer equipment that enabled Iraqi crews to fire the battlefield missiles against Israel and Saudi Arabia.

—USAF photo by SSgt. Robert Jackson

"Coming on the pickle button," the pilot told his wizzo over the cockpit intercom.

"Fire the pickle whenever," came the reply from the back-seat weapons officer. The Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system enabled the WSO to "lase" enemy targets from up to ten miles away while the pilot released the laser-guided bomb.

"Roger that," said the pilot, pressing the bomb-drop button.

The F-15E flight knocked out most of the Scud missiles and launchers displayed on their consoles. "Those were ours," Lt. Colonel Pringle said. "We got particularly lucky that night."

"I Have Check-In Dreams"

Crew members aboard the Air Force's fleet of E-3 Airborne Warning and Control System (AWACS) aircraft had what they call a "god's-eye view" of the war. Those in the cockpits saw burning Kuwaiti oil fields and the battleships USS *Missouri* and USS *Wisconsin* firing sixteen-inch guns at targets in Kuwait. The crew members at consoles in the rear of the windowless plane relied on their screens and radio traffic to follow developments.

Capt. Laurie Whitman recalled "checking in" as many as 600 "packages" of allied warplanes during one twelve-hour shift at the peak of the air campaign. "Sometimes at night," she said, "I have 'check-in' dreams."

Lt. Laura George vectored hundreds of warplanes toward dozens of aerial tankers for weeks on end. "You'd try to keep up with it," said Lieutenant George. "But sometimes they'd come out of Iraq and would need a tanker real fast. It kept you busy."

One of the greatest advantages enjoyed by American forces was advance knowledge of Iraqi air operations gleaned from eight years of eyeballing the Iran-Iraq war. Many AWACS crews from Tinker AFB, Okla., had experience operating from the Arabian peninsula off and on since 1981.

The experience was invaluable, according to Col. Gary A. Voellger,

—USAF photo by MSgt. Kil Thompson

Above, an A-10 from the 23d TFW, England AFB, La., is uploaded with 30-mm cannon ammunition, Mk. 87 cluster bombs, AGM-65 Maverick missiles, and AIM-9 Sidewinder missiles. The threat was not just from ordnance. Decontamination exercises and chemical warfare gear (top) prepared troops for other dangers.

commander of the 552d AWACS Wing from Tinker. "As Patton told Rommel," said Colonel Voellger, recalling how the American general studied his German rival's writings, "I read your book."

Crews aboard the E-3 AWACS planes were constantly on watch for an "Iraqi surprise"—a surge of Iraqi warplanes against allied warships or vital targets in Saudi Arabia.

Had Saddam ordered a counterstrike by the estimated 200 warplanes that remained operational, detection of the offensive would have fallen to the highly trained technicians manning consoles in the body of the converted, gleaming white Boeing 707 aircraft worth more than $190 million.

"They could launch," said Colonel Voellger, who moved most of the 552d's 3,500 people and two dozen E-3s to Saudi Arabia. "We would take them out. I'd like to think it would be 100 percent, but maybe five percent could get through to face our antiaircraft missiles."

From their eye-in-the-sky perspective, AWACS crew members agreed that taking off in an Iraqi warplane was a one-way ticket to eternity. "When they show up and we can get a fighter on them, they're gone," said Capt. Donald G. "Dusty" Somerville, an Air Force Academy graduate piloting the AWACS codenamed "Okie Seven," on the last day of the ground war.

© Dennis Brack/Black Star

An F-15 fighter pilot prepares for another Gulf War mission. F-15s maintained allied air superiority over Iraq so easily that USAF commanders had to watch for signs of overconfidence in F-15 crews.

Air-to-air engagements were tense affairs. Capt. Sheila G. Chewning orchestrated the interception of a pair of MiG-29s southwest of Baghdad in the first six hours of the air war. "The minutes between hearing the pilots say 'contact,' 'engaged,' and then 'splashed' seemed like a long, long time," she recalled.

The Junkyard Dogs

To their base commander, they were unsung heroes whose behind-the-scenes maintenance kept airborne warning, command, and control aircraft aloft. Within their own tight-knit ranks, they were known as "the junkyard dogs"—the men and women with dirty hands and smudged fatigues who swarmed around E-3 AWACS and EC-130 ABCCC (Airborne Battlefield Command and Control Center) planes to repair and refuel them as quickly as possible.

"Those of us who get to wear the wings and get some of the glamor frequently get the recognition for flying these great pieces of equipment," said Col. Charles M. "P. J." Pettijohn, commander of 4409th Operational Support Wing, a unit supporting seventeen Air Force operations at Riyadh AB. Without the maintenance crews, Colonel Pettijohn said, "we could do absolutely nothing."

Col. John P. Miller, commander of the maintenance squadron for AWACS aircraft, said his handpicked crews could turn an AWACS airplane in ninety minutes after a fifteen-hour mission. By keeping a backup plane aloft at all times and maintaining one on alert status, the AWACS wing did not lose a single minute of station time in seven months.

Though forward air controllers (FACs) lacked the "god's-eye view," they also directed airpower to where it was needed. On one war-

—USAF photo by Sgt. Pedro Ybanez

An explosive ordnance disposal team assigned to the 4409th Combat Support Group recovers the remains of a Scud missile northwest of Riyadh. Of all Iraq's military assets, the Scud was used to best advantage, but between F-15Es and Patriot missiles, Iraqi Scuds and launchers were severely inhibited.

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An A-10 is prepared for a Desert Storm sortie. During the day, close-air-support A-10s and F-16s kept pressure on Iraqi ground forces, using their Maverick missiles to great effect on Iraqi tanks (below).

time patrol, Air Force Lt. Col. Tom Coleman was debating whether to carry out one more close air support mission or break off to refuel. "You got anything immediate?" he asked the FAC.

"We're taking artillery fire," came the reply. "Can you help us right now?" An allied unit, part of VII Corps, was taking artillery fire from an Iraqi battery two miles to the north.

Colonel Coleman, commander of the 706th Tactical Fighter Squadron, a reserve unit from New Orleans, decided to try to take out the artillery battery. "I figured I had enough gas to make it without going to the tanker," he said. He radioed the FAC to have ground forces mark the Iraqi battery with their own artillery barrage. Then the A-10 pilot dropped two 500-pound bombs, silencing the position for good.

Close-quarters, nighttime warfare put a premium on tight coordination between ground troops and aircraft providing close air support. To make sure friendly fire claimed as few casualties as possible, Air Force liaison officers traveled with armored battalions as fire-control officers.

Tanks carried special displays visible through night vision equipment. "Killing boxes," defined by map coordinates, opened and closed depending on movement of ground forces. Any dispute between Army ground commanders and Air Force coordinators was referred to CENTAF in Riyadh.

"I'm not going to sit here and tell you that this will work perfectly," said Air Force Maj. Bob Baltzer, who was serving as the Air Force liaison with the 1st Infantry Division. "Some things will probably go wrong. But the main thrust of what we are doing is to make sure we get eyeballs on the right targets."

The air traffic became so thick that officers divided the "killing box" over Kuwait to lower the risk of midair collisions. Sometimes pilots were ordered to depart from targets before they'd dropped all their ordnance. No allied aircraft were reported lost to midair mishaps.

—Photo by Wesley Bocxe/Sipa Press

Some allied troops did fall victim to friendly fire. The worst tragedy occurred in late January when a Maverick missile slammed into a Light Armored Vehicle, killing seven US Marines.

Tent Cities

When A1C Edward Garey heard he was going to a "bare base" in Saudi Arabia, he had visions of living in shelter halves and sleeping on the ground in a sleeping bag.

Far from it. The Air Force erected a city for 4,500 servicemen and -women in 650 sand-colored tents, each with electric heating and cooling units, plastic flooring, lights, desks, chairs, and cots. Similar tent cities dotted the Saudi desert. Said Airman Garey, "This is a lot more than I expected."

The twenty-foot by thirty-two-foot tents, equipped with "environmental control units" to pour warm or cool air through the living space, featured a two-tiered roof with a fly separated from the tent roof by eight inches, which provided an insulating cushion of air. A canvas liner on the inside of the tent provided a second insulating layer of air to moderate the temperatures, which could swing from a damp, windy thirty-five degrees Fahrenheit in winter to a dry, punishing 130 degrees in summer.

The only down side was the noise. Ten turbine generators, operating around the clock, produced a roar equivalent to a taxiing jumbo jet on the outskirts of town.

Base security at Air Force installations was enhanced by guard dogs. Typical were the six dogs from Security Police units at Minot and Grand Forks AFBs, N. D.

"Rapport between the dog and the handler is important," said SSgt. William McAdoo, kennel master at Minot AFB, based temporarily at a remote site serving F-16s from Hill AFB, Utah, and Moody AFB, Ga. "The handler reads the dog like a book. You know your dog like [you know] your wife or children."

Keeping the dogs trained required "Wrap Man"—someone covered hand to elbow with a burlap and leather sheath to protect him from the attack dogs, a Belgian breed resembling a German Shepherd.

"Attack," ordered Duke's handler. Duke seized the arm of Wrap Man.

"Out," ordered the handler. Duke released the suspect's arm.

"He's a real lovable dog," Sergeant McAdoo said. "In a real situation, there's no telling what the dog will go for."

—USAF photo by TSgt. Rose Reynolds

Air Force B-52 bombers (in still-classified numbers) operated across the Gulf theater, logging 1,624 missions and dropping 25,700 tons of munitions on Iraqi troop concentrations, storage areas, and factory complexes. The thirty-some-year-old B-52's wartime mission capable rate was higher than its peacetime rate.

Search and Rescue

Saddam Hussein's threat to move captured American flyers to Iraqi military sites didn't cut much ice with US flyers. "It won't impede our mission," said a Navy lieutenant commander known as "J. P.," who was flying an F/A-18 Hornet off the carrier USS *America* in the Red Sea.

It was not that US flyers were unconcerned about captured comrades. Once over enemy territory, pilots were too busy staying alive to worry about the possibility of collateral damage from their bombs. The Iraqi threat to use captured pilots as human shields merely made US flyers more determined.

"I know if I were in their place, I would be cheering when I heard the bombs coming down," said one F-14 pilot who also flew off the *America*. "The [Iraqis] would be there with you, and you would know that you would take a few of them out with you."

For radar surveillance technicians aboard planes and ships, the tension, exhaustion, and thoughts of home all came to a halt whenever an American pilot was reported as going down.

One day, word swept through the combat information center aboard the AEGIS-equipped cruiser USS *Valley Forge* that an F-16 pilot was in trouble coming off a target in Kuwait. The search-and-rescue operation played out on the AEGIS display screens.

Navy Capt. Ernest F. Tedeschi, Jr., tapped several buttons on his console deep inside the ship's warfighting center, expanding the display area to show where the F-16 was going down. It was off the Kuwaiti coast over the Gulf. A fixed-wing aircraft rushed into the area to circle over the downed pilot. A slow-moving helicopter approached from the east, off an allied ship in the northern reaches of the Gulf.

Twelve minutes after the first sign that the F-16 was going down, a radio message reported that the Air Force pilot was safely aboard an allied helicopter. A cheer erupted in the close quarters of the ship's war room. "They got the pilot," a *Valley*

—US Navy photo by Lt. Cmdr. Dave Parsons

An F-14 Tomcat fighter jet from USS John F. Kennedy (CV-67) prepares for aerial refueling from a USAF KC-135 tanker. The air campaign got so feverish at times that Navy ordnance specialists on one carrier loaded nearly any bomb they could find rather than waiting for Rockeye bombs to arrive on the flight deck.

Forge crewman announced. "They are outbound from Kuwait."

Locusts and Herky Birds

It looked like a swarm of locusts pouring out of the blinding, sand-colored mist. More than 300 attack and transport helicopters from the 101st Airborne Assault Division stormed deep into Iraq in the largest operation of its kind in history. It was, said Army Maj. Dan Grigson, "a bold, bodacious action."

Within hours, 2,000 assault troops carved out a sixty-square-mile staging area to serve as a fuel and ammunition dump for leapfrog helicopter assaults even deeper into Iraq along the Euphrates River. Artillery pieces, "Humvees," giant fuel bladders, and ammunition were ferried into the staging site by CH-47 Chinooks and other helicopters. Some of them were flown by the 101st's twenty-two women helicopter pilots.

Troops didn't miss the irony of mounting an attack in the cradle of civilization. "Where life was created is where lots of life is fixing to end," said Sgt. Thomas Andricos.

Ungainly, unnoticed, and unsung, the Air Force's fleet of Hercules C-130 transports carried out crucial resupply missions, as they have in almost every US operation in the airplane's thirty-seven-year history. The "Herky birds" were visible at every allied airstrip, ready to ferry troops and materiel to some distant site.

Crews withstood winter storms. Summer temperatures rose so high that the thermometer in one C-130 cockpit exploded. The landscape offered few distractions. "It doesn't matter if you're at 5,000 feet or 20,000 feet," said 2d Lt. Anthony Gordon, a navigator. "The view never changes."

The endless troop movements and resupply missions week after week offered little relief. "It never stops," said Capt. Scott Smith, a C-130 pilot.

To maintenance crews, the Hercules was a troubleshooter's dream. "Aboard planes using a lot of electronics, the job is a lot of box switching," said SSgt. Joe Bechtold, a six-year veteran working on aircraft from the 7th Airborne Command and Control Squadron, Keesler AFB, Miss. "Here, every day is a new day

—USAF photo by TSgt. Bill Bloszinsky

Air Force C-130 Hercules transports moved troops and materiel throughout the Gulf War. Above, Army troops and vehicles wait for "Herky Birds" to transport them to forward locations. The C-130 called for creative troubleshooting from maintenance troops like crew chief SSgt. Roger L. Oberhelman of the 314th OMS (below).

—USAF photo by TSgt. Hans Deffner

in troubleshooting. This is a job where you have to be creative sometimes to make it work."

As operations over Iraq and Kuwait progressed, Air Force commanders stayed constantly alert for signs of overconfidence in fighter and bomber crews.

"It is becoming a routine, and that is something that we in the leadership are trying to fight," said Col. Hal Hornburg, commander of the 4th TFW, Seymour Johnson AFB, N. C. "Routine breeds complacency." It was important, he said, to keep reminding his F-15E pilots that they were "not bulletproof."

Each pilot has to be "right on the edge of his toes at all times," Colonel Hornburg said. "You just don't know where that golden BB's going to be shot from."

Beneath the cockpit window was a picture of the Pittsburgh skyline and the words "Pittsburgh's finest." The hometown pride expressed by the ANG's 171st Air Refueling Wing could be found in almost every Air Force Reserve and ANG unit.

Maj. David Baumann left his job as a commercial airline pilot to guide a KC-135 over Saudi Arabia, Kuwait, and southern Iraq to refuel allied warplanes. His olive-painted tanker by then displayed fifteen red camels, denoting successful missions out of Saudi Arabia, and two inverted camels for aborted missions. Twenty-two falcons were also painted on the fuselage, symbolizing missions conducted from another Persian Gulf country.

Commercial pilots "don't have to be nearly as precise and on time as we do flying here on these missions," said Major Baumann during a four-hour refueling mission in which his crew topped off three flights of four F-16A jets. "With the commercial airlines, it's not critical if we're not on time. Here, it is."

Spring Break Is Over

As Iraqi troops laden with stolen property fled north from Kuwait City, traffic on the highways was bumper to bumper. The scene looked

familiar to some of the carrier pilots attacking the enemy convoy.

"This was [like] the road to Daytona Beach at spring break," said Navy Lt. Brian Kasperbauer, as he returned to the carrier USS *Ranger* to reload his A-6E attack plane with Rockeye cluster bombs. The only difference, said he, was that, for the Iraqi occupiers, "spring break's over."

The air campaign got so feverish at times that Navy ordnance specialists were loading just about any bomb they could find rather than waiting for the "weapon *du jour*"—a Rockeye bomb with antiarmor cluster munitions—to arrive on the flight deck from below.

The Iraqi vehicles were "basically just sitting ducks," said Navy Capt. Frank Sweigert, commander of *Ranger*'s Silverfox bomber squadron.

Operation Desert Storm spawned GI slang every bit as profane, innovative, and colorful as that produced by US troops in any bygone war. Rare was the sentence that did not contain a four-letter word as a first name, last name, nickname, noun, verb or adjective.

In the conservative Islamic kingdom of Saudi Arabia, where profanity is officially unacceptable, soldiers routinely masked their language behind the alphabet-laden chatter of the type used on field radios. "Foxtrot," for instance, became one of the most widely used substitutes for a familiar Anglo-Saxon obscenity.

The GI dialect became a fast-changing mix of descriptions of local sights intermingled with the substitutions.

A typical example: "Desert Cherries in a Humvee sped past Bedouin Bob and some Black Moving Objects heading downrange to find the REMFs in Riyadh. The driver got so Lima Alpha Foxtrot that it took hours to reach the destination."

Translation: A pair of newcomers to the desert in a high-mobility multiwheeled vehicle passed a local in traditional dress and two women in black chadors while heading from Dhahran to Riyadh to look for rear-echelon personnel in the Saudi capital. The driver got so lost that it took longer to reach the capital than expected.

From their bunker, Golf Two, A1C Jake Myres and A1C John Dlugos had a keyhole view of the Persian Gulf War. The pair, manning an M60 machine gun at a Saudi air base, were assigned to intercept intruders or suspicious vehicles that penetrated the first line of defense and could threaten US tankers and other aircraft.

—US Navy photo by CWO2 Ed Bailey

Iraqi troops withdrew from Kuwait in February, leaving destruction and confusion in their wake. Above, a burning oil field silhouettes US Marines in Kuwait. Putting out the oil fires and rebuilding Kuwait's oil industry, to say nothing of cleaning up the damage to environment and infrastructure, will take years.

The only hint of combat was the occasional breathtaking departure of Patriot missiles to intercept inbound Scud missiles, followed by falling Scud debris.

"In the United States there was not really a threat," said Airman Myres, who served with Airman Dlugos as part of a ground defense force at Vandenberg AFB, Calif. "Here the threat is real. I feel like I have a real job, a real purpose."

"They know when they see hostile actions they can engage," said the pair's supervisor. "They've got a lot of responsibility."

Eyeballing From 10,000 Feet

For all the sophisticated satellite intelligence and reconnaissance photography available to pilots, it often came down to a pilot eyeballing targets.

Iraqi tanks and artillery pieces were so widely dispersed and well camouflaged that some US pilots flew with binoculars. Others relied on the eyes of younger wingmen to ferret out tank turrets for the daylight bombing raids.

F-16s dropped to about 10,000 feet to carry out bombing strikes with "dumb" bombs while staying above the reach of Iraqi antiaircraft fire.

Colonel Scott, the former "aggressor" leader, broke away from headquarters duty in Riyadh to fly eight combat missions at the height of the air war. "The way we assess a direct hit is whether you get a secondary explosion," said Colonel Scott at the time. "If you get that, you know you hit something."

Each day, the revised Air Tasking Order scheduled packages of aircraft, time over target, and inbound and outbound courses, but many pilots wanted more time to take action. "Sometimes we have bad boys that want to play longer than their time," said one Air Force officer at Riyadh AB.

"In spite of the AAA and everything else, they're there to blow something up and they want a chance to do that. They hate leaving with ordnance. They really get frosted about that." ■

Stewart M. Powell, national security correspondent for Hearst Newspapers, has covered defense for a decade in Washington and London. He was in Saudi Arabia throughout Operation Desert Storm. His most recent article for AIR FORCE *Magazine, "Voices from the War," appeared in the April 1991 issue.*

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GENERAL DYNAMICS
A Strong Company For A Strong Country

The Desert Storm "air boss" describes how the campaign was planned and fought.

A Conversation With Chuck Horner

By Richard Mackenzie

LT. GEN. Charles A. Horner, Central Air Forces commander, analyzed the performance of Air Force weapons, tactics, and personnel in Operation Desert Storm when he spoke with Richard Mackenzie at USCENTAF headquarters in Riyadh, Saudi Arabia, in March.

Q: The success of the ground war seems largely due to the phenomenal success of the air war. Would you agree?

A: I think a lot of people have made that case. I'm not one to. I think you have to examine it. I go at it from a little different approach. I don't try to find the answer. I try to find what we did right, what [the ground forces] did right, and how we worked together.

I'd say the things that helped the ground war were [Gen. H. Norman Schwarzkopf's] directions to us to take out armor and artillery. I think that was the key to [the ground forces'] low casualties. I think the success of the land war is because of initiative and maneuver and the way they did it. They worked together.

Q: Let's go back to the beginning. You arrived early.

A: August 5.

Q: I understand that, among the three or four generals here at the time, the only weapon was a pocketknife.

A: [Lt. Gen.] John Yeosock [Commander of the Third Army] had it. I was acting for the CINC [Commander in Chief Schwarzkopf], and John, of course, headed the land forces. One night I said to him, "Jack, what have you got to defend us?" He pulled out his pocketknife. That was it.

Q: Obviously the logistics, the buildup, and everything that followed worked. When you first started thinking about the possibility of conflict, of employing the Air Force, did you start thinking about strategic targets?

A: This goes back well before August. This goes back a year or so before August.

When General Schwarzkopf took over, he brought us in and we talked about what kind of military planning we should be looking at. Before, we had focused on a Russian invasion of Iran. That was the early 1980s. General Schwarzkopf said, "That's just not going to happen. Russia is a

changed state. They have internal problems that will preclude them from attacking Iran. So what we need to do is look at other situations where our country may call upon us to function."

Iraq Could Cause Problems

The obvious potential was this huge military power called Iraq causing problems for Kuwait and Saudi Arabia. At that time, we went back and studied the problem. [Around March 1990], I went to General Schwarzkopf and gave him a long briefing that I had coordinated with the Army, with General Yeosock. I had stopped by his headquarters in Atlanta. We looked at what kind of things would be important from an air standpoint if there were going to be a conflict in this part of the world.

At that time, we talked about Patriots defending against Scuds. We talked about how we would provide close air support to the Army in a very fluid desert maneuver battle. We talked about chemical weapons and how we could counter chemical weapons. Also during that time, we talked about attacking [Saddam's] war-making potential—strategic targeting, if you want to call it that.

We've been working this, from a theoretical standpoint, and I've been identifying the resources I would need to bring to the party if the party ever were to occur—in terms of command and control, in terms of types of airplanes, where you'd bed them down.

Now the Air Force had about $1 billion worth of prepositioned equipment. All this stuff was over here already—ammunition and fuel and things like that.

In July, we went to Florida, and we actually exercised a scenario very similar to this. We looked at working together with the Army and the Navy. The one thing we didn't exercise was working with the other nations. It was just too hard to conjure up how they would be involved.

Q: Who would have thought up the coalition?

A: We sat there and watched in wonder as Iraq built up on the border. I think most of us were convinced that nothing would come of it. We believed the Arab brethren would never attack one another and things like that. So when we were invited to come over here by the Saudi Arabians, we were immediately intent on deterring an invasion of Saudi Arabia or defending Saudi Arabia if deterrence should fail.

Thinking Ahead

At that time, I was over here as the acting CENTCOM commander for CENTCOM Forward while General Schwarzkopf was in the States, organizing the deployment and sending stuff over. We'd bedded it down. At that time, he asked the Joint Staff to develop target material, a list of targets, and that was sent over here about the second or third week of August. We took that information—there were between fifty and 100 targets nominated—and we said, "OK. How would we strike these?" And we laid out a tasking order for that. About the third week in August, or the end of August, knowing the forces that were coming in, we were ready to conduct offensive operations. We had no guidance to do that, no mission to do that. That was just "what-if" planning.

Q: You considered it just part of the job?

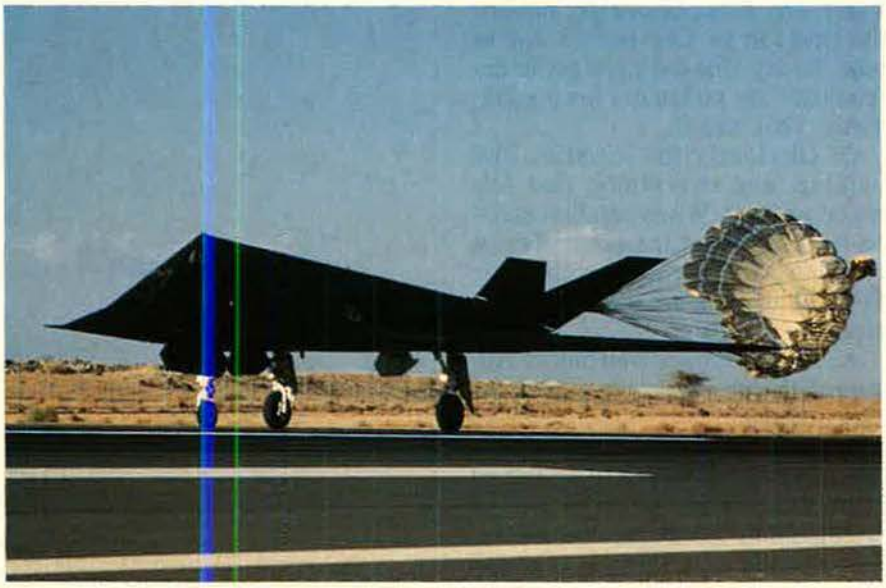
A: That's right. You think ahead. It became apparent that our deterrence was working. About mid-September, we had sufficient ground forces to defend Saudi Arabia from any kind of attack. When the 24th Mechanized Infantry Division got here, we were in pretty good shape.

Then we worked hard at developing an offensive air campaign. I had the luxury of doing that [since] I had the [first] mission taken care of, that of deterring and defending. I created a group under [Brig. Gen. Buster C.] Glosson. . . . It was his job to build upon the fundamental goals that the CINC laid out for us. The CINC defined the overall campaign, and we took the air portion of that campaign, such things as getting control of the air. That was first and foremost, because then you're allowed to do all other things. Other things would be to destroy [Saddam's] long-range offensive capability. That would include the Scuds, [Iraq's] research and development production, their warheads, chemical production, and nuclear/biological production and storage. We would isolate the leadership from the battlefield—that's communications.

You have those overall goals, and you develop targets that support that. Essentially, that was inherent in the targets we had already worked up.

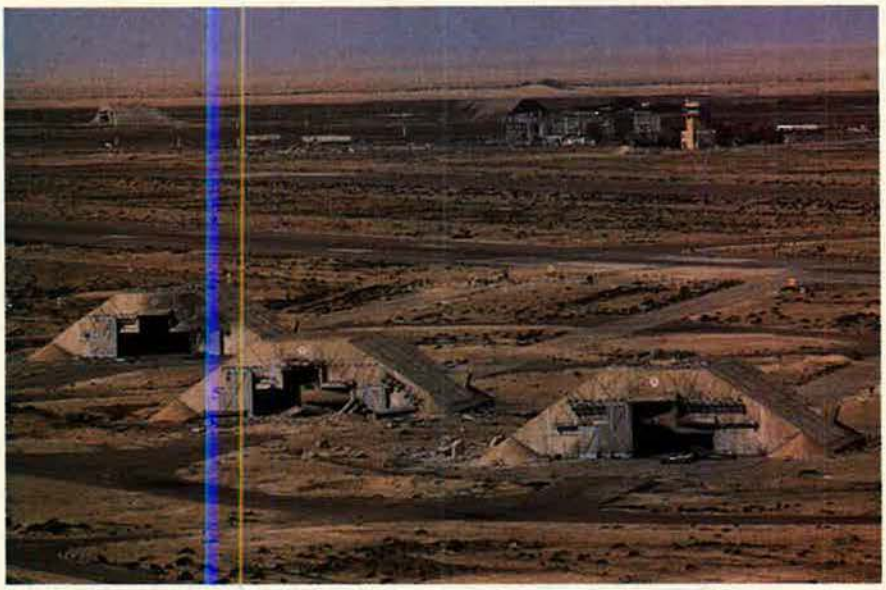
We continued to probe and seek and refine, and [the list] grew to about 350 to 400 targets. As we added forces over time, we compressed the time the campaign would require. Meantime, of course, the Army was also doing similar planning. We developed what we would do to the [enemy] forces in the field, the

—Photo by J. Witt/Sipa Press



—USAF photo by TSgt. Rose Reynolds

Rating the F-117 (above, landing in Saudi Arabia), General Horner said, "There is nothing to stop it." He estimated that up to 300 B-17s would have been needed to do what a single F-117 did to his Iraqi counterpart's headquarters (facing page).



—USAF photo by TSgt. Perry Heimer

Hiding in hardened shelters was no guarantee of survival for Iraqi aircraft, as this photo attests. Coalition F-117s, F-111s, F-15Es, and F-16s equipped with LANTIRN made sure of that, according to General Horner.

Republican Guard kind of being a strategic target, the Army in the field having to be addressed in light of what the ground campaign looked like, which units you attack based on what the ground guys plan to do.

The whole campaign fleshed out: strategic in detail, ground in terms of destroying certain aspects—artillery and armor—which really never changed. And, obviously, isolating the battlefield. We did not want the Republican Guards to run away early in the campaign. We wanted them to stay fixed, so we could destroy them [where they were].

They obliged, surprisingly. We didn't think they would. General Schwarzkopf was very concerned about them decamping and going back to Baghdad or spreading out. Fortunately, they stayed nicely grouped up for us.

No Idea of Airpower

Q: They just didn't seem to know what was coming?

A: Two things worked against the enemy. One is that Saddam decided to maintain absolute control, and he is obviously a very sorry soldier. He doesn't have a clue.

Second, there is no doubt in my mind that they had no idea what airpower is. We flew in one day as many sorties as [Saddam] faced in eight years of war with Iran. He had no air experience. There was nobody to teach him. He used his own air force so poorly.

Q: Had he used his air force, such as it was, could it have been more difficult for you?

A: Yes. You could say that about any element of his military forces, except maybe the Scuds, which he used about as well as he could under the circumstances. Any of my captains could have run his air force and caused much more trouble than he did. They wouldn't have prevailed. Instead of a six-week war, it might have been a twelve-week war, or a four-month war.

Q: All Iraqi military decisions have to be approved by Saddam himself.

A: We knew that right from the start. One of his principal weaknesses was centralized command.

Q: We've seen the bomb going down the air shaft. That was the F-117. It played a huge role in the air war.

A: It did. The A-10s and the F-16s did a lot of work that was not really heralded. They basically kept pressure on Saddam during the daytime. He could not move his forces. He just had to sit there and absorb punishment during the daytime. The F-117s, F-111s, and F-15Es gained a lot of positive notoriety because the taping system allowed you to see what they did. They were very, very efficient. You'd send a -117 out and it would kill one or two targets, bang. That was it—every night. In past wars, that would have taken several days of bombing by a whole armada. You saw the building take the one 2,000-pound bomb. To take out that building in World War II would have taken a raid of B-17s—150 or 300 airplanes. That's the benefit you get out of the precision weapon. Furthermore, the -117 strikes anywhere at will. There is nothing to stop it.

Q: What types of targets did you use the F-111 for?

A: The -117, the -111, and the F-15E and, to some extent, the F-16 LANTIRN aircraft all did much the same work. They were most useful against hard-point targets, bunkers, aircraft shelters, bridges, the things you saw on television. . . . They were very efficient. We did adapt the F-15E with 500-pound bombs to hit individual tanks. They would go out and take out 100 to 200 tanks a night. We called it "tank plinking."

Q: That's rather a quaint term.

A: Fighter pilots do that. At first, General Schwarzkopf asked us to name it something more "combat," like "tank busting." Of course, whenever you tell fighter pilots to do something they do exactly the opposite. "Tank plinking" became the preferred term.

A-10s vs. F-16s

Q: Did the war have any effect on the Air Force's view of the A-10?

A: No. People misread that. People were saying that airplanes are too sophisticated and that they wouldn't work in the desert, that you didn't need all this high technology, that simple and reliable was better, and all that.

Well, first of all, complex does not mean unreliable. We're finding that out. For example, you have a watch that uses transistors rather than a spring. It's infinitely more reliable than the windup watch that you had years ago. That's what we're finding in the airplanes.

Those people . . . were always championing the A-10. As the A-10 reaches the end of its life cycle—and it's approaching that now—it's time to replace it, just like we replace every airplane, including, right now, some early versions of the F-16.

Since the line was discontinued, [the A-10's champions] want to build another A-10 of some kind. The point we were making was that we have F-16s that do the same job.

Then you come to people who have their own reasons—good reasons to them, but they don't necessarily compute to me—who want to hang onto the A-10 because of the gun. Well, the gun's an excellent weapon, but you'll find that most of the tank kills by the A-10 were done with Mavericks and bombs. So the idea that the gun is the absolute wonder of the world is not true.

Q: This conflict has shown that?

A: It shows that the gun has a lot of utility, which we always knew, but it isn't the principal tank-killer on the A-10. The [Imaging Infrared] Maverick is the big hero there. That was used by the A-10s and the F-16s very, very effectively in places like Khafji.

The other problem is that the A-10 is vulnerable to hits because its speed is limited. It's a function of thrust, it's not a function of anything else. We had a lot of A-10s take a lot of ground fire hits. Quite frankly, we pulled the A-10s back from going up around the Republican Guard and kept them on Iraq's [less formidable] front-line units. That's fine if you have a force that allows you to do that. In this case, we had F-16s to go after the Republican Guard.

Q: At what point did you do that?

A: I think I had fourteen airplanes sitting on the ramp having battle damage repaired, and I lost two A-10s in one day [February 15], and I said, "I've had enough of this." It was when we really started to go after the Republican Guard.

Initially, much of the air assets were devoted to strategic targets, to make sure we got those down, while we were also hitting the front-line forces. As we killed off the research and development stuff—storage, those kinds of targets—we brought more and more assets into the Kuwait Theater of Operation. We really started heating the battle up in the KTO.

Q: General Schwarzkopf said that he didn't care to kill the Republican Guard; his goal was to break its will.

A: He never emphasized the killing of people. I think that is personally abhorrent to him, as it is to most of us. It really didn't serve any purpose other than to ensure hatred in the postwar era. What we had to do is destroy the enemy's capability to inflict casualties on us. Since we were fighting tanks, the way you do that is destroy tanks and artillery. I think we were very successful at that.

Avoiding Civilian Targets

Q: In that vein, you clearly avoided civilian areas. But what about the notorious bunker incident? What do you feel now, looking back?

A: The story that has been told all along is the true story. The bunker was a military target. It was being used for military purposes. It was one of several that were targeted and struck. The only thing I could think of while I was trying to figure out what happened was [that Iraqi military] guys on the third floor down [in the underground bunker] had probably brought their families in. It's a horrible tragedy. Somebody said, "You failed to know they were in there." The answer is, "We just don't know everything."

Q: You're not watching it twenty-four hours?

A: It's just that you are always dealing with less than perfect knowledge. If we had perfect knowledge, I probably could have defeated him with one bullet.

Q: Was the bunker incident frustrating to you? The inability to release peripheral intelligence that would have proved conclusively that you were telling the truth?

A: Not particularly. I understood the outcry from the press. Just as I don't overreact to favorable news, I don't overreact to criticism.

The concern would come if the President or the Secretary of Defense had overreacted to the criticism. I'm sure they thought it was a tragedy, but we never received any attempt to limit what we did with regard to operations.

Everybody recognized it was unfortunate, but it had very little impact on the conduct of operations.

Q: It didn't slow you down at all? It didn't make you think twice?

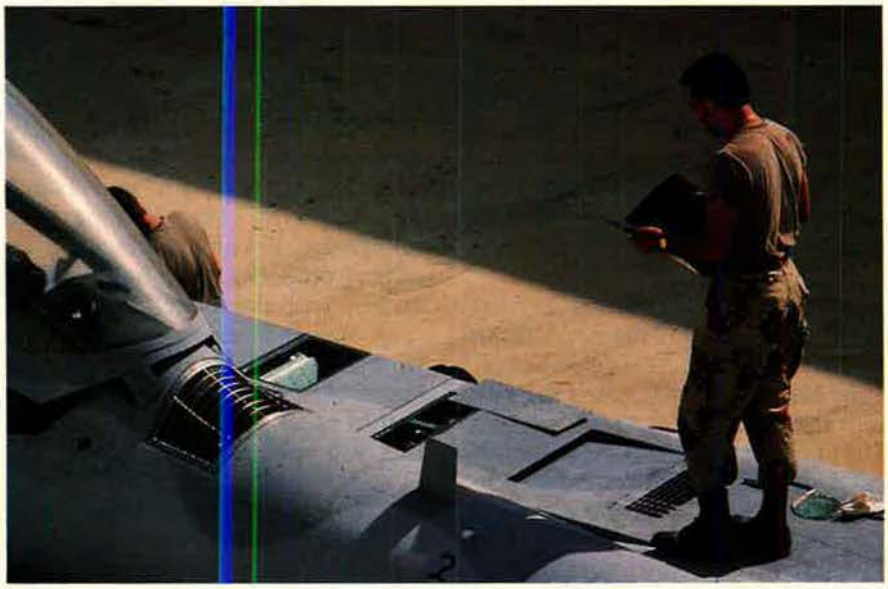
A: You see, we'd been thinking about that all along. Thinking twice wasn't appropriate. We would scrupulously look at attack axes. We'd look at the target. We discounted some targets because of proximity to civilian areas that were likely to suffer damage. We discounted some targets because they were near antiquities. Saddam learned that very quickly. He started firing Scuds out of residential areas. There's an infamous picture of two MiG-21s parked by a temple.

Q: Let's talk about the great Scud hunt. For a militarily ineffective weapon, that missile made you spend an inordinate amount of time chasing it down.

A: Sure. It had tremendous psychological impact on the governments of Israel and Saudi Arabia, and it was a threat to Bahrain.

We spent a great deal of effort on eliminating the Scuds or at least inhibiting their operations. We were blessed in that the failure of Saddam's air force gave me extra assets that I would otherwise have had to use for bombing airfields, orbiting in Combat Air Patrol, and things like that.

—USAF photo by TSgt. Perry Helmer



General Horner had special praise for the maintainers of Desert Storm. Their "superb" training and "selflessness" contributed to the outstanding mission capable rates. In his words, "These guys wouldn't allow the airplane to get broken."

Fortunately, it didn't constrain our overall operation. But we certainly employed many, many more assets toward keeping the Scuds inhibited than we originally thought we'd have to.

Q: Than would normally make sense?

A: If you did a military equation, yes. But there is a point that you shouldn't miss. Any country nowadays has the capacity to put another country in strategic jeopardy. If, psychologically, you combine the Scud with chemicals. . . . No, the Scud is World War II level. Let's take something from the 1960s, Atlas, [for example]. If you put chemical weapons on it, it doesn't make it a good military weapon, it makes it a hell of a psychological weapon to civilians.

If you put on some kind of nuclear device, suddenly anybody can be a world power. It's going to affect the way we approach international security arrangements. I think that, if one country sees another country developing nuclear weapons and ballistic missiles, they will take a far more serious view of it than they would have.

Q: This is war by terrorism?

A: In a form.

Joint STARS

Q: What's your assessment of the Joint STARS performance?

A: It's in research and development testing. It worked very well. It does for the ground picture what AWACS does for the air picture. It allows you to see what the enemy is doing in terms of movement, in terms of massing.

Q: Was it originally in your planning?

A: No. The reason it came here, quite frankly, is that part of its research and development testing involved a demonstration in Europe. They had taken two prototypes to Europe and had flown them to see how they'd work. They worked fine. So somebody said, "Since it worked in Europe, why not try it down here?" We didn't do testing. We brought it over and used it.

Q: Was that a pleasant surprise?

A: Let's put it this way: It was reasonable to expect that it would work. It was also reasonable to expect that we would have Ph.Ds. maintaining it, which I'm sure was the case. So it was not an operational system that we flew, but it was a system that worked and provided the information we wanted.

Q: Was there something that you wanted but did not get?

A: We wanted field jackets made out of [desert camouflage] material. They never got here.

Fortunately, we fought the battle in the cool time of year. But I have long been trying to get lightweight chemical gear. If we had fought in the summer and we had had an actual chemical environment, it would have been a problem. Our chemical gear is built for Europe. The heat stress would have been very high.

There's no reason to have that kind of heavy protective garment. In theory and probably in practicality, we could have met the threat with much lighter gear. That's one thing I wanted. I had all the weapons I wanted. We didn't have all the weapons we wanted prepositioned. . . . But that's fine, we brought a lot of things in.

Q: Any other pleasant surprises?

A: We had a pleasant surprise with the Global Positioning System. This was the first time we had used it. The forward air controllers really liked it. They were out in the middle of this trackless desert where the maps actually looked like this bare table. There is no relief on the map. Everything is the same, so it's very difficult to know where you are, and that's important if you're a forward air controller.

Q: Explain how GPS played into the operation.

A: It's a series of satellites. First, you receive a time signal from them. Since the system knows where the satellites are, it can measure the time distance, and it says, "OK, here's where you are." It reads out your latitude and longitude. If you want to go to another place, you type in the "lat" and "long" and it will say, "OK, steer this course for so many miles."

High Safety Rates

Q: Your safety record has been described as "absolutely amazing."

A: Yes. We have a good safety record. We had some accidents, obviously, when we first got here. Everyone was concerned. You never are pleased with anything other than perfection.

From a realistic standpoint, you know that if you're practicing to survive in combat, you're going to have some accidents. We normally use about three [accidents] per 100,000 [flying] hours as a guideline. If you're getting less than three, your training is probably not as challenging as it might need to be. If it gets above three, then you're . . . getting into resource expenditure you can ill afford.

Q: What was your rate?

A: We never got a full year of flying, so we don't know. I would say it was probably around that number.

Q: On one side or the other?

A: It depends. We had two or three accidents right off the bat, so that put us high on the curve. When people got used to the environment and what we were practicing for, boom, it dropped way down.

Q: What about the US deaths from friendly fire?

A: It is a worthwhile point to discuss, because it's something we pay a lot of attention to. We had three incidents that I know of. There may well have been more. On the night of Khafji, we had an A-10 shoot a missile that hit a Marine armored vehicle and killed some guys.

I don't know whether it was misidentification of the target or the missile did what we call a "hard-over." If you look at the [pilot's] video clip, he is locked on to a target at the end of [an enemy] column. The Marines were raiding the "V" to hit the lead vehicles. It's probable that the missile came off, the seeker head locked down, and the missile [did a forty-five degree turn] and got a one-in-a-million BB shot.

Q: He was locked onto another target, however?

A: Yes.

Q: An enemy target?

A: Yes. I tend to believe that, but we have no way of knowing.

Q: The others?

A: The second was [a fighter-bomber attack] on a Marine column. The allied aircraft dropped [cluster bombs] on them. That would be misidentification because they're ballistic weapons. That happens.

Then we had an A-10 hit a British vehicle. In that case, it was a failure in command and control. The forward air controller was a British guy. The [US planes] had taken off, and they came on station. They were cleared to a crossroads with a police station or a border post or something.

So the FAC cleared them, and he said, "We do not have any friendly forces within 4,000 meters, four kilometers of your location." So the US pilots . . . saw this column in the north coming in, and they shot at them. In fact, it was British people.

Q: What had you done to guard against that happening?

A: We had a whole series of measures designed to preclude these kinds of things from happening. It's a very high-level concern. We have books written on the subject. We have all sorts of measures.

For example, I had more than 2,200 Air Force people on the ground up north with various units. Their two purposes were to coordinate air and ground operations and to preclude this blue-on-blue from occurring. Plus we have all kinds of rules. This was discussed early. I discussed it with [General Schwarzkopf] because I said we would probably fight alongside allied forces. While we understood our procedures, because we practice them all the time—daily in exercises and on the ranges at the forts in the States—we don't practice with, say, the Saudi Arabian Army.

That's when we first talked about things like colored panels, and you've seen the inverted V painted on everything. It goes well beyond airplanes, to TOW missiles and tank guns and that kind of stuff.

Q: Pilots who worked the battle of Khafji spoke openly of problems.

A: After Khafji, we realized it was an extremely difficult task. A lot of these systems like the LANTIRN and the Maverick are relatively new to the inventory, so we don't have a lot of experience practicing with these devices in joint exercises. When the war started, we looked at putting things like infrared flashers and stuff like that on vehicles. We never really got a chance to develop additional measures like that.

The main thing we did was talk to the guys and say, "If in doubt, don't drop." That's what it amounted to.

[Friendly fire is] a terrible thing. Of course, the guys feel very badly about it. But I would imagine there are infantrymen who got shot by their own infantrymen.

Q: But measures were pretty much limited to the colored panels and the inverted Vs?

A: The fundamental system is the support coordination line. It is generally out to about the limit of friendly artillery. Anything inside that line has to be controlled by a forward air controller. That is how the pilot operates. He can't drop [ordnance] unless he's cleared by a forward air controller, except in an emergency. Under these rules, the Army assumes responsibility for where the ordnance lands. Outside the fire support coordination line, the flight leader is allowed to attack any target within the general rules of engagement.

Managing Air Traffic

Q: Managing the air traffic, of course, was a mammoth task.

A: A big job. We were helped greatly by computers. What you do each day is build an air tasking order. A portion of that order has to do with airspace management. I managed airspace for the theater along with the Saudis.

We put in every sortie by time, by altitude, and by location to get them up to the battle. To deconflict that, the computer sits there and matches all that information. It would take days to do it yourself.

Once aircraft get into the battle area, they're deconflicted in the planning process by the area they're going to. Over the Army, we deconflict them using forward air controllers.

In the current operations tactical air control center, you have the same computer. Say a pilot decides to hit this hot target over here. He calls it in, we enter it in the computer, and we see if there's any conflict. If there is, we just make whatever adjustments need to be made in order to deconflict it.

We are always deconflicting airspace. To implement that, we have the AWACS aircraft, which has a total view of the battlefield. I can sit here and view the air situation from the surface up, over the entire country of Iraq.

I didn't do anything with the information, because that would have been micromanaging the forces.

Q: Like the days of President Johnson picking targets in the Vietnam War.

A: That was a disaster.

Q: Did that have an impact on you?

A: I saw it happen in Vietnam. That's why it didn't happen here. Many of us came through the same experience in Vietnam and saw all the gross errors in the operation there and vowed it would never happen again. Just like I wouldn't talk to [General Schwarzkopf] at night about battle-damage assessment, and he would never talk about body counts.

First of all, it's macabre. Second, the next day it's "What have you

—Photo by Wesley Bocxe/Sipa Press

Asked to comment on the war's antiseptic "Nintendo image," General Horner warned against such misconceptions, defining war as "pain, suffering, fear, death, and destruction" and cautioned nations not to "think that war is like a Super Bowl."

done for me so far?" It just gets worse and worse. You can have good days and bad days. What we talked about was how things were going in general and what needed to be done. He would tell us what he wanted done, and we would go out and implement that.

Q: So the discussions were general?

A: We had six weeks, five and a half of which were air war, and half a week was ground war. So it was generally me and the CINC with all the other guys watching.

The last thing we did each night was brief him on what we were going to do the next day, what targets we were going to hit. I can't remember his making any major adjustments. Obviously, his intelligence guy would get with him during the day and get with us.

Q: How soon in the war did you feel that you'd shattered Saddam Hussein's Baghdad infrastructure?

A: We more or less had sort of a timetable. I made sure that we generally stayed on the timetable.

We had things working for us, such as a lack of the need to hit airfields. We had things working against us. The weather was much worse than we had anticipated. And the Scuds.

We generally stayed on a reasonable schedule. It wasn't that we had to have this many buildings destroyed by this time. It was that we felt we would have about half of the research and development functions killed by a certain date. For example, we hit the storage areas first so they couldn't be used against us, then hit the production so [the Iraqis] couldn't replenish the storage, and then hit the research and development facilities for the long-term implications.

No Nintendo War

Q: On television, the war had a kind of Nintendo image. Have you given any thought to that?

A: I'm sure it was fascinating to people. It made great television. You've got to remember, too, that I was isolated from much of the press. I spent my time fighting the war, not watching CNN. I would occasionally get glimpses of it. I did sense from some of the questions I'd get asked that people were thinking of war in sterile, mechanical, technological terms, when I was thinking of the guys going through this hail of lead, having surface-to-air missiles shot at them, and having the sweat running down their necks.

It may have a long-term negative effect of making war seem antiseptic. It is not. It is pain, it is suffering, it's fear and death and destruction. It's bad, bad—all bad.

I guess we all should beware of the attitudes that this kind of antiseptic display of combat gives us. It might make nations think that war is like a Super Bowl.

Q: Is there an additional point that you would like to make?

A: I would like to make a point about the excellence of the young people who fought this war. It was a piece of cake because of them. I didn't have any problems. My [mission was to] satisfy the CINC, which I could do. If I needed an airplane loaded, it got loaded. If I needed bombs delivered, they got delivered. If I wanted to move a squadron from Base A to Base B, it happened.

The airplanes stayed in commission. Over ninety percent of the time they were ready to fly. A normal, reasonable number for this type of activity would be sixty or seventy percent. These guys would not allow the airplane to get broken. It's a function of their training, which is superb. It's a function of the equipment, which is great and lends itself to this kind of stuff. Even more, it's a function of their selflessness. They just jumped in and did whatever needed to be done, didn't question, didn't have to be urged. Leadership was strictly telling them what was needed, not exhorting them to do it.

As the guy said, it's great to be out there being pushed around by such a mob.

Q: Was there any great disappointment?

A: Every loss hurt. And what the Iraqis did to the Kuwaitis was outrageous. I've talked to some of the people who escorted the allied POWs home. I learned that some of the POWs were treated very savagely. Not all; some of them. That was very, very painful.

Q: Was the difference based on who happened to capture you?

A: Yes. The Republican Guard and the secret police were outrageous in their behavior. The regular army tended to treat our people reasonably well. I was surprised at the Republican Guard. I tended to think of them as regular army, but I guess they really aren't.

Q: They're monsters.

A: They really are. ■

Richard Mackenzie covered the Persian Gulf War for Insight *Magazine. His most recent article for* AIR FORCE *Magazine, "The Afghan War," appeared in the September 1988 issue.*

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East Asia is still a tough neighborhood, and the Japanese plan a steady buildup of their defenses.

Japan Bucks a Trend

By Robert S. Dudney, Executive Editor

WITH the US and most other industrial nations pursuing significant military reductions, Japan has assumed the unlikely role of the only world power that continues to increase its armed might.

The Pacific nation is embarked on a $168.5 billion, five-year defense program that promises to produce notable advances in its modest land, sea, and air forces. The new spending blueprint exceeds the preceding five-year program by $32.2 billion.

"While other countries' defense budgets are decreasing, Japan will increase its budget by three percent over the five-year plan," notes an official commentary issued by the US Defense Department, which in the same period faces a planned budget reduction of eleven percent.

In the process, says DoD, "Japan will improve the infrastructure of its defense forces and increase its defensive capability." Also on tap are significant additions of new fighter aircraft, more sophisticated air defenses, better naval weapons, and advanced ground arms, to name only the most visible items.

No one is saying that Tokyo, with its 247,000-strong force, is about to become the military colossus of the Far East. The Japanese defense budget, though now the world's third largest, still is one-tenth the size of the US defense budget. Tokyo's forces have serious weaknesses. Japan also is moving very cautiously to avoid provoking a backlash from its neighbors.

Still, the situation marks a turnabout for a nation frequently derided as a defense slacker. Moreover, Japan's new buildup program—which officially began on April 1 and is due to run into early 1996—comes on the heels of a five-year buildup that transformed its force from the laughingstock of Asia into a credible defensive outfit *[see "Japan Steps Up to a Stronger Defense," November 1989 issue, p. 42]*.

What accounts for Japan's decision to press on with its modernization program in the face of declining tension in Europe and other hot spots? In its most recent white paper, "Defense of Japan 1990," the Japan Defense Agency (JDA) argues that, whatever may be happening elsewhere in the world, east Asia is still a tough neighborhood. It cites several dangers.

First and foremost is what the JDA regards as a continuing Soviet threat. It urges armed vigilance for years to come.

Cooking the Books?

However, the white paper deemphasizes the peril that Soviet power poses for Japan. For example, the JDA, for the first time in a decade, declined to cite the "latent Soviet threat" specifically as a direct menace. The paper acknowledges that Moscow should no longer be viewed as an enemy and that formal Soviet-Japanese security talks should begin.

But this shift may have more to do with politics than with pure military assessments. The Japan Economic Institute, a think tank in Washington with excellent contacts in Tokyo, maintains that Prime Minister

The US-designed, Mitsubishi-built, high-performance F-15 fighter is the backbone of Japan's Air Self-Defense Force. For the air-to-surface mission, Japan will replace outdated F-1s (at left) with surplus F-4EJKais in coming years.

Toshiki Kaifu "pressured the JDA to soft-pedal the Soviet military threat" in order to improve the atmosphere for last spring's meeting between the Japanese leader and Soviet President Mikhail Gorbachev.

The JDA's paper, though it confirmed a reduction in the number of major Soviet weapon systems in Asia, called attention to the qualitative upgrades that left net Soviet power about the same. The Soviet Air Force eliminated about 300 MiG-21s and other old fighters, yet it shipped in 110 new, fourth-generation types such as MiG-31s.

In the JDA's words, "Soviet military forces in the Far East have commenced full-scale transition from quantitative expansion to qualitative improvement."

The JDA notes that, in the Far East, sixty percent of Soviet ground divisions and sixty percent of fighter planes are arrayed against Japan. Though the number of Soviet military flights in the proximity of Japan has decreased, Soviet maneuvers in the region continue at "high levels."

"Defense of Japan 1990" also sounds a warning about a second danger, one emanating from the volatile Korean peninsula across the Sea of Japan. The paper notes that 1.4 million South and North Korean troops face each other across the 38th parallel. The Northern regime of the fanatical Kim Il-Sung devotes twenty-five percent of North Korea's economy to arms spending. And, the paper warns, Pyongyang shows every sign of wanting to "go nuclear."

In North Korea, the paper continues, "construction of nuclear-related facilities and research and development for short-range ground-to-ground missiles appear to be making progress." The JDA states explicitly that such moves "could lead to the development of nuclear weapons." US intelligence agencies report that North Korea built a nuclear reactor at Yongbyon that is too large for research, too small to generate electric power efficiently, but just right for producing bomb materials.

"We view nuclear proliferation on the Korean peninsula as the number one threat to stability in East Asia," says Assistant Secretary of State for East Asian and Pacific Affairs Richard Solomon.

Nuclear proliferation experts Leonard S. Spector and Jacqueline R. Smith, writing in *Arms Control Today,* warn that North Korea's possession of the bomb would have huge consequences for Japan's security. "Even if Japan continued its policy of nuclear abstinence," the authors say, "a nuclear-armed North Korea could encourage a Japanese military buildup that would, in turn, trigger anxieties throughout Asia."

Watching China

Though the issue is not directly addressed in the white paper, Japan's military planners worry that they may some day have to cope with the threat of an expansionist China. US defense experts say that their Japanese counterparts closely study the direction of Chinese military affairs, especially since the People's Liberation Army in 1989 led the massacre of pro-democracy demonstrators in Beijing.

In a recent issue of *Foreign Affairs,* the problem was put this way by Fred Iklé, Under Secretary of Defense for Policy in the Reagan Pentagon: "Tokyo is beginning to realize that the Soviet Union may not be Japan's only security concern in the future. The importance of Chi-

The upgraded F-4 is seen as a half measure at best. The proper solution will not be implemented until the turn of the century, when the SX-3 support fighter, an extensively modified F-16 powered by GE engines, comes into service.

na, relative to that of the Soviet Union, is likely to grow."

For these reasons, Japan concludes that its military modernization should continue. At the same time, Tokyo vigorously opposes calls for Pacific arms-control agreements, especially those that would threaten to reduce the US presence beyond a 12,000-troop cut announced last year.

In the 1980s, Japan conducted the most consistent defense buildup of any nation, focusing on acquisition of modern weaponry. In the coming five years, however, Tokyo will ease up on arms purchases and devote more of the defense budget to personnel and support operations.

JDA officials say that, over the 1991–95 period, the JDA will spend only twenty-two percent of its total allocation on new weapon systems and other hardware. By contrast, the JDA has earmarked forty-one percent of the budget for armed forces support functions such as logistics and military construction and thirty-seven percent for manpower costs.

There will still be a respectable amount of money for new weapon procurement. In 1991 alone, Japan's Air Force, known officially as the Air Self-Defense Force (ASDF), will move to acquire eleven more expensive, high-performance F-15J fighter aircraft, the mainstay of Japan's nationwide air defense system.

US Defense Department officials say that this purchase is the opening wedge of a five-year purchase of forty-two of the US-designed, Mitsubishi-built fighters, which Japan has been coproducing for a decade. When and if the entire order is procured, the ASDF will boast more than 200 of the sleek air-superiority fighters—more than are available to the Pacific Air Forces throughout the theater. That would be enough to fully equip eight squadrons with the F-15, out of the ASDF's maximum of ten squadrons. Currently only seven squadrons of F-15s exist. The F-15s also will come with their own upgrade program.

For the foreseeable future, the other two fighter squadrons are to be composed of aging but newly updated F-4EJKai fighters.

Turbulence in the Squadrons

Backing up the ten ASDF fighter-interceptor squadrons will be three support fighter squadrons, used principally for air-to-ground and air-to-ship missions. There will be significant turbulence in these squadrons, say US officials, as aging Japanese-built F-1 support fighters are swapped out for surplus F-4EJKais over the next few years.

The F-1s are viewed as outdated. Use of the F-4EJ is a half-measure at best, but it is the only obvious step available to Japan. As it is, Japan will reduce the number of its F-4EJ fighters.

The proper solution will not be implemented until the turn of the century, when the planned Japanese-US SX-3 support fighter is to come into service. Japan plans to buy as many as 130 of these extensively modified F-16 aircraft. However, the program has slipped by two years, and the JDA failed to include production funds in the five-year plan. Japan did, however, decide on which powerplant to use. Tokyo picked the GE F110-129 Increased Performance Engine to power the SX-3. It will be built under license in Japan.

In addition to the fighter purchases, says the US Department of Defense, the ASDF plans over the next five years to purchase four US-built E-3 Airborne Warning and Control System (AWACS) aircraft to conduct airborne surveillance of Japanese airspace.

Japan's plans call for buying two AWACS a year in 1992 and 1993, at a total cost of $1.2 billion. The purchase, though large, disappoints many in the US. Experts say that the United States wanted Japan to buy up to twenty AWACS planes and that, until very recently, Japan had considered procuring as many as twelve. Now some question whether Boeing, the AWACS prime contractor, will be able to keep the line open for such a limited run.

In other purchases through 1996, the ASDF plans to procure three C-130H transports, two CH-47J helicopters, and ninety T-4 intermediate trainers.

AEGIS and Submarines

The big news for Japan's Maritime Self-Defense Force (MSDF) over the next five years will be its procurement of more destroyers equipped with the AEGIS high-capacity air defense system. Japan bought two of these ultrasophisticated air defense warships during the late 1980s. The Pentagon says that Japan's five-year plan calls for purchasing at least two more.

In a wartime crisis, Tokyo would rely heavily on the 44,000 sailors of the Japanese fleet to keep open critical sea-lanes or to blunt a seaborne attack. The AEGIS warships are considered essential to the protection of other warships from air and missile attack by Soviet bombers.

In the field of antisubmarine war-

fare, the new defense program will permit the Japanese Navy to press forward with its submarine production program; US experts say that it probably will level off at seventeen boats. Over the next five years, the MSDF also will increase its inventory of P-3C ASW aircraft from sixty-eight to ninety-four, replacing older P-2J ASW aircraft.

During 1991, Japan plans to reach its goal of deploying sixty destroyers, twice the number in the US Seventh Fleet. It will also acquire thirty-six SH-60J ASW helicopters, which will replace the older SH-3, and one MH-53E minesweeper helicopter.

Current plans call for the Army, or Ground Self-Defense Force (GSDF), to acquire thirty-four new Japanese-built Type 90 tanks and a package of Patriot surface-to-air missile systems in Fiscal 1991.

Over the five-year period, says the Department of Defense, Japan plans to purchase and introduce the Multiple Launch Rocket System to the ground forces. According to US sources, the Japanese Army is set to buy up to thirty-six units of the MLRS. The total buy over ten years could reach 150 launchers. Japan also wants to coproduce the LTV Corp. system.

On the aviation side of the Japanese Army, the budget provides for twenty more AH-1S antitank helicopters and fourteen CH-47J transport helicopters. The GSDF also plans to improve the Hawk antiair missile system it deployed in recent years.

In the final months of budget deliberations, the Kaifu cabinet pared the five-year defense budget by nearly $15 billion in light of the easing of East-West tensions. It was an act that caused the JDA to cancel or defer a number of major programs.

For example, Tokyo had been considering the development and deployment of an expensive, US-designed, over-the-horizon radar station, but it has since scrapped the idea. The ASDF has deferred the purchase of new tanker aircraft that would extend the range and patrol times of Japanese fighters.

Largely protected in the budget, however, are initiatives and funds aimed at easing one of the Japanese military's biggest headaches: attracting and retaining high-quality personnel.

In the white paper, the JDA notes that the Self-Defense Forces must attract about 25,000 new personnel every year. Recruitment of male Private Second Class personnel for short-term service—eighty percent of the annual enlistees—"has been difficult every year," the JDA concedes.

The Japan Economic Institute cites reports that the SDF is short of its quota by 25,000 troops. One consequence of the shortages, it says, is that many of Japan's warships consistently are listed as being in a state of "half-readiness" due to crew shortages.

The long-term outlook is bleak. In a total national population of about 123,000,000, the cohort of Japanese males aged eighteen to twenty-six—the prime age for military service—is expected to peak in 1993 at about 9,000,000 and then go into a long-term decline. The number of eighteen-year-olds, approximately 1,000,000 in 1991, is expected to decrease to about 700,000 in Fiscal 2003, says the JDA. Thus, says the agency, it is virtually certain that the recruitment environment will become "increasingly severe."

The Social Stigma

Compounding the recruiting difficulties is the fact that Japan's booming private-sector economy attracts the best and brightest of Japan's youth. In addition, a social stigma still attaches to the Japanese military as a result of World War II.

With the 1991 budget, the JDA, for the first time in memory, places more emphasis on improving troop facilities, welfare, and morale than it does on buying advanced armament. Whether it can arrest the decline in high-quality enlistments is yet to be seen.

The forthcoming improvements will come on top of a far-reaching but underpublicized strengthening of the Japanese military that occurred in the 1980s. Strongly encouraged by Washington, Japan in 1981 decided to acquire the ability to defend its own sea-lanes and airspace to a distance 1,000 miles from its shores.

More importantly, the 1985 five-year defense plan provided for a steady increase in resources for the JDA. According to calculations by the Japan Economic Institute, annual increases in Tokyo's defense budgets over the past decade, starting with 1980, were 6.5 percent, 7.6 percent, 7.8 percent, 6.5 percent, 6.6 percent, 6.9 percent, 6.6 percent, 5.2 percent, 5.2 percent, and 5.9 percent. The figure in 1990 was 6.1 percent.

The JDA's white paper maintains that, as a result of the 1980s defense buildup, the air defense capability of Japanese forces, their capability to counter invasion, and their capability to secure the seas "will vastly improve," and Japan can attain the level of capability laid down in 1976 in its so-called National Defense Outline.

Japan fully funded or came close to fully funding production of all its planned tanks, artillery, armored vehicles, antitank helicopters, destroyers, submarines, ASW patrol planes and helicopters, transports, airborne surveillance planes, training aircraft, and surface-to-air missile groups. It has bought about eighty-six percent of the planned number of F-15 fighters.

Only in procurement of surface-to-surface missiles (SSM-1) did Japan fall well short, the JDA reports. It acquired thirty-eight of fifty-four planned units.

Whatever the improvement in its own forces, Tokyo continues to rely on the American military umbrella for its basic security. Last year, the US-Japan Mutual Security Treaty marked its thirtieth year. The US stations some 50,000 military personnel in Japan. The Japanese further understand that, in the past, the bilateral security relationship has shielded Japan from US trade retaliation.

Now, under mounting pressure from Congress, Japan's leaders have shown willingness to boost Japan's share of costs to support US forces there, which comes to about $7.5 billion per year. By 1995, JDA officials say, Tokyo plans to pay half of these costs, up from forty percent today. In January, the two nations signed an accord that increases Japanese funding for US forces in Japan by $1.7 billion over five years.

The Pentagon reports that, if one excludes salaries paid to US forces in Japan, Tokyo's contribution will amount to more than seventy percent of the total stationing cost. ■

Gallery of Soviet Missiles

By John W. R. Taylor

Intercontinental Ballistic Missiles (ICBMs)

SS-11 (NATO "Sego")

Under the terms of the Strategic Arms Reduction Talks (START) between the US and USSR, intended limits for each nation include 154 heavy intercontinental ballistic missiles (ICBMs), a total of 4,900 ICBM and submarine-launched ballistic missile (SLBM) warheads, and 1,100 mobile ICBM warheads. The aggregate throw-weight of deployed ICBMs and SLBMs will be cut to 50 percent of the current Soviet level.

Meanwhile, modernization of the Soviet ICBM force continues, with deployment of additional SS-24 and SS-25 missiles, upgrading of the SS-18, and corresponding removal of older and less effective weapons. As a result of replacement of more of the original SS-11 "light" ICBM force with SS-17s and SS-25s, the Department of Defense reported a further reduction of 45 to a total of 335 deployed in September 1990. Although the SS-11s are considerably less capable than the missiles that are replacing them, and housed in less survivable silos, DoD maintains that "their destructive potential against softer area targets in the US and Eurasia is significant."

There are two current versions:

SS-11 Mod 2. Single reentry vehicle (1 megaton), with added penetration aids. Deployment began in 1973.

SS-11 Mod 3. First operational Soviet missile with MRVs (three 200 kiloton). Deployment began in 1975.

Launch Mode: silo based (not upgraded in hardness); hot launched.
Power Plant: two-stage storable liquid-propellant.
Guidance: inertial.
Warhead: single nuclear (Mod 2); three MRVs (Mod 3).
Dimensions: length 62 ft 4 in, max diameter 7 ft 10½ in.
Launch Weight: 105,820 lb.
Performance: max range 8,075 miles (Mod 2), 6,585 miles (Mod 3). CEP 1.1 km (0.7 miles).

SS-13 (Soviet designation **RS-12/SS-12;** NATO "Savage")

When development of the SS-13 began, in 1957, its use of solid propulsion made it unique among large Soviet missiles. Only 60 were deployed, in Mod 2 configuration from 1971. Of these, 40 remain, each in approximately the same category as the US Minuteman.

Launch Mode: silo based; hot launched.
Power Plant: three-stage solid-propellant, each with four nozzles and separated by truss structures.
Guidance: inertial.
Warhead: single nuclear (750 kilotons).
Dimensions: length 65 ft 7½ in, max diameter 5 ft 7 in (first stage base).
Launch Weight: 72,750 lb.
Performance: range 5,840 miles. CEP 1.8 km (1.1 miles).

SS-17 (Soviet designation **RS-16;** NATO "Spanker")

As a "light" ICBM, the SS-17 was constrained in size and weight by the early SALT negotiations, but, when it entered service in 1975, it introduced several significant advances. Like the other fourth-generation Soviet ICBMs, the SS-18 and SS-19, the basic Mod 1 version had independently targetable multiple reentry vehicles. All three weapons were also tested with a single reentry vehicle for a multimegaton warhead, in case it might be needed for use against future very hard targets. By 1980, a total of 150 SS-17s had been emplaced in modified SS-11 silos, into which they were loaded inside their transportation canisters. A new cold launch technique enables the missile to be "popped" out of its launcher by a gas generator before the main booster motors are fired. As a result, the silo would not be heavily damaged in operational use and could be reloaded, although this would be a slow process.

All SS-17s were upgraded to Mod 3 standard, as described below. They are being withdrawn following deployment of SS-24s, and only 70 remained by September 1990.

Launch Mode: silo based; cold launched.
Power Plant: two-stage storable liquid-propellant.
Guidance: inertial.
Warhead: four MIRVs (each 200 kilotons).
Dimensions: length 78 ft 9 in, max diameter 8 ft 2½ in.
Launch Weight: 143,300 lb.
Performance: max range 6,200 miles. CEP 1,300 ft.

SS-18 (Soviet designation **RS-20;** NATO "Satan")

There are 308 of these cold launched "heavy" missiles in the Soviet ICBM force, in converted SS-9 silos. In the 1980s most were upgraded to Mod 4 standard, with ten MIRVs, each with more than 20 times the destructive power of the nuclear bombs dropped on Hiroshima and Nagasaki in 1945. According to DoD's *Soviet Military Power,* silo conversion is now under way to replace the present missiles with the "SS-18 Mod 5 (with substantially more accuracy and warhead yield and equipped with MIRVs), and the single-warhead Mod 6. The Soviets are modernizing their SS-18 force with START constraints in mind, requiring a 50 percent cut in heavy ICBMs. Despite this limitation, improvements in the Mod 5's accuracy and yield will allow the Soviets to maintain a credible wartime hard-target-kill capability."

DoD believes that the current SS-18 force, by itself, has the capability to destroy 65–80 percent of US ICBM silos and command facilities, using two warheads against each silo. After doing so, 1,000 SS-18 warheads would still be available for further attacks on US targets.

Launch Mode: silo based; cold launched.
Power Plant: two-stage liquid-propellant.
Guidance: inertial.
Warhead: Mod 5 ten or more MIRVs (each 750 kilotons), Mod 6 one RV (20 megatons).
Dimensions: length 114 ft 10 in, max diameter 9 ft 10 in.
Launch Weight: 440,920 lb.
Performance: max range 6,835 miles. CEP 820 ft.

SS-19 (Soviet designation **RS-18;** NATO "Stiletto")

Although the SS-19 was the latest of the fourth-generation Soviet ICBMs, deployed in 1974–82, more than 50 of its silos have already been converted to take the newer SS-24 Mod 2. In September 1990, about 300 SS-19s remained; but all are expected to be destroyed. This will reduce the number of ICBM types from the seven deployed currently to three or four by the second half of the 1990s and will place more emphasis on mobile systems.

The hot launched SS-19 Mod 3, now deployed, is a light ICBM, comparable in size to USAF's Peacekeeper, with the flexibility to attack targets in Eurasia as well as in the US. Although less accurate than the SS-18, it is reckoned to have significant capability against all but hardened silos.

Launch Mode: silo based; hot launched.
Power Plant: two-stage liquid-propellant.
Guidance: inertial.
Warhead: six MIRVs (each 500 kilotons).
Dimensions: length 88 ft 7 in, max diameter 8 ft 2½ in.
Launch Weight: 198,400 lb.
Performance: range 6,200 miles. CEP 985 ft.

SS-13 (NATO "Savage")

SS-25 (NATO "Sickle")

SS-24 (Soviet designation **RS-22;** NATO "Scalpel")

Designated as the first Soviet fifth-generation ICBM by the US military, the Mod 1 version of the SS-24 typifies the current attention being paid to survivability through weapon system mobility. The latest edition of *Soviet Military Power* states, "The Soviets currently have several garrisons for the rail-mobile SS-24 (Mod 1). This system can roam most of the Soviet rail network, which consists of more than 145,000 km (90,100 miles) of broad-gauge track. The military is involved in all aspects of railroad operations and, in spite of recent rail network problems, would ensure the highest priority is given to the SS-24 train on all routes. The broad area available for deployment of both the SS-24 and SS-25 mobile systems and the use of concealment measures would complicate locating these systems in wartime."

Similar in size to the US Peacekeeper, the rail-mobile SS-24 Mod 1 and road-mobile SS-25 are expected to constitute about two-thirds of the Soviet ICBM force in the future. By September 1990, about 80 SS-24s were deployed, but more than 50 of these were Mod 2s, emplaced in converted SS-19 silos. The accuracy of the system is believed to be better than that of the SS-18 and SS-19, but it is intended for use against only soft or semi-hardened targets.

Launch Mode: rail-mobile (Mod 1) or silo based (Mod 2); cold launched.
Power Plant: three-stage solid-propellant.
Guidance: inertial.
Warhead: up to ten MIRVs (each 300–500 kilotons).
Dimensions: length 72 ft 2 in, max diameter 7 ft 6½ in.
Launch Weight: 198,400 lb.
Performance: max range 6,200 miles. CEP 660 ft.

SS-25 (Soviet designation **RS-12M;** NATO "Sickle")

As the Soviet designation RS-12M implies, Moscow regards this Minuteman-sized ICBM as a variant of the SS-13 (Soviet designation RS-12). This would enable it to conform with the limitations on modernization required by the SALT negotiations. Since the 1989 edition of *Soviet Military Power* was published, the SS-25 force has increased by 100 to about 270. Most operational deployments of the road-mobile missiles are to former SS-20 IRBM bases eliminated under the INF Treaty. At each base, a number of garages with sliding roofs house the system's massive off-road wheeled transporter-erector-launchers; other buildings shelter the mobile support equipment. Advances claimed for the SS-25 include a greater throw-weight and nine times the accuracy of the SS-13, as well as greater survivability, because it is mobile, and an inherent refire capability. SS-11 silos are being deactivated in compensation for SS-25 deployments, which are expected to total 350 by 1992.

Launch Mode: road-mobile, with optional launch from inside garage; cold launched.
Power Plant: three-stage solid-propellant.
Guidance: inertial.
Warhead: single RV (550 kilotons).
Dimensions: length 62 ft 4 in, max diameter 5 ft 7 in.
Launch Weight: 72,750 lb.
Performance: range 6,525 miles. CEP 660 ft.

Submarine-Launched Ballistic Missiles (SLBMs)

SS-N-6 (Soviet designation **R-21;** NATO "Serb")

Under the terms of the SALT I arms agreement, the Soviet Navy is allowed to have 62 SSBNs (nuclear-powered ballistic missile submarines), carrying a total of 950 SLBMs (submarine-launched ballistic missiles). The oldest class of submarines still operational is known to NATO as "Yankee I," of which 34 were built in 1963–74, each with two rows of launchtubes in its hull for 16 SS-N-6 intermediate-range missiles. Although not subject to INF Treaty restrictions, which apply to land-based systems, only 15 still carry a total of 240 missiles. One sank;

the others have been replaced by "Typhoons" and "Deltas" and have had their launchtubes removed. The missiles are of two types:

Mod 1: entered service 1967, with a single warhead. Range adequate to cover the US eastern seaboard as far as the Mississippi and western seaboard to the east side of the Rockies.

Mod 2: as Mod 1, but range increased.

Launch Mode: submarine-launched; intermediate range.
Power Plant: two-stage liquid-propellant.
Guidance: inertial.
Warhead: single RV (one megaton).
Dimensions: length 31 ft 8 in, body diameter 5 ft 5 in.
Launch Weight: 50,700 lb.
Performance: max range (Mod 1) 1,500 miles, (Mod 2) 1,865 miles. CEP 4,265 ft.

SS-N-8 (NATO "Sawfly")

The test ship for this third Soviet SLBM was the one-off "Hotel III," converted to carry six SS-N-8 missiles instead of three SS-N-6s in its large sail. It was followed by 18 "Delta Is," developed from the "Yankee," with a deeper housing for the longer SS-N-8s above its rear casing. To compensate for the added top-weight, the number of missiles was restricted to 12. This was restored to 16 in the four Delta IIs, which have a lengthened hull at the expense of a small speed reduction to 24 knots. This gives a total of 286 SS-N-8s still believed to be operational, all of Mod 2 type, as described.

Launch Mode: submarine-launched; intercontinental range.
Power Plant: two-stage liquid-propellant.
Guidance: inertial, with stellar reference update to improve accuracy over SS-N-6.
Warhead: one RV (one megaton), according to DoD; other sources 2 MRVs (each 800 kilotons).
Dimensions: length 42 ft 6 in, body diameter 5 ft 5 in.
Launch Weight: 66,135 lb.
Performance: max range 5,655 miles. CEP 1,315 ft.

SS-N-17 (NATO "Snipe")

Development of this second-generation Soviet SLBM began in 1967. A "Yankee I" was converted to house 12 SS-N-17s and received the NATO designation Yankee II. It conducted the first test firing in 1974, but the SS-N-17 does not appear to have justified series production, and no more SSBNs were built or converted to carry it. Despite this, it remains at sea in the one Yankee II and is significant as the first Soviet solid-propellant SLBM and the first to carry a post-boost vehicle (PBV) as a step toward MIRVs on later missiles.

Launch Mode: submarine-launched; intermediate range.
Power Plant: three-stage solid-propellant.
Guidance: inertial.
Warhead: nuclear (one megaton).
Dimensions: length 36 ft 3½ in, body diameter 5 ft 5 in.
Launch Weight: 55,115 lb.
Performance: max range 2,425 miles. CEP 4,600 ft.

SS-N-18 (Soviet designation **RSM-50**; NATO "Stingray")

Possibly derived from the SS-N-8, the SS-N-18 was the first Soviet submarine-launched missile to have a MIRV warhead-dispensing system. Its length required an even higher housing above the ship's casing. Testing at sea began toward the end of 1976, following proving tests ashore, and the SS-N-18 was deployed on 14 "Delta III" submarines in 1976–82. Each ship carries 16 missiles, in two rows, making a total of 224 deployed in the 1980s. Some may have been replaced with SS-N-23 "Skiff" SLBMs in a modernization program. Versions currently operational:

Mod 1: armed with three MIRVs.

Mod 3: with seven MIRVs.

The Mod 2, with a single higher-yield reentry vehicle and longer range, is not in service.

Launch Mode: submarine-launched; intercontinental range.
Power Plant: two-stage liquid-propellant.
Guidance: inertial, with stellar reference update.
Warhead: Mod 1 three MIRVs (each 200 kilotons), Mod 3 seven MIRVs (each 100 kilotons).
Dimensions: length 46 ft 3 in, body diameter 5 ft 11 in.
Launch Weight: 74,955 lb.
Performance: max range 4,040 miles. CEP 2,950 ft.

SS-N-20 (Soviet designation **RSM-52**; NATO "Sturgeon")

Largest and heaviest of the current Soviet SLBMs, the SS-N-20 is carried by the formidable "Typhoon" class. The six ships of this class are by far the biggest submarines ever put into service, with a length of 562 ft and displacement of 18,500 tons surfaced, 26,500 tons submerged. Six entered service in 1982–89, but there are suggestions that the Soviet Navy might decide to abandon further Typhoon construction in favor of more Delta IVs. The latest edition of DoD's *Soviet Military Power* refers to these two classes as "thirteen of the most modern, capable platforms carry[ing] MIRVed, long-range SLBMs that eventually may have a hard-target-kill potential against targets in the continental United States."

SS-N-6 (NATO "Serb")

AS-6 (NATO "Kingfish") (Piotr Butowski)

First test firing of the SS-N-20 took place in January 1980 after an eight-year development period. What was intended to be the first series-production, solid-propellant SLBM incurred repeated failures before two successful tests were reported in 1981. Four missiles were launched simultaneously in October 1982, but a new version is said to be at the flight testing stage. Meanwhile, 20 of the current SS-N-20s are carried by each Typhoon in a unique configuration with the launchtubes forward of the sail.

Launch Mode: submarine-launched; intercontinental range.
Power Plant: three-stage solid-propellant.
Guidance: inertial, with stellar reference update.
Warhead: ten MIRVs (each 100 kilotons).
Dimensions: length 49 ft 2½ in, body diameter 7 ft 4½ in.
Launch Weight: 132,275 lb.
Performance: max range 5,150 miles. CEP 1,640 ft.

SS-N-23 (NATO "Skiff")

The fact that this latest Soviet SLBM, first tested in 1983, has liquid propulsion suggests that this is still preferred by that country's submariners. To carry the SS-N-23, six new "Delta IV" ships have been built at Severodvinsk, at the rate of about one a year, with at least four more currently planned. Each carries 16 SS-N-23s inside the conventional type of raised housing aft of the sail. Few reliable details of the missile are yet available, and the following should be regarded as provisional:

Launch Mode: submarine-launched; intercontinental range.
Power Plant: three-stage liquid-propellant.
Guidance: inertial, with stellar reference update.
Warhead: ten MIRVs (each 100 kilotons).
Dimensions: length 45 ft 11 in, body diameter 5 ft 11 in.
Launch Weight: 88,185 lb.
Performance: max range 5,150 miles. CEP 1,640 ft.

Airborne Nuclear Attack and Cruise Missiles

AS-4 (NATO "Kitchen")

As many as 700 Kitchens could still be operational with Soviet air army and naval forces, despite the age of the missile and increasing deployment of AS-15 ALCMs. The original version, first seen on a Tu-22 "Blinder" bomber during the 1961 Aviation Day flyby over Moscow, had inertial guidance and a 350 kiloton nuclear warhead, needing no terminal homing. When an alternative version, with a 2,200 lb high-explosive warhead for antishipping use, was developed in the early 1970s, active radar terminal homing was added. A defense-suppression version, with passive radar homing, has also been reported.

Type: short-range, air-to-surface missile.
Power Plant: liquid-propellant rocket.
Guidance: inertial, or inertial plus active radar homing, or inertial plus passive radar homing.
Warhead: alternative nuclear (350 kilotons) or high-explosive (2,200 lb).
Dimensions: span 9 ft 10 in, length 37 ft 1 in, body diameter 3 ft 3½ in.
Launch Weight: 13,000 lb.
Performance: max speed Mach 4.6, range 185 miles at low altitude, 285 miles at high altitude.
Carried by: Tu-22 "Blinder-B" (one), Tu-22M "Backfire" (one or two), Tu-95 "Bear-G" (two).

AS-6 (NATO "Kingfish")

Kingfish has an airplane configuration very like that of "Kitchen" but is fitted with a solid-propellant rocket motor. It was first photographed under the port wing of a Tu-16K, replacing the bomber's 1961-vintage AS-2 "Kipper" antishipping missile. "Badger-C Mod" carried a Kingfish under each wing, and the same arrangement is standard on the Tu-16K Badger-G Mod. It was expected that the Tu-22M "Backfire" would also progress from Kitchens to Kingfish on the pylons under its wing glove panels, but there is no evidence of this so far. The missile itself began, like Kitchen, with a 350 kiloton nuclear warhead and inertial guidance, requiring no terminal homing. To optimize its accuracy in an antiship role, a second version was developed with an active radar terminal seeker and alternative nuclear or high-explosive warhead. The third variant has a defense-suppression role, with a passive radar seeker that homes on ship- or land-based radars. Deployment is believed to have started in 1973, with about 300 missiles now operationally available.

Type: short-range, air-to-surface missile.
Power Plant: solid-propellant rocket.
Guidance: inertial, or inertial plus active radar homing, or inertial plus passive radar homing.
Warhead: alternative nuclear (350 kilotons) or high-explosive (2,200 lb).
Dimensions: span 8 ft 2½ in, length 36 ft 1 in, body diameter 2 ft 11½ in.
Launch Weight: 12,125 lb.
Performance: max speed Mach 3, range 250 miles.
Carried by: Tu-16K Badger-G Mod.

AS-15 (NATO "Kent")

This air-launched cruise missile (ALCM) has not been shown in published photographs but is believed to be similar in configuration to the smaller US BGM-109 Tomahawk, fired with great success from Navy ships during the Gulf War. Both missiles are turbofan powered, and the AS-15 has a terrain-comparison/inertial guidance system like the Tomahawk's Tercom. Development rounds were tested on the Tu-22M "Backfire" bomber in the late 1970s and early 1980s, but this aircraft is not expected to become an operational carrier of the AS-15. Deployment on the Tu-142 "Bear-H" began in 1984, with six missiles on an internal rotary launcher in each aircraft and with provision for two more under each wing-root. The newer Tu-160 "Blackjack" variable-geometry supersonic bomber has two rotary launchers for a total of 12 AS-15s. When the START arms restrictions come into force, about three-fourths of the Soviet strategic bomber force will consist of Bear-Hs and Blackjacks armed with AS-15s. With the aid of flight refueling, they would have all of Canada and the US within range of their missiles. In a global sense, the AS-15s provide the Soviet attack force with greatly improved capabilities for low-level and standoff attack in both theater and international operations. A submarine-launched version of the missile is designated SS-N-21 "Sampson" by NATO. The SS-CX-4 "Slingshot" GLCM had to be destroyed under the INF Treaty; the accompanying exchange of data provided some of the information that follows.

Type: long-range, air-to-surface missile.
Power Plant: turbofan.
Guidance: inertial with terrain comparison.
Warhead: nuclear (200 kilotons).
Dimensions: span approx 10 ft 10 in, length 23 ft 3½ in, body diameter 1 ft 8 in.
Launch Weight: 3,750 lb.
Performance: speed subsonic, range 1,850 miles. CEP 500 ft.
Carried by: Tu-142 Bear-H, Tu-160 Blackjack.

AS-16 (NATO "Kickback")

The AS-16 short-range attack missile is described by the Soviets as being in the same class as USAF's AGM-69 SRAM. Development is assumed to have begun in the early 1970s, with IOC in about 1978. It became known that 12 are carried as an alternative to six AS-15 ALCMs on each of the Tu-160 "Blackjack's" rotary launchers when former US Defense Secretary Frank Carlucci was shown a Tu-160 at Kubinka Air Base in 1988. The following data are estimated.

Type: short-range, air-to-surface missile.
Power Plant: solid-propellant.
Guidance: inertial.
Warhead: nuclear (200 kilotons).
Dimensions: span 2 ft 11½ in, length 16 ft 5 in, body diameter 1 ft 5¾ in.
Launch Weight: 2,650 lb.
Performance: max speed Mach 3, range 125 miles.
Carried by: Tu-142 "Bear-H," Tu-160 Blackjack.

AS-19

This supersonic cruise missile, with a reported range of 2,000 miles, is being developed as an alternative weapon for "Bear-H" and might also be carried by the Tu-160 "Blackjack." A diagram in DoD's *Soviet Military Power* suggests that it is a sweptwing/swept tail missile, with an overall length of about 40 ft. This would make it much too large to be carried on the standard Soviet rotary launcher, implying an underwing mounting of the kind used for the AS-6 "Kingfish" or AS-4 "Kitchen." DoD comments, "As part of their ongoing development programs, the Soviets likely will integrate advancing technologies like enhanced ranges, lower radar cross sections, and conventional munitions into their new cruise missiles." The AS-19 is expected to become operational in the early 1990s and to be partnered by the similar but submarine-launched SS-N-24.

Surface-to-Air Missiles

SH-01/SH-11 (Soviet designation **UR-96;** NATO "Galosh")

The USSR maintains around Moscow the world's only operational ABM (antiballistic missile) system, to provide a measure of protection for military and civil central command authorities during a nuclear war. Under the terms of the 1972 ABM Treaty with the US, the entire system was updated during the 1980s and became operational in its new form in 1989. Instead of the original 64 reloadable above-ground launchers for SH-01 Galosh exoatmospheric or high-altitude, long-range interceptor missiles, there are now thought to be 36 silo-based SH-11 Modified Galosh, plus up to 64 high-performance silo-launched SH-08 "Gazelle" endoatmospheric missiles, and the multifunctional "Pill Box" radar at Pushkino, north of Moscow. A total of 100 launchers is permitted under the Treaty. The US believes that each launcher has the capability of one refire.

Early Galosh vehicles were paraded through Moscow inside containers about 65 ft long, with one open end, on frequent occasions from 1964. No details of the missiles could be discerned, except that the first stage had four combustion chambers. Galosh and Gazelle are deployed at four original sites to the north and west of Moscow, at Aleksandrov, Klin, Novo-Petrovskoye, and Verena, plus an inner ring of new sites at Kaliningrad, Lytkarino, Mervskino, and Schodna. The large, four-sided Pill Box phased-array radar has many antenna elements that direct the radar beams rapidly with a high degree of tracking accuracy, over 360 degree coverage, to control the missiles. Overall effectiveness is limited by the relatively small number of launchers and reliance on the single Pill Box, but the system provides defense against a limited attack or accidental launch. It could have some use against satellites in low-Earth orbit.

Type: silo-launched, exoatmospheric, antiballistic missile.
Power Plant: three-stage liquid-propellant.
Guidance: command.
Warhead: nuclear (one megaton).
Dimensions: length 65 ft, base diameter 8 ft 5 in.
Launch Weight: 72,750 lb.
Performance: range more than 200 miles.

SH-08 (NATO "Gazelle")

This quick-reaction, high-acceleration interceptor missile is designed to destroy in the atmosphere reentry vehicles that leak through the outer layer of ABM defense. Up to 64 are thought to be silo-based around Moscow, as the second stage of the capital's antiballistic defenses. Gazelle is described as being similar in general configuration to the long-abandoned US Sprint, with a low-yield nuclear warhead. Like the exoatmospheric "Galosh," it is command-guided from the ground via the "Pill Box" phased-array radar at Pushkino. The following data are estimated:

Type: silo-launched, endoatmospheric, antiballistic missile.
Power Plant: solid-propellant.
Guidance: command.
Warhead: nuclear (10 kilotons or less).
Dimensions: length 32 ft 10 in, max diameter 3 ft 3 in.
Launch Weight: 22,000 lb.
Performance: range 50 miles.

SA-2 (Soviet designation **V-750 Dvina;** NATO "Guideline")

First displayed in public in the 1957 parade through Moscow to mark the 40th anniversary of the Russian Revolution, the SA-2 was delivered to 28 countries, in many forms. Its first known operational success was the destruction of Gary Powers's U-2 on May 1, 1960, near

SA-3 (NATO "Goa") (Polish Air Force)

SA-4 (NATO "Ganef")

SA-6 (NATO "Gainful")

Sverdlovsk. The latest firings were in the Gulf War, by Iraq; but the missile's effectiveness has been reduced dramatically by modern airborne countermeasures. Its "Fan Song" radar, with a crew of four to six, operates in target acquisition and automatic tracking modes. It can track up to six targets simultaneously before switching to automatic tracking and missile guidance against the selected target. Unless the SA-2 picks up its narrow UHF line-of-sight guidance beam within six seconds of launch, it will go ballistic. It reaches its maximum velocity at 25,000 ft and has only limited maneuverability against modern tactical aircraft. The number deployed in the USSR has declined from a peak of more than 4,600 in the late 1960s to fewer than 2,400. All are land-transportable on a semitrailer and can be transferred to the standard single-round launcher in 12 minutes. Only the SA-2E version has alternative high-explosive (650 lb) or command-detonated nuclear (15 kiloton) warheads in a more bulbous nose. By the end of this decade, all SA-2s are expected to be replaced by SA-10s.

Type: medium-altitude, transportable, surface-to-air missile.
Power Plant: liquid-propellant sustainer, burning nitric acid–kerosene mix; solid-propellant booster.
Guidance: radio command.
Warhead: high-explosive (430 lb; except on SA-2E), with proximity and/or command fuzing.
Dimensions (SA-2F): length 35 ft 1 in, body diameter (second stage) 1 ft 8 in, wing span (second stage) 5 ft 7 in.
Launch Weight (SA-2F): 5,040 lb.
Performance: max speed Mach 3.5, slant range 21.75 miles, effective ceiling 300–90,000 ft.

SA-3 (Soviet designation **S-125 Neva;** NATO "Goa")

Soviet counterpart of the US Hawk, the SA-3 entered service on its original twin-round launcher in 1961. It was first used in action by a joint Egyptian-Soviet defense network covering the Suez Canal during the closing stages of the 1968–70 Egyptian-Israeli War of Attrition, shooting down five F-4E Phantoms. Like the SA-2, it has since been used in many campaigns, having been exported to 26 nations, including Iraq. It is road-transportable and can be fired from either a twin-round or a four-round semifixed launcher. Reload time on four rails is 50 minutes. The export version is named Pechora, in the Soviet tradition of naming its static and towed surface-to-air missiles after national rivers.

The system's P-15M "Squat Eye" early warning and target acquisition radar has a range of 130 miles; the "Low Blow" radar used for target monitoring and missile control has an acquisition range of 68 miles and a tracking range of 25–52 miles. Six targets can be tracked simultaneously and one or two missiles guided. Production was continuing in 1990, with more than 300 battalion sites still operational in the USSR. (See also Naval SA-N-1.)

Type: low/medium-altitude, transportable, surface-to-air missile.
Power Plant: two-stage solid-propellant.
Guidance: radio command.
Warhead: high-explosive (132 lb), with Doppler radar proximity and contact fuzing. Lethal burst radius 41 ft.
Dimensions: length 20 ft 0 in, body diameter (second stage, max) 1 ft 2½ in, wing span (second stage) 4 ft 0 in.
Launch Weight: 2,095 lb.
Performance: max speed Mach 3.5, slant range 1.5–11.4 miles, effective ceiling 150–60,000 ft.

SA-4 (Soviet designation **9M8 Krug** ["Circle"]; NATO "Ganef")

Since full deployment began in 1969, SA-4 brigades have formed major air defense elements of Soviet armies, with a peacetime strength of three Ganef batteries in each brigade. Deployed normally 6 to 15 miles behind the FEBA, each battery has three SPU twin-round tracked mobile launchers, four Ural 375 TZM transporter/reload vehicles each carrying one missile, and one SSNR "Pat Hand" mobile missile guidance radar. Acquisition range of Pat Hand is 75–80 miles and tracking range, at which a single missile can be launched, 50–56 miles. The radar can guide two missiles to a single target, if required. Reload time for the SPU is 10–15 minutes.

At least four variants of the SA-4 were built. Major current versions, often mixed in a battery, are as follows:

9M8M1 (SA-4A): 1967 version, with overall length of 28 ft 10½ in; slant range 5–34 miles; effective ceiling 330–88,600 ft.

9M8M2 (SA-4B): 1973 version, with shorter nose; improved close-range performance at expense of max range and effective ceiling.

In 1990 some 1,300 SA-4 SPUs were operational with the Soviet forces, and others with the Warsaw Pact armies of Bulgaria, Czechoslovakia, East Germany, and Hungary. Replacement with SA-11 and SA-12A brigades was under way in the USSR at army and front level. All elements of the SA-4 system are air-transportable in An-22 and An-124 military freighters. *(Data for SA-4B follow.)*

Type: medium/high-altitude, air-transportable, surface-to-air missile system.
Power Plant: ramjet sustainer, burning kerosene; four wraparound solid-propellant boosters.
Guidance: radio command, with semiactive radar terminal homing.
Warhead: high-explosive (300 lb), with proximity fuzing.
Dimensions: length 27 ft 3 in, body diameter 2 ft 10 in, wing span 7 ft 6½ in.
Launch Weight: approx 5,500 lb.
Performance: max speed Mach 2.5, slant range 0.7–31 miles; effective ceiling 330–78,750 ft.

SA-5 (Soviet designation **S-200 Volga;** NATO "Gammon")

The SA-5 was developed in the 1950s to destroy such new generations of high-performance aircraft as the B-70 strategic bomber. Production was continued after the B-70 cancellation, and the Soviet Union's 8,000 home defense missiles are believed to include about 1,950 SA-5s at 130 sites. Others have been exported to East Germany (now being deactivated), North Korea, Libya, Poland, and Syria. The Soviet missiles are deployed in Air Defense Rocket Brigades, made up of battalions of SA-3 and SA-5 launchers, plus 23-mm or 57-mm antiaircraft guns. Each SA-5 battalion has a 200 mile range P-35M "Barlock-B" target search and acquisition radar with integral IFF, a 165 mile range "Square Pair" missile guidance radar, and six single-rail missile launchers. There have been three or four versions of the SA-5, as follows:

SA-5A: initial production version, operational from 1966.

SA-5B: as SA-5A, but with nuclear warhead. Entered service 1969–70.

SA-5C: as SA-5B, but with improved terminal guidance and alternative nuclear or conventional warhead. Standard version from 1975–76.

SA-5E: reported antiradiation version with passive seeker for use against electronic warfare aircraft.

Over the years, SA-5s have been launched against USAF SR-71s, without success. No better results were achieved by Libya against US aircraft equipped with ECM and armed with AGM-88 HARMs (high-speed antiradiation missiles) in March–April 1986.

Type: medium/high-altitude, surface-to-air missile, fired from single-rail static launcher.
Power Plant: storable liquid-propellant sustainer; four wraparound solid-propellant boosters.
Guidance: command, with active radar terminal homing.
Warhead (SA-5C): nuclear (25 kilotons) or high-explosive, with proximity and command fuzing.
Dimensions: length 35 ft 2 in, body diameter 2 ft 9½ in, wing span 9 ft 4 in.
Launch Weight: 17,415 lb.
Performance: max speed above Mach 4, slant range 155 miles, effective ceiling 1,000–100,000 ft.

SA-6 (Soviet designation **9M9 Kub** ["Cube"]; NATO "Gainful")

Although development of this self-propelled tactical weapon system was started in 1959, it was not displayed on its three-round tracked transporter-erector-launcher (TEL) until the annual military parade through Red Square in November 1967. In its basic SA-6A form, it was first used in action by Egypt, destroying about 20 Israeli aircraft during the 1973 war. Its unique integral solid rocket/ramjet propulsion system was a decade ahead of comparable Western technology, and the US-supplied ECM that enabled Israeli aircraft to survive attack by other missiles proved ineffective against the SA-6. Currently, the USSR has about 850 SA-6 three-round TELs, deployed in antiaircraft regiments at divisional level. Each regiment consists of an Hq. with EW and height-finding radars, and five SA-6 batteries. Each battery has an SSNR "Straight Flush" fire-control radar, mounted on the same kind of tracked chassis as the TEL; four SA-6 TELs; and two ZIL 131 TZM reload vehicles, each carrying three missiles. Straight Flush has a detection/acquisition range of 34–46 miles and 32,800 ft altitude capability. It performs IFF interrogation, target tracking and illumination, and missile radar command guidance functions. The missile is capable of sustained 15*g* maneuvers.

Pending availability of the new SA-11 "Gadfly" weapon system, one of the original **SA-6A** TELs in some batteries was replaced with a TELAR (transporter-erector-launcher and radar) with added SA-11 "Fire Dome" engagement radar. This overcame an earlier shortcoming by enabling two targets to be engaged simultaneously by such a battery. The TELAR carries modified **SA-6B** missiles. Export SA-6 systems are known as **Kvadrat** ("Quadrant") and are used by 19 nations.

Type: low/medium-altitude, mobile, surface-to-air missile system.
Power Plant: solid-propellant booster; after burnout, its empty casing becomes a ramjet combustion chamber for ram air mixed with the exhaust from a solid-propellant gas generator.
Guidance: radar command; semiactive radar terminal homing.
Warhead: high-explosive (123 lb), with proximity and contact fuzing. Lethal burst radius 16 ft.
Dimensions: length 18 ft 9 in, body diameter 1 ft 1.2 in, wing span 4 ft 1 in.
Launch Weight: 1,320 lb.
Performance: max speed Mach 2.8, slant range 1.8–15 miles, effective ceiling 330–36,000 ft.

SA-7 (Soviet designation **9M32 Strela-2** ["Arrow-2"]; NATO "Grail")

This shoulder-fired passive infrared homing missile is comparable in many respects with its first-generation US contemporary, the FIM-43 Redeye. It was designed to be tube-launched by infantry, to offer protection against relatively slow battlefield support aircraft and helicopters. Shortcomings of the initial **SA-7A** Grail were that it could be fired only from behind a target at a very hot exhaust area, over a narrow field of fire, and tended to home on the sun if pointed within 20° of that heat source. Solar reflection from clouds or heat from sun-exposed rocks could guide it astray, limiting its usefulness against low-flying aircraft. In 1971, the improved **SA-7B** Grail Mod 1 (Soviet **9M32M Strela-2M**) entered service, with an extended field of fire of 30° each side of the target's tail, a seeker able to filter out spurious heat sources, including early IR decoys and flares, and an improved warhead. The operator could also have a small passive RF antenna fixed to his helmet, to provide audible warning of an approaching aircraft by picking up emissions from its radar and radar altimeter. In this form, Grail achieved modest successes when used by Egypt against Israeli aircraft and a number of kills against US aircraft in Vietnam. Since then, Grail has been supplied to about 55 nations and more than 25 guerrilla/terrorist movements worldwide. Major version since the mid-1970s has been the **SA-7C** Grail Mod 2, with improved launcher and more effective RF detector mounted forward of the gripstock. The second member of a Soviet army SA-7 team carries a reload missile.

The SA-7 is also carried by vehicles, including ships, in batteries of four, six, and eight, for both offensive and defensive employment, with radar aiming. Some are deployed on helicopters for air-to-air combat use.

Type: low-altitude, man-portable, surface-to-air missile system.
Power Plant: solid-propellant booster/sustainer.
Guidance: infrared passive homing.
Warhead: high-explosive (2.5 lb), with contact and graze fuzing.
Dimensions: length 4 ft 8¾ in, body diameter 2.83 in.
Launch Weight: 21.7 lb. Launcher: 10.9 lb.
Performance: max speed Mach 1.7, slant range 0.5–2.6 miles, effective ceiling 165–7,550 ft.

SA-8 (Soviet designation **9M33 Romb** ["Diamond"]; NATO "Gecko")

First displayed in a 1975 military parade through Moscow, the SA-8 is an all-weather, low-altitude SAM, intended to fill the gap between the SA-7/SA-9 and the SA-6. Like the SA-4 and SA-6, it is categorized as a ZRK-SD complete and integral missile system able to self-deploy over medium ranges. It was the first Soviet tactical air defense weapon system in which all components necessary to conduct a target engagement are carried by a single vehicle. In the original **SA-8A** Gecko Mod 0 (Soviet designation **9M33**), two pairs of exposed missiles were carried, ready to fire; the later **SA-8B** Gecko Mod 1 (typically **9M33M3**) system has six missiles in launcher/containers. Fire-control equipment and launcher are mounted on a rotating turret, carried by a BAZ-5937 six-wheel, fully amphibious, all-terrain vehicle. The "Land Role" fire-control radar, to the rear of the one-man gunner–radar operator's position, has a 360° scan over a 22 mile range. It folds down behind the launcher, enabling the weapon system to be airlifted by Soviet transport aircraft. Range of the monopulse tracking radar is 15.5 miles. Each vehicle carries up to six reload missiles.

Together with the SA-6, Gecko has largely replaced S-60 57-mm towed antiaircraft guns in Soviet service. Five batteries are deployed with each divisional antiaircraft regiment. A battery comprises, in peacetime, four BAZ-5937 launch vehicles and two TZM reload vehicles, supported by 24 ZIL 131 trucks to serve as missile transporters. More than 1,000 systems are operational with the Soviet armies; others serve in 15 countries, including Iraq, Jordan, Libya, and Syria. *(See also SA-N-4.)*

Type: low-altitude, self-contained, mobile surface-to-air missile system.
Power Plant: dual-thrust solid-propellant.
Guidance: radar command, permitting two missiles to be guided simultaneously against a single target, on different frequencies to complicate ECM.
Warhead: high-explosive (42 lb), with proximity fuzing. Lethal burst radius 16 ft.
Dimensions: length 10 ft 4 in, body diameter 8.26 in, fin span 2 ft 1¼ in.
Launch Weight: 286 lb.
Performance: max speed Mach 2.4, slant range 0.9–6.2 miles, effective ceiling 82–16,400 ft.

SA-9 (Soviet designation **9M31 Strela-1** ["Arrow-1"]; NATO "Gaskin")

After more than 20 years of service, with 23 armies and two guerrilla forces, this mobile amphibious weapon system is being replaced in the USSR with the SA-13. It comprises a BRDM-2 four-wheel vehicle carrying a box launcher for two pairs of infrared homing solid-propellant missiles in place of the normal turret. The launcher rests flat on the rear of the vehicle when not required to be ready for action. Four reload rounds are stowed in the BRDM-2. Sixteen SA-9 transporter-erector-launchers (TELs) equip each Soviet division, in four batteries, together with ZSU-23-4 tracked self-propelled antiaircraft gun systems, with four 23-mm guns. Surveillance is provided by a "Dog Ear" radar vehicle, supplemented by "Hat Box" passive radar antennas on one TEL in each battery. Early **SA-9A** Gaskin Mod 0 **(9M31)** missiles were followed by **SA-9B** Gaskin Mod 1 **(9M31M)** with improved cooled seeker and longer range. *(Data for SA-9B).*

Type: low-altitude, mobile, surface-to-air missile system.
Power Plant: dual-thrust solid-propellant.
Guidance: infrared passive homing.
Warhead: high-explosive (5.75 lb), with proximity fuzing. Lethal burst radius 5 ft.
Dimensions: length 5 ft 11 in, body diameter 4¾ in, wing span 1 ft 2¾ in.
Launch Weight: 66 lb.
Performance: max speed Mach 1.5, slant range 0.35–5 miles, effective ceiling 32–20,000 ft. Range is reduced considerably in head-on engagement.

Libyan Army SA-6* Kvadrat *(export version)

SA-8 (NATO "Gecko") (TASS)

SA-10 (NATO "Grumble")

Last year's "Gallery of Soviet Aerospace Weapons" in AIR FORCE Magazine stated that "some 15 percent of Soviet strategic SAM launchers carry the highly efficient all-altitude SA-10, which offers major advantages compared with systems such as the SA-1 and SA-2 that it is replacing." The latest edition of DoD's *Soviet Military Power* updates the figure to 25 percent, adding that the SA-10 is also replacing the SA-3, improving the Soviet Union's air defense capabilities against low-flying aircraft and cruise missile attacks. Deployment of the fixed-base **SA-10A** Grumble Mod 0 began in 1980, with about one-third of the first 150 launch units stationed around Moscow, suggesting a priority on terminal defense of command and control, military, and key industrial complexes. Each unit has ten four-rail launchers, representing impressive firepower. The track-via-missile (TVM) system guidance, like that of the US Patriot, with active radar terminal seeker, means that several SA-10s can be airborne simultaneously from any battery, each with a different target. Like Patriot, they should be able to destroy reentry vehicles from ballistic missiles in the class of the Scuds used by Iraq in the Gulf War.

For improved survivability, the Soviets are also deploying the land-mobile **SA-10B** Grumble Mod 1 version on four-axle, four-round TELs based on the MAZ-7910 vehicle. Reload missiles and a "Flap Lid B" planar array target tracking and fire-control radar are carried on basically similar trucks. The Soviet Navy uses a similar missile as the main defensive armament of *Kirov*-class nuclear powered battle cruisers. Exports of the SA-10A began with sufficient systems to equip two battalions of the Bulgarian army. *(See also SA-N-6.)*

Type: all-altitude, fixed site and mobile surface-to-air missile system.
Power Plant: single-stage solid-propellant.
Guidance: radar command, with semiactive radar terminal homing.
Warhead: high-explosive (200–285 lb) or low-yield nuclear.
Dimensions: length 23 ft 0 in, body diameter 1 ft 5¾ in, wing span 3 ft 3½ in.
Launch Weight: 3,300 lb.
Performance: max speed Mach 6, range 1.85–62 miles, effective ceiling 80–98,500 ft.

SA-11 (NATO "Gadfly")

Together with the SA-12, this weapon system is replacing the SA-4 in army-level missile brigades and some SA-6s at divisional level, for defense against high-performance aircraft and cruise missiles at low to medium attitudes. The SA-11 system is self-contained on a GM-569 tracked vehicle, which carries a 360° traversing four-rail launcher and "Fire Dome" monopulse guidance and tracking radar. The missile resembles the US Navy's Standard MR1 RIM-66 in general appearance and can sustain 23*g* maneuvers.

An SA-11 regiment is made up of five batteries, each with four TELs and similar GM-569 vehicles carrying "Tube Arm" early warning and acquisition radars and reload missiles. The same chassis is also used to carry the regiment's long-range early warning radar. If this is not available, the SA-11 TELs can be integrated into an SA-6 battery, using the latter's "Straight Flush" fire-control radar. Non-Soviet operators of this system include India, Poland, Syria, and Yugoslavia.

Type: low/medium-altitude, mobile, surface-to-air missile system.
Power Plant: solid-propellant.
Guidance: semiactive monopulse radar command.
Warhead: high-explosive (198 lb).
Dimensions: length 18 ft 4½ in, body diameter 1 ft 3¾ in, wing span 3 ft 11¼ in.
Launch Weight: 1,433 lb.
Performance: max speed Mach 3, slant range 1.85–17.5 miles, effective ceiling 100–46,000 ft.

SA-12A (NATO "Gladiator")

Deployment of this formidable land-mobile tactical missile system began in 1986 to supersede the aging SA-4. The total number currently operational is unknown, but several dozen launchers were stationed with Soviet army units in East Germany before reunification. They appear to exist in two slightly different forms, to engage aircraft and tactical ballistic missiles in the class of the US Lance, respectively. All components of the SA-12A system are based on the tracked MT-T chassis, a derivative of the T-64 main battle tank. The three batteries of an SA-12A battalion each have three transporter-erector-launchers (TELs), a "Grill Pan" fire-control vehicle, and a reload transporter. The main "Bill Board" long-range target search and acquisition radar vehicle and additional reload transporters are held at battalion Hq. level. Three battalions make up a brigade, with further Bill Boards assigned to Hq.

Each TEL carries two missile container/launchers that can be raised independently to a vertical position for launch and a telescopic missile guidance radar. The latter is believed to control the missile in flight after its target has been tracked and handed on by Grill Pan.

Type: all-altitude, mobile, surface-to-air missile system.
Power Plant: two-stage solid-propellant.
Guidance: semiactive radar command.
Warhead: high-explosive (330 lb).
Dimensions: length 23 ft 7½ in, body diameter 1 ft 7¾ in, wing span 4 ft 5 in.
Launch Weight: approx 4,400 lb.
Performance: max speed Mach 3, slant range 3.4–50 miles, effective ceiling 2,950–98,400 ft.

SA-12B (NATO "Giant")

This considerably scaled-up derivative of the SA-12A was conceived as part of the rail-mobile SS-24 Mod 1 "Scalpel" ICBM system. Its MT-T two-round tracked TELs were to be carried on low-loader railcars. After the ICBM train emerged from its tunnel concealment to move to its launch area, the SA-12Bs were intended to disperse into the surrounding area to defend the Scalpel launchers from attacking enemy aircraft and strategic missile reentry vehicles. Such a use, capable of nationwide deployment, would contravene the terms of the ABM Treaty, and the present status of the SA-12B program is not known. DoD reported that it had reached flight test status by 1987.

Type: all-altitude, mobile, surface-to-air missile system.
Power Plant: two-stage solid-propellant.
Guidance: radar command, with active homing.
Warhead: unknown.
Dimensions: length 34 ft 5½ in, body diameter 3 ft 3½ in.
Performance: max slant range 62 miles.

SA-13 (Soviet designation 9M37 Strela-10 ["Arrow-10"]; NATO "Gopher")

This tracked mobile weapon system entered service in 1977, and more than 1,200 are reportedly operational with the Soviet army and naval infantry. The missiles are carried in two twin-box launchers on transporter-erector-launcher and radar (TELAR) vehicles of two types. The only apparent difference is that TELAR-1 has four "Hat Box" passive radar detection antennas on its upper surface; TELAR-2 has none. It is suggested that TELAR-1 is used only by the battery commander. High-readiness tank and motorized rifle divisions of the army have four air defense battalions, each with six SA-13 TELARs and six ZSU-23-4 antiaircraft gun systems, the SA-13s having replaced SA-9s one for one. Eight reload missiles are normally carried by each of the vehicles, which are fully amphibious. The associated "Dog Ear" acquisition/tracking radar vehicle of the SA-9 is retained.

There are two versions of the missile. That known as **9M37** has an all-aspects, cryogenically cooled, infrared seeker that is highly resistant to such countermeasures as flares and decoy pods. The later **9M37M** has a further-enhanced seeker. Exports have been made to 13 countries, with production continuing.

Type: low-altitude, mobile, surface-to-air missile system.
Power Plant: solid-propellant.
Guidance: infrared passive homing. TELAR has range-only radar.
Warhead: high-explosive (13 lb).
Dimensions: length 7 ft 2½ in, body diameter 4¾ in, wing span 1 ft 3¾ in.
Launch Weight: 121 lb.
Performance: max speed Mach 1.8, slant range 0.3–3.1 miles, effective ceiling 33–11,500 ft.

SA-14 (Soviet designation Strela-3 ["Arrow-3"]; NATO "Gremlin")

This development of the SA-7 shoulder-fired SAM concept entered service with the Soviet army in 1978, replacing the earlier weapon one for one. It is also used by naval infantry and by 13 other nations. Compared with the SA-7, it has an uprated rocket motor, a more powerful warhead, and a cryogenically cooled IR seeker with proportional guidance that is effective in head-on as well as tail-chase firings and against targets maneuvering at up to 8*g*. Effectiveness against targets equipped with flare dispensers and IR jammers is claimed to be much enhanced. A passive RF direction finder antenna system is optional. *(See also SA-N-8.)*

Type: low-altitude, man-portable, surface-to-air missile system.
Power Plant: solid-propellant booster/sustainer.
Guidance: infrared passive homing.
Warhead: high-explosive (4.4 lb), with contact and graze fuzing.
Dimensions: length 4 ft 7¼ in, body diameter 2.95 in.
Launch Weight: 21.8 lb. Launcher: 13.4 lb.
Performance: max speed Mach 1.76, slant range 0.37–3.7 miles, effective ceiling 33–18,000 ft.

SA-15

Known currently only by its NATO designation of SA-15, this mobile SAM is being deployed to replace the SA-8 "Gecko." Few details are available, except that the missile is thought to be similar to that used in the Soviet Navy's SA-N-9 system. About 20 launchers were reportedly operational by the beginning of this year, on modified GM-569 tracked vehicles. The following data are provisional:

SA-16* Igla *("Needle")

SA-N-1 (NATO "Goa")

Type: low/medium-altitude, mobile, surface-to-air missile system.
Power Plant: dual-thrust solid-propellant.
Guidance: radar command, supplemented by TV/IR trackers in heavy jamming or ECM environment, and active radar homing.
Warhead: high-explosive (33 lb).
Dimensions: length 11 ft 6 in, body diameter 7.87 in, wing span 2 ft 0 in.
Launch Weight: 375 lb.
Performance: max speed Mach 3, max slant range 5–7.5 miles, effective ceiling 60–59,000 ft.

SA-16 (Soviet name Igla ["Needle"])

This third-generation, shoulder-fired, surface-to-air missile, together with the self-propelled 2S6 antiaircraft weapon system (see SA-19), is replacing the earlier SA-7, SA-14, and ZSU-23-4 gun system. It seems to have entered service in about 1981 and has been used operationally by Angola and Iraq. The system deployment time is 13 seconds, and launch time from target acquisition is five seconds. Guidance is by proportional navigation, and the cooled IR seeker improves resistance to countermeasures. Maximum bearing angle for launch is ±40°.

Type: low-altitude, man-portable, surface-to-air weapon system.
Power Plant: dual-thrust solid-propellant.
Guidance: infrared passive homing.
Warhead: high-explosive (4.4 lb), with contact and graze fuzing.
Dimensions: length 5 ft 1 in, body diameter 3.15 in.
Launch Weight: 23.8 lb. Launcher: 9.25 lb.
Performance: average speed Mach 1.68, slant range 0.37–3.1 miles, effective ceiling 33–11,500 ft.

SA-17

Intended to supersede the SA-11 "Gadfly," this new low/medium-altitude SAM was identified by NATO in 1986–87 and is expected to achieve initial operational status during the coming year. It has a similar configuration to the SA-11 and is based on the same GM-569 tracked vehicle. A major innovation is a new surveillance radar known to NATO as "Snow Drift," also carried on a modified GM-569, which replaces the SA-11's "Tube Arm."

SA-18

First mentioned in the 1990 edition of DoD's *Soviet Military Power,* this fourth-generation, shoulder-fired, surface-to-air missile is described as "highly capable." It is said to embody Western technology.

SA-19

This tube-launched missile was developed as one element of the armament of the 2S6 gun/missile tracked regimental air defense vehicle, which entered service in 1986. Eight SA-19s are mounted in clusters of four on each side of the turret that carries four 30-mm cannon. They are believed to be similar to the Soviet Navy's SA-N-11, installed on the battle cruiser *Kalinin.* The following details should be regarded as provisional:

Type: tube-launched, low/medium-altitude, surface-to-air missile.
Power Plant: solid-propellant.
Guidance: possibly semiactive laser or infared homing.
Warhead: high-explosive (17.6 lb).
Dimensions: length 6 ft 6¾ in, body diameter 5.9 in.
Launch Weight: 66 lb.
Performance: speed hypersonic, max range 4.3–6.2 miles.

Naval Surface-to-Air Missiles

SA-N-1 (Soviet designation M1 Volga-M; NATO "Goa")

Ship-launched variant of SA-3, carried on roll-stabilized twin-launcher by 42 destroyers and cruisers of the Soviet Navy from 1961. Data for the current SA-N-1B (Goa Mod 1) are similar to those given for the SA-3.

SA-N-3 (NATO "Goblet")

Goblet is the only surface-to-air missile known to have been developed exclusively for use by the Soviet Navy. More effective than the SA-N-1, it is carried by larger vessels, including the *Kiev*-class carrier/cruisers, helicopter cruisers *Moskva* and *Leningrad,* and *Kara* and *Kresta II* cruisers. Compared with the original **SA-N-3A** Goblet Mod 0 version, the **SA-N-3B** Goblet Mod 1 has internal improvements and greater range but is otherwise similar. Both versions are fired from a twin launcher and have a secondary antiship capability.

Type: short-range, shipborne, theater defense missile.
Power Plant: dual-thrust solid-propellant.
Guidance: radar command, with semiactive homing.
Warhead: high-explosive (176 lb).
Dimensions: length 20 ft 0 in, body diameter 1 ft 11½ in.
Launch Weight: 1,863 lb.
Performance: slant range 1.85–18.5 miles (SA-N-3A), 1.85–34 miles (SA-N-3B), effective ceiling 330–82,000 ft.

SA-N-4 (NATO "Gecko")

More than 123 Soviet Navy ships, of 14 classes, are fitted with this close-range surface-to-air missile system. The retractable twin-round "pop-up" launcher is housed inside a bin below deck. The missiles are similar to those used in the land-based mobile SA-8B system.

SA-N-5 (NATO "Grail")

Approximately 200 small Soviet Navy ships have this simple air defense system, which consists of four SA-7 Grail launchtubes in a framework that can be slewed for aiming.

SA-N-6 (NATO "Grumble")

Operational for more than a decade, this system was developed simultaneously with the land-based SA-10 and uses the same basic missile. It is assumed to deal with the same multiple threats as the US Navy's AEGIS area defense system. However, it is doubtful if the SA-N-6 could intercept sea-skimming cruise missiles of low radar cross section. This may explain why it is partnered by the smaller SA-N-9 system in later ships of the *Kirov* class. Standard *Kirov* installation comprises 12 vertical launchtubes under the foredeck, with a total of 96 missiles. *Slava*-class cruisers have eight launchtubes and 64 missiles. The *Kara*-class *Azov,* used as a trials ship for the SA-N-6 system, has six launchtubes and 24 missiles. Data are as for the SA-10.

SA-N-7 (NATO "Gadfly")

Each ship of the *Sovremennyy* class of guided missile destroyers has two single-rail launchers for this missile, which was developed in parallel with its land-based counterpart, the SA-11. A total of 44 SA-N-7 missiles is carried, with 22 in each magazine. The sophistication and rapid-fire potential of the weapon system are indicated by the requirement for six associated "Front Dome" fire-control/target illuminating radars on each ship. Missile data are as for the SA-11.

SA-N-9

In addition to the SA-N-4 and SA-N-6 surface-to-air missile systems installed in the battle cruiser *Kirov,* its sister ships are each armed with a total of 128 shorter-range SA-N-9 missiles. These are distributed between two rows of four vertical launchers, on each side of the stern helicopter pad, and two rectangular groups of four launchers on the forecastle. The same system is carried by *Udaloy*-class antisubmarine ships (each eight vertical launchers, 64 missiles), and the carrier/cruisers *Novorossiysk* and *Baku* (24 vertical launchers, 96 and 192 missiles, respectively). The new carriers of the *Admiral Kuznetsov* (former *Tbilisi*) class also have four sextuple launchers and 192 missiles. SA-N-9 missile data are as for the SA-15.

SA-N-10

This new close-in surface-to-air missile system is installed on the naval missile range ship *Kapusta.* The four quadruple launchers differ from that used for the SA-N-5 by being reloaded automatically instead of by hand. The missile is believed to be similar to the army's SA-14 "Gremlin." ■

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Recalling the short pants, the fifty-mission crush, the cowboy boots, the US brass flap, and more.

The Sartorial Splendor of the Air Force That Was

By Bruce D. Callander

SOME thirty-five years before US forces were ordered to the Persian Gulf, the Air Force unveiled the uniform for just such a parched environment. Fortunately for the troops in Operation Desert Storm, it had a mercifully short life.

The Air Force's original idea was to allow short pants as a clothing option. What emerged in the 1950s, however, was a full tropical wardrobe, complete with Bermuda shorts, knee-length socks, bush jacket, and optional pith helmet.

When freshly pressed, the outfit didn't look bad on the models in the uniform manual. In the field, particularly on stocky men with knobby knees, it looked ludicrous. Noncoms fumed that the outfit made them look like oversized Boy Scouts. Wives said that, just to keep it presentable, it had to be washed and ironed every night. Several generals said they wouldn't be caught dead in the thing. After going through a brief trial run, the Air Force gave the outfit a decent burial.

Ironically, that ill-fated uniform had grown out of the Air Force's effort to correct the unmilitary state of dress that had prevailed in the old Army Air Forces. As one general officer put it, "the exigencies of war and undesirable practices have permitted officers to deviate from a prescribed uniform to the point where they have been designing their own and the name 'uniform' has lost much of its meaning."

That trend began long before World War II. From the beginning of military aviation, flyers outfitted themselves in ways that distressed their ground-bound superiors. In a sense, the "aviator look" had become a metaphor for their struggle for independence.

It hadn't begun as a revolt. The first airmen simply wanted something practical to wear in their open-frame aircraft. The old Army uniform, with leg-hugging breeches and high-necked blouse, was adequate to a point, but it had its limitations. In warm weather, many preferred light civilian clothes. In the cold, they piled on sweaters, hunting jackets, and even fur coats.

Bugs and Goggles

Flying posed unique hazards, such as colliding with flying bugs and being pitched out of the machine head first. To guard against these perils, pilots adopted the goggles used by race drivers and the helmets worn by football players and motorcyclists. Soon civilian garment makers were offering a full line of gear designed specifically for aviators. What the Army didn't buy for them, military flyers bought on their own.

On the ground, airmen conformed fairly well to regulations. By World War I, however, they were mixing bits of flight gear with their service uniforms. In combat zones, at least, the Army chose not to notice if a pursuit pilot wore his flight boots and woolen muffler into the mess.

Even the regulation uniform took on a distinctive, if not always legal, Air Service flavor. By 1917, insignia makers were bootlegging collar insignia with a winged propeller superimposed on the crossed flags of the Signal Corps. These became so popular that the Army authorized them. By war's end, the flags were gone altogether and only the winged propeller remained, later to become the official Air Corps insignia.

The Air Service approved silver wings for pilots, ob-

In 1955, the Air Force introduced its new summer uniform (above, getting a second look from conventionally dressed airmen at MacDill AFB, Fla.). In addition to the shorts and pith helmet, options included a bush jacket and long pants, but the look never really caught on.

servers, and balloonists. Those who flew with British or French forces wore their foreign wings as well. Some mixed RAF flight caps and blouses with their US uniforms. Others, including Capt. Eddie Rickenbacker, wore pins bearing the emblems of their wartime squadrons.

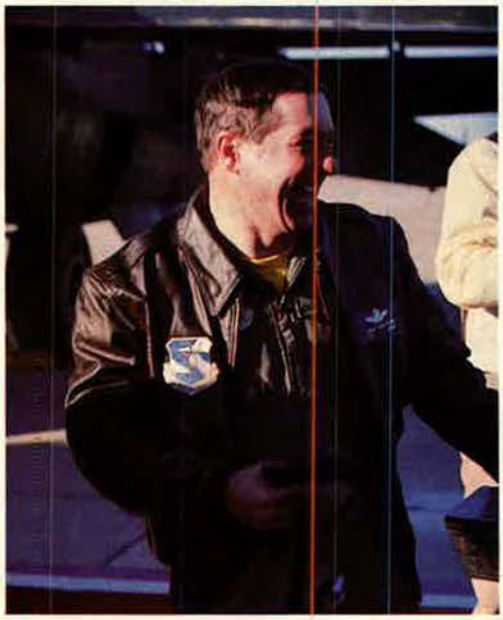
Between the wars, pilots continued to fly in whatever mixture of military and civilian clothing served the purpose. On the Army's 1926 goodwill flight to Latin America, Capt. Ira Eaker landed in Rio de Janeiro in helmet, goggles, and shorts. Three years later, when *Question Mark* set a week-long endurance record, Captain Eaker and other crew members wore plus fours, baggy knickers favored by golfers.

When enclosed cockpits gave flyers something like a shirtsleeves environment, they were more willing to fly in prescribed uniforms. In the early 1930s, the Air Corps introduced a light, horsehide jacket that created a whole new set of problems. The aviators fell in love with the A-2 jacket, and the Army spent the next decade trying to convince them it wasn't part of the service uniform. (The jacket was retired after World War II, but it made a comeback in the 1980s, not only in the Air Force but also in the civilian market. It sold for $17 during World War II. Replicas now cost up to $250.)

By 1939, the Army Air Forces had authorized an array of distinctive insignia. Besides their lapel pins, AAF members could wear the patch of the Air Corps on one shoulder and that of a numbered air force on the other. More than a dozen types of wings existed. There were sleeve patches for aviation specialists and dangling badges for mechanics and technicians. The uniform was still Army, but the adornments made it unmistakably AAF.

Still, some airmen, particularly aircrew members, felt compelled to make their own fashion statements—for example, with footwear. Some favored high-heeled cowboy boots, pants legs stuffed into tops. Others, flying the southern route overseas, picked up gaudy gaucho boots in Brazil. Still others "borrowed" jump boots from paratroopers or thick-soled brogues from British colleagues. Everything from sandals to sneakers was acceptable—so long as it wasn't government issue.

The A-2 jacket remained the outer garment of choice for almost all occasions until Gen. Dwight Eisenhower appeared in a British-style, waist-length blouse. Before the Army could made the Ike jacket official, airmen were having local tailors chop the tails from regulation blouses and turn them into stylish, if not always authentic, copies. With wings, shoulder patches, and even combat ribbons embroidered into the fabric, some creations were works of art. Others were surrealistic nightmares.



Lt. James Goodson, far left, sports two wildly popular looks of the 1930s and 1940s: the fifty-mission crush and the A-2 jacket. The new blue cap introduced in 1949 resisted the crush, but the jacket, retired after World War II, made a comeback in the 1980s. At near left is F-111 pilot Lt. Col. John Plantikow, wearing his A-2 jacket in 1981.

The "Fifty-Mission Crush"

Flyers took even more outrageous liberties with the AAF headgear known officially as the garrison cap. The desired look was the "fifty-mission crush," attained by spending long hours aloft with radio earphones clamped over the crown of the hat. In practice, most combat flyers spent so much time in helmets and oxygen masks that their caps didn't see that much wear, at least not enough to become authentically "crushed." To achieve the desired raunchiness, therefore, caps had to be conditioned.

One wartime service journal prescribed six steps for speeding the process: Remove metal stiffener; soak cap overnight, in sea water if available; stuff with folded towel and wrap with string; leave cap in direct sunlight until only slightly damp; remove string and stuffing and wear until dry; for added character, sprinkle with light engine oil and run over with Jeep.

Ground officers, particularly those from the prewar Army, shuddered at such desecration. But what could they do when such senior generals as Jimmy Doolittle, "Tooey" Spaatz, and "Hap" Arnold were wearing the same disreputable headgear?

Stateside discipline was tighter, but the flyers still managed to cut a distinctive figure. The most popular uniform for AAF officers was the Army's standard "pinks and greens," an olive-drab blouse or battle jacket with gray trousers of a slightly reddish cast. Embellished with wings, shoulder patches and other adornments and crowned with a well-crushed cap, the outfit fairly sang of "the wild blue yonder."

When the Air Force gained independence in 1947, members still wore the uniforms of their "brown shoe" days. Air leaders two years earlier had begun planning a separate USAF wardrobe, but their efforts were slowed by disagreements and other problems.

In one early effort at consensus, Brig. Gen. William Hall, then deputy assistant chief of the Air Staff, issued a lengthy memo offering various possibilities for discussion. For color, his shop favored dark gray but offered such alternatives as medium green, cocoa, and sapphire blue.

General Hall also proposed a duty uniform with a short battle jacket and a dress outfit with a single- or double-breasted blouse. The double-breasted model, he noted, would hide a protruding stomach, while the single-breasted would add an illusion of height. He suggested Navy-style rank stripes for officers. For enlisted men, he favored chevrons that wrapped halfway around the sleeve. Otherwise, he said, the uniforms should be identical for all ranks.

No Identical Uniforms

Other staff officers disagreed, to put it mildly. Some wanted a two-tone outfit like the old pinks and greens. Most vetoed the proposed rank insignia. Brig. Gen. Francis Griswold, another deputy assistant, flatly rejected the idea of identical uniforms for all grades. "Good enlisted men," he said, "respect officers of superior appearance."

There was almost unanimous agreement on one point. Maj. Gen. Lauris Norstad, assistant chief of the Air Staff, put it this way in a memo: "Heartily concur in the necessity for discouraging any attempt to destroy the neat and military appearance of the uniform by deforming the headgear. Witness the absolutely unacceptable top pieces now worn by many of our officers."

By the time the leaders agreed on a basic blue uniform and went to Congress for funding, they faced another problem. The Defense Department had been established to unify the services. Many lawmakers, rather than being enthusiastic about giving the Air Force its own uniform, wanted to put all services in a single suit.

USAF leaders rallied the other services to oppose the "purple suit" idea and assured Congress that having their own uniform would make Air Force members no less loyal to the overall establishment. Newly installed Air Force Secretary Stuart Symington told the lawmakers, "Airmen need and are entitled to that feeling of pride of organization which is engendered by the wearing of a distinctive uniform, whether it be Army, Navy, or high school band."

On the second try, the Air Force got its funding. By April 1949, the new blue uniform was ready for distribution.

It opened to mixed reviews. Some members liked the outfit's no-nonsense simplicity. Others thought it dull. When they tried to give it more character by shining the buttons and "processing" the new service cap, they were frustrated. A process of oxidation had permanently dulled the buttons. Worse, the cap had a foam rubber ring sewn into it that resisted the best efforts to produce a fifty-mission crush.

If the blue suit lacked the dash of the old pinks and greens, however, there was some consolation in the new summer combination. It included the old Army khakis set off with a blue cap, blue belt, and black shoes. The two-tone effect became even more satisfying when the khaki was replaced with a "silver tan" material. Even the blues weren't so dreary when they were decorated with enough badges, patches, and other insignia.

The Pentagon had something else in mind. Officials wanted a "plain blue suit," and they began systematically to strip off the offending hardware. Some members thought it ironic that the generals, with chests full of ribbons and caps covered with lightning bolts, wanted everybody else to wear an uncluttered uniform.

The first adornments to go were the relics of the Air Force's Army past. Unit emblems, shoulder patches, overseas stripes, service bars, marksmanship medals, specialty badges all disappeared. Pilots' and crewmen's wings survived, but the badges for other aeronautical ratings were redesigned or made obsolete.

Where's the Bus Station?

As their uniform was denuded, airmen complained that they were being mistaken for bus drivers. This writer, when stationed in Baltimore, was approached one day by a woman who demanded to know why the transit company didn't run vehicles north on Charles Street.

The strip-down operation continued until Headquarters committed a tactical error. It ordered members to remove their "US" lapel insignia. That was too much. Outraged troops likened the action to burning the flag. Were we ashamed to be Americans? Did we have to copy the British in everything? Why not just put everybody into pinstripes and derbies and be done with it?

Flooded with such complaints, the Pentagon rescinded the order, and the drive to unclutter the uniform ground to a halt. Not long after that, in fact, the trend was reversed. During one of the Air Force's recurring bouts of poor retention of personnel, somebody decided that specialist badges for a few of the hardest-to-hold skills might help relieve the problem.

It was another miscalculation, but this time there was no turning back. When one group got a badge, six more demanded equal recognition. Soon devices existed for missile men, pararescuers, JAGs (military lawyers assigned to The Judge Advocate General), academy professors, and a flock of medical specialties. Security police, fire fighters, and air traffic controllers received whole families of ratings to identify different levels of proficiency.

Commands added their own touches, including colored shoulder loops for NCO Academy graduates and others in key positions. The Air Force countered that trend by issuing new service ribbons to recognize such achievements.

Then came the beret craze. When the Air Force approved blue berets for special security units, other outfits wanted their own. Soon the floppy headgear, legal and otherwise, blossomed in all colors of the rainbow.

The blue Air Force uniform distributed in 1949 was deliberately plain and simple. The Pentagon stripped off as many insignia as possible, starting with relics of the Air Force's Army past. Everything from unit emblems to specialty badges disappeared; only pilots' and crewmen's wings survived. The trend continued until Headquarters made the tactical error of removing the "US" lapel insignia.

In the first years after it became an independent service, the Air Force seemed intent on maintaining a ladylike image with its women's uniforms (far left). As women moved into more occupational specialties, however, the uniform evolved from a costume to an appropriate working outfit (left).

To keep things from getting out of hand, the Air Force allowed members more leeway to decorate flight clothes and fatigues. It limited the number of qualifying badges they could wear at one time and discouraged commands from adding their own devices. The uniform never quite achieved the business-suit look that some officials had in mind, but it stopped short of becoming the Christmas tree that some members seemed to want.

Over the years, the uniform evolved. Summer tans were replaced by all-seasons blues. The Ike jacket, which survived briefly in Air Force blue, was retired. Fabrics became softer; dyes improved. Lightweight shirts with contrasting epaulets were introduced. In a move that convulsed traditionalists, the Air Force even allowed male personnel to wear earmuffs and carry umbrellas.

Interring the WAC Uniform

The men's uniform was born of the Air Force's effort to repair the damage incurred during its AAF past. The women's uniform, however, had a different origin.

The first Air Force women also happened to be former members of the Women's Army Corps. Many held bitter memories of the WAC uniform. They had reason. Early versions of that outfit were designed and produced largely by men. The result was a scaled-down male uniform, complete with shirt and necktie. The main concessions to femininity were an ill-fitting skirt and a hat that looked like a gun turret.

When recruiting of women slumped and the Army realized that its unattractive uniform was part of the problem, it came out with an improved version. Since officials intended for women to work largely in office jobs, they did not think to provide them with adequate work clothes. Throughout World War II, Air WACs worked on flight lines and in motor pools in men's fatigues.

When the Air Force began to rework the women's uniform, it wisely followed the example of the Navy, which outfitted its wartime WAVEs through women's fashion houses. The new WAF outfit reflected the male uniform but was clearly feminine.

During the early years, the Air Force seemed preoccupied with maintaining a ladylike image in the WAF. At one point, the Chief of Staff ordered the Recruiting Service to accept only attractive recruits. Applicants had to submit full-length photos. In her book, *Women in the Military,* Maj. Gen. Jeanne Holm, now retired, recalls that "it was a beauty contest, and the commander of the Recruiting Service was the final judge."

Air Force women were encouraged to wear pumps rather than oxfords or combat boots. They were reminded that ladies did not attend social functions without wearing gloves and never removed their hats on such occasions. Well into the Vietnam War, women in the field still did not have suitable work clothes.

In time, more occupational specialties opened up to women, and the uniform became less a costume and more a working outfit. The Air Force gave ground on small adornments such as earrings, but it held the line against some of the more radical civilian fads. It fought off bouffant hairdos and reached a negotiated settlement on the Afro style.

However, when the "real world" went into miniskirts, Air Force officials were hard-pressed to cope. They eased regulations to let hemlines creep to the top of the knee, but no higher. It didn't matter. As General Holm recalls, Air Force women simply rolled their skirts at the waist and achieved the look.

In a sense, the short skirt was the Air Force woman's equivalent of the fifty-mission crush. In the end, both gestures were quashed in the interest of good order and discipline. Both were statements of a sort, suggesting that even in the best-regulated organizations, individuals will still tend to do their own thing. ■

Between tours of active duty during World War II and the Korean War, Bruce D. Callander earned a B.A. in journalism at the University of Michigan. In 1952, he joined Air Force Times, *becoming editor in 1972. His most recent article for* AIR FORCE *Magazine, "The Aces That History Forgot," appeared in the April 1991 issue.*

We Believe...

We believe in a strong national defense. The Gulf War was unexpected (as wars tend to be), but none were more surprised than those who had said the nation no longer needed armed forces of a high caliber. The war reminded us that we have global interests, dependencies, and responsibilities, and that we cannot predict where or when military power may be required.

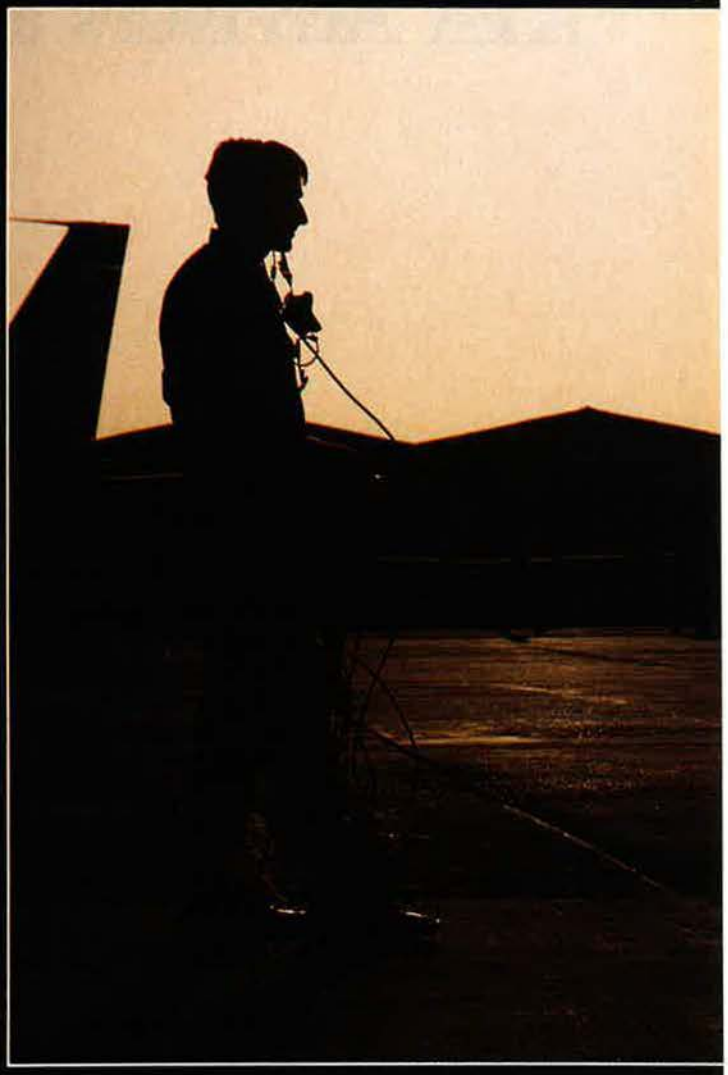
Technology transforms Third World nations into first-class military problems. By the year 2000, at least fifteen developing nations may be able to build ballistic missiles. Eight will have or be near to having nuclear capabilities. Thirty countries will have chemical weapons. Ten will also be able to deploy biological weapons.

The Soviet Union is retrenching but will remain a potential threat that we cannot take lightly. Its strategic nuclear capabilities are increasing rather than diminishing. Conventional forces are improving, too. Even after massive reductions, the Soviets will command the largest armed force on Earth.

The United States is reducing its defenses too deeply and too fast. Defense spending is falling toward 3.6 percent of GNP, the lowest level since the 1930s. The nation can—and, we believe, should—allocate more than that for its fundamental security.

We believe in a strategy of deterrence, of *preventing* wars. That objective is best achieved by credible power and clear policies that unequivocally notify an aggressor that aggression will not pay.

If you would like more information about the requirements for a strong national defense, write to us.



—USAF photo by TSgt Hans Deffner

The Air Force Association
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AFA Advisors and Councils

By Toni Kuzma

AFA Presidential Advisors


Daly


Farage


McRaney


Schittulli


Turner


Willard

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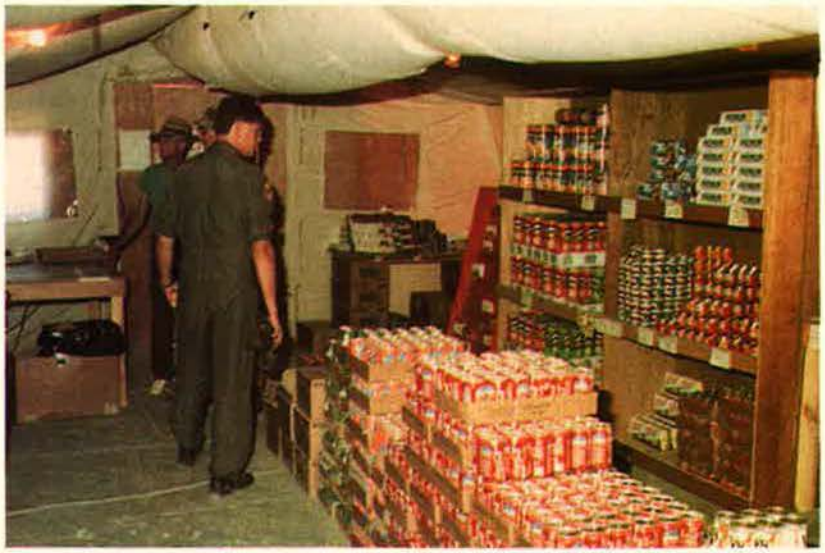
Kittelson

Street

When the troops go to war, so does the base exchange.

The Store in the Desert

By Amy D. Griswold, Editorial Assistant



—USAF photo by MSgt. Ivan Burch

Shoppers browse inside the BX "Dhahran Express," operated by the Air Force Commissary Service for the 136th Tactical Airlift Wing (ANG), Hensley Field, Tex. AAFES sales during Operations Desert Shield and Desert Storm totaled $107.2 million.

THE tent looked like all the other khaki tents in the Arabian desert, with one exception: A hand-lettered cardboard sign next to the entrance informed passers-by that this was the BX "Dhahran Express."

Inside, the shelves and tables were clearly makeshift, hastily assembled from plywood, but filled with an assortment of pudding, crackers, chips, cookies, T-shirts, innersoles, shampoo, toothpaste, and toiletries. A cardboard sign directed shoppers to the back for cold soda, where it was stacked case upon case.

It was a far cry from the stores servicemen were used to back in Dallas, but in the desert, this tactical field exchange, operated by the Air Force Commissary Service for members of the Air National Guard's 136th Tactical Airlift Wing, Hensley Field, Tex., was the only store they had. It filled their needs admirably.

Throughout the Saudi desert from the summer of 1990 through the early spring of 1991, the Army and Air Force Exchange Service (AAFES) set up exchanges to support the men and women serving in Operation Desert Shield.

When one thinks of AAFES, images of modern shopping malls and free movie theaters on bases around the world come to mind. Though AAFES ranks among the top ten retailers in the United States, that's only part of the story. AAFES is the only store that goes to war.

Since 1895, when it was established as the post exchange system, AAFES has accompanied soldiers, airmen, and Marines wherever they are sent, operating from trucks and tents on the battlefields of all the major conflicts in which the US has been involved. In Operations Desert Shield and Desert Storm, servicemen and -women were able to buy consumer goods from AAFES exchanges set up in tents in the Saudi desert.

Until the summer of 1990, AAFES had assigned only one manager to handle operations in Saudi Arabia, with responsibility for three tiny exchanges. There was no warehouse. The Giessen Distribution Center in Germany supported all AAFES exchanges throughout the Middle East.

All of that changed very rapidly once President Bush launched Operation Desert Shield. The first unit exchange arrived in Saudi Arabia in early September at about the same time as the 354th Tactical Fighter Wing from Myrtle Beach AFB, S. C. AAFES workers brought merchandise with them when they deployed. Within four days of their arrival in the kingdom, they opened their tent for business.

Within fifteen days of the start of Desert Shield, AAFES set up thirty field exchanges in Saudi Arabia to support the Army, Air Force, and Marine units deployed there. At the peak of the buildup, US forces were supported by 152 unit exchanges, which are owned and operated by the military with funding provided by AAFES. In addition, AAFES ran seventeen direct operations in Saudi Arabia, staffed by fifty-nine AAFES civilians.

In Saudi Arabia, a full-fledged distribution center was put in place. It handled 1,006 different items, with a peak inventory value of $162 million at the end of February. Soldiers who could not visit one of the exchanges could order goods electronically, by laptop computer, even from remote areas. ■

By John L. Frisbee, Contributing Editor

Eareckson of the Aleutians

Col. William O. Eareckson earned every major combat decoration except the Medal of Honor, but his superiors found him too hot to handle.

THERE were no aces in the Aleutian Islands campaign of World War II. This is not to say there were no heroes. Anyone who endured life in so inhospitable a region had some claim to that distinction, especially the aircrews, who faced the worst flying weather in the world. Forty-one AAF planes fell in combat, about half to flak, but 184 were lost to other causes, largely weather-related.

During the fifteen months of that campaign, six men were awarded the Distinguished Service Cross. The first was Col. William O. Eareckson, who had tenaciously followed a tortuous path to pilot wings and command. At seventeen, he enlisted in the Army, two months before the US entered World War I. He was wounded in France, then reenlisted in the hope of entering West Point, which he did through a presidential appointment in 1920. His goal was to be an Army pilot, but a year after graduation from the Academy, he washed out, went to balloon school, and became one of the Army's top balloon pilots. In 1928, he and Maj. William Kepner, captain of the US balloon team, won the most prestigious of all ballooning events, the Gordon Bennett International Balloon Race. Two years later, at the advanced age of thirty, Eareckson won his airplane pilot wings, and in 1939 he was given command of the 36th Bombardment Squadron. In the spring of 1941, Eareckson led his squadron to Alaska, only then beginning to gird for a probable Japanese attack. As more and newer bombers replaced Eareckson's obsolete B-18s, he was named head of Eleventh Air Force Bomber Command.

On June 3, 1942, Japanese carrier planes hit ill-prepared Dutch Harbor on Unalaska Island. The Aleutian war was on. Colonel Eareckson led a flight of B-26s through impossible weather in an attempt to find and attack the Japanese fleet with torpedoes, which he had scrounged from the Navy. After two relatively unsuccessful attacks, the enemy fleet withdrew and occupied Attu and Kiska Islands at the western end of the long, treeless Aleutian chain. Eareckson's bombers

first had to find the enemy. Then they attacked enemy island bases and shipping whenever fog and gale-force winds permitted. Colonel Eareckson earned the respect and devotion of his men by flying in every position—from left-seater to tailgunner.

Eareckson led most of the toughest missions, to the displeasure of Maj. Gen. William Butler, commander of Eleventh Air Force. The cautious, unimaginative Butler believed a commander should be primarily an administrator, using his forces according to accepted doctrine. Eareckson believed that a leader should lead and a tactician should devise better tactics, no matter what the book said.

Because traditional high-altitude bombing produced poor results at Attu and Kiska, Eareckson turned to unprecedented low-level attacks with heavy bombers, leading the first missions himself to convince his crews that they would live to bomb another day. Butler, unhappy with his unconventional bomber commander, reassigned Eareckson to the mainland in January 1943. Army Gen. Simon Bolivar Buckner, an unconventional warrior himself and head of Alaska Defense Command, thought Eareckson too valuable an asset to lose and assigned him to the ADC staff, sending him to San Diego to help plan the invasion of Attu, which took place in May 1943.

In terms of the ratio of casualties to combatants, Attu was, second to Iwo Jima, the bloodiest battle of World War II. Colonel Eareckson, as air liaison officer, in effect called the shots for Eleventh Air Force. Using a single-engine Kingfisher float plane borrowed from the Navy, Eareckson flew up and down the fog-enshrouded passes of that mountainous island, calling in targets to the Air Force and Navy and assessing bomb damage. So often was his little plane hit that on every mission he carried plugs to seal the pontoons on landing. In the final days of the battle, Eareckson went to the front lines, borrowed a rifle from an infantryman, and entered the fray. Before the day was over, he was wounded by a Japanese sniper.

When the Aleutian campaign ended with the Japanese evacuation of Kiska in August 1943, Adm. Chester Nimitz presented the Navy Cross to Colonel Eareckson to complement his DSC, Silver Star, and lesser combat decorations earned in the Aleutians. Always a maverick—caustic, outspoken, and contemptuous of red tape—Eareckson was regularly passed over for promotion to brigadier general. He retired in 1954 and died in October 1966, loved and respected by the men who served with him, but, for his superiors, too hot to handle. ■

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TEXAS (Abilene, Amarillo, Austin, Big Spring, College Station, Commerce, Corpus Christi, Dallas, Del Rio, Denton, El Paso, Fort Worth, Harlingen, Houston, Kerrville, Lubbock, San Angelo, San Antonio, Waco, Wichita Falls): **John P. Russell,** P. O. Box 5789, Abilene, TX 79608 (phone 915-698-8586).

UTAH (Bountiful, Clearfield, Ogden, Salt Lake City): **Dan Hendrickson,** 1930 North 2600 East, Layton, UT 84040 (phone 801-825-1012).

VERMONT (Burlington): **Andrew D. Clark,** 4 General Greene Rd., Shelburne, VT 05482 (phone 802-985-3772).

VIRGINIA (Alexandria, Charlottesville, Danville, Harrisonburg, Langley AFB, Lynchburg, McLean, Norfolk, Petersburg, Richmond, Roanoke): **Mary Anne Thompson,** 3146 Valentino Ct., Oakton, VA 22124-2836 (phone 703-734-6401).

WASHINGTON (Seattle, Spokane, Tacoma): **Theodore O. Wright,** 9644 Hilltop Rd., Bellevue, WA 98004-4006 (phone 206-454-5548).

WISCONSIN (Madison, Milwaukee, Mitchell Field): **Gilbert M. Kwiatkowski,** 8260 W. Sheridan Ave., Milwaukee, WI 53218-3548 (phone 414-463-1849).

WYOMING (Cheyenne): **Irene G. Johnigan,** 503 Notre Dame Ct., Cheyenne, WY 82009 (phone 307-775-3641).

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

Michigan's Heroes

Continuing its support of Operation Desert Storm, the American public is bestowing accolades on returning troops to a degree not seen in many years. The people of Michigan, through their elected representatives, typify this renewed appreciation of America's military men and women. Michigan State AFA President Bill Stone was instrumental in drafting legislation that honored the men and women of the 379th Bombardment Wing from Wurtsmith AFB, Mich. When they were introduced to the legislature, members of the wing were greeted by a standing ovation from the lawmakers, and the resolution was quickly passed. The legislation singled out Col. Kenneth Boykin, wing commander, and his B-52 crew for special praise and took note of the wing's 500 KC-135 missions, 1,000 B-52 sorties, and successful efforts against Iraq's Scud production facilities. In a separate action, the Michigan Senate and Gov. John Engler joined the House in producing a special tribute to the 379th.

Michigan State President Bill Stone, Vice President Jonathan Dayton, and Secretary Treasurer Robert H. Witkop (left to right) go over plans to revive the PE-TO-SE-GA Chapter, which has been inactive for several years.

Col. Kenneth Boykin (center) and members of the 379th Bomb Wing display resolutions by the Michigan legislature praising their work in Desert Storm. Also seen are (from left) B-52 Crew Chief Anthony Thompson, B-52 Commander Capt. Mark Batway, KC-135 Commander Heidi Hernandez, and KC-135 Crew Chief TSgt. Mark Thornhill.

AFA on Campus

AFA is reaching out to young Americans through its strong support of AFROTC, AFJROTC, and the Arnold Air Society. In an effort to recognize top performers, AFA announced the awarding of six AEF Lovelace Medallions, honoring the outstanding AFROTC cadets in the nation, at the Arnold Air Society (AAS) and Angel Flight–Silver Wings national conclave in San Antonio, Tex. Richard A. Vaia of Cornell University, Michael F. Hernandez of the University of Florida, Amy M. Patrin of the University of Notre Dame, Andrew J. Adams of the University of Colorado at Boulder, John B. Gross of Mississippi State University, and Christy R. Green of San Diego State University are to receive the medals for their achievements in 1990.

The advisors and supporters of these organizations were not neglected. Lt. Col. John R. Sanders, Jr., the 1991 national conclave advisor from

Gen. George L. Butler, SAC's Commander in Chief, meets the Omaha community courtesy of the Ak-Sar-Ben Chapter, which held a luncheon in his honor. More than 600 people heard the General delineate SAC's contribution to Desert Storm.

the University of Texas at San Antonio; Col. Howard T. Hanson, AAS national staff advisor from Notre Dame; and Col. Byron Scott, the Angel Flight national staff advisor from Oklahoma State University, all received AFA Medals of Merit. Maj. Henry L. Andrews, Jr., of the 51st Tactical Fighter Wing, Osan AB, Korea, and Col. George R. Davis, commander of the AFROTC detachment at the University of Maryland, both got AFA Presidential Citations.

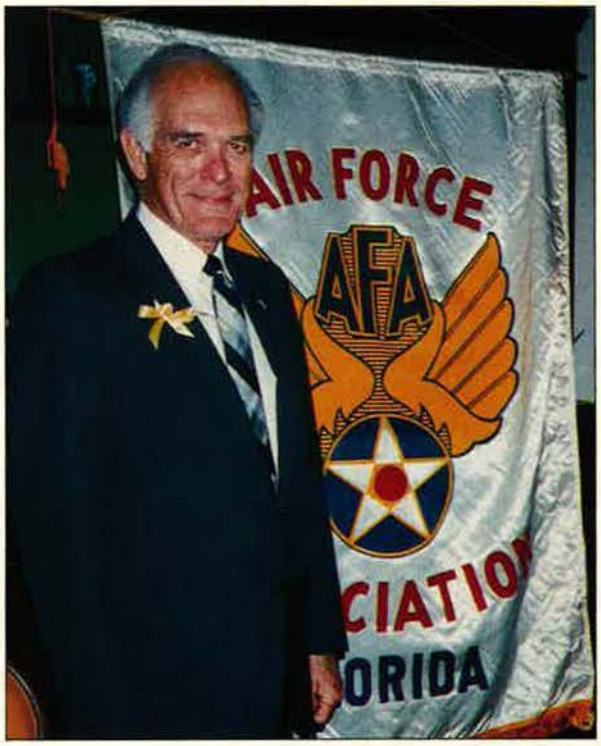
Life Memberships in AFA were awarded to outgoing AAS National Commander Clinton G. Wander III of Notre Dame and to Angel Flight National Commander Kathy Smith of Oklahoma State. Karen Carter of the University of Texas at San Antonio was announced as the winner of this year's Diane F. O'Malley Outstanding Angel Award. She will be honored at the AFA National Convention in September.

More than 250 AAS cadets and Angel Flight members gathered in Huntsville, Ala., for their Area VIII/Region C conclave. **Birmingham (Ala.) Chapter** President Col. James F. Brown, ANG, commander of the 117th Tactical Reconnaissance Wing, addressed the gathering, as did former astronaut Col. James B. Irwin, USAF (Ret.). Colonel Irwin, who participated in the fourth moon landing as part of the Apollo 15 mission, signed copies of his book, *Destination: Moon,* after his speech, during which he also told the audience about his evangelical foundation, High Flight. Also at the conclave, Cadet Maj. Rob Sandlin of AFROTC Det. 12 (Samford University) was named the outstanding AAS member in the Alabama/Mississippi area.

Chapter News

The **Ak-Sar-Ben (Neb.) Chapter** made its annual banquet a double celebration. Since it did not have one in 1989, the chapter used the most recent banquet to honor its Citizens of the Year for both 1989 and 1990. Harold W. Andersen, retired president and publisher of the Omaha *World-Herald,* received the award for 1989, and Willis A. Strauss, retired chairman of Enron Corp., got the nod for 1990. The awards were presented by Chapter President James McCoy, the retired sixth Chief Master Sergeant of the Air Force. Vice Adm. Ronald Eytchison, vice commander of the Joint Strategic Target Planning Staff at nearby Offutt AFB, addressed the audience and praised the honorees. Chapter board member Ken Cousino received a Medal of Merit for his outstanding work in the community partner program. Among the many dignitaries from SAC headquarters and surrounding civilian communities at the banquet were Maj. Gen. Frank B. Horton, DCS/Intelligence for SAC, and his wife, Patty; CMSgt. Joseph D. "Dan" Cook, SAC's Senior Enlisted Advisor, and his wife, Gerry; Omaha City Councilman Subby Anzaldo and his wife, Janice; and Inez Boyd, mayor of Bellevue, Neb.

Recruiting will be one of the areas most affected by the recent budget cuts. Brig. Gen. John J. Salvadore, commander of the Air Force Recruiting Service, spoke to the **Dacotah (S. D.) Chapter** recently about the changes already taking place and those to come in this vital area of the USAF mission. He also presented National Vice President (North Central Region) John E. Kittelson with the Air Force Recruiting Commander's Award for his efforts on behalf of the Recruiting Service. South Dakota President Bob Jamison, Dacotah Chapter President Chuck Nelson, Col. Jack Downey, commander of the



AFA National President Oliver R. Crawford addressed a meeting of Florida AFA leaders in Orlando. He emphasized the importance of recruiting and mapped out several strategies that Florida AFA could use to attract new members.

3504th Recruiting Group, and Lt. Col. Bill O'Brien, commander of the 3543d Recruiting Squadron (which nominated Mr. Kittelson), were on hand for the speech and the awards presentation.

The state of the US industrial base is of growing concern both to civilians and the military. The **Greater Seattle (Wash.) Chapter** got some good news on this topic from Ron Ostrowski of the Boeing Co. He gave a detailed report on Boeing's new 777 airliner, which already has dozens of firm orders. His talk focused on the airliner's development, design, and manufacture. As the chief project engineer for the 777's configuration development, Mr. Ostrowski was eminently qualified to discuss the aircraft. Chapter President Phil Giambri presented him with a plaque as a token of appreciation.

National Treasurer Bill Webb was in his home state of Oklahoma for the presentation of the Gen. Earl T. O'Laughlin, Jr., Award to the Oklahoma City Air Logistics Center's Directorate of Distribution. The **Thomas P. Gerrity Chapter** presents the award to recognize outstanding achievements in logistics. Col. James Corbett, the center's director of distribution, accepted the award, while the center's commander, Maj. Gen. Joseph K. Spiers, Deputy Director of Distribution Jerry McMillin, Oklahoma State President Ken Calhoun, and Mr. Webb looked on.

Many USAF leaders credit the advanced electronic systems on US aircraft for a big part of the stunning success in Operation Desert Storm. Members of the **Ventura County (Calif.) Chapter** listened intently to a briefing from a man well versed in the electronic components of the Gulf War, Lt. Gen. Gordon E. Fornell, commander of Air Force Systems Command's Electronic Systems Division. Chapter President John R. Costello expressed appreciation to chapter member Jerry Knotts, who arranged General Fornell's visit. The briefing was heard by California State President Art Trost, State Vice President Tom Pierce, Thousand Oaks Mayor Bud Sweeney, Lt. Gen. James Stansbury, USAF (Ret.), Maj. Gen. John Stihl, USAF (Ret.), and almost 100 others.

Also in California, the **Antelope Valley Chapter** joined with the Lancaster and Palmdale Chambers of Commerce to host its twenty-first annual Honors and Awards Banquet. Thirteen members of the Air Force Flight Test Center (AFFTC) and tenant units at Edwards AFB, Calif., were honored. Maj. Gen. John P. Schoeppner, Jr., commander of AFFTC, cited the "wealth of skills" exhibited by the honorees, and Desert Storm veteran TSgt. Jeffrey D. Solie of the 6500th Security Police Squadron related his experiences in the Middle East.

AEF President Gerald V. Hasler traveled to Arizona to urge members of the **Tucson Chapter** to support AEF and its efforts to promote membership among the young people in the Tucson area. He also discussed the new Eagle Award, which is designed to encourage continuing education among Air Force enlisted personnel. While in Tucson, Mr. Hasler visited the Pima Air Museum, accompanied by Charles Niblett, Arizona AFA's director of communications, and Ned Robinson, the museum's director.

In Memory of McGuire

Though USAAF Medal of Honor recipient and second leading ace of all time Maj. Thomas B. McGuire, Jr., has been dead for nearly fifty years, his name and memory live on in many forms throughout the US. McGuire AFB in New Jersey bears his name, as does the local AFA chapter. The chapter recently held its twenty-first annual awards dinner-dance, attended by a crowd of more than 200. Maj. Gen. Paul E. Landers, Jr., commander of MAC's 21st Air Force at McGuire, gave an eloquent address on the changing world situation, with particular emphasis on the Middle East. National Vice President (Northeast Region) Bob Gregory followed the General, discussing AFA's role in national security and the need for increased membership. Chapter President Frank Kula presented twenty-four Scott Associate awards to personnel stationed at McGuire, and the chapter donated $1,000 to Operation Kind Heart, which helps the families of

Georgia State President Dr. Dan Callahan applauds the Tift County AFJROTC drill team, winners of the "Best in Meet" trophy at the statewide drill meet. MSgt. Ken Mathis led a panel of judges from Air Force Logistics Command's NCO Academy at Robins AFB who rated the cadets' performance.

Three Airpower Stalwarts Pass Away

Henry Coffin III, Lloyd P. Nolen, and Arthur Littman—three men united in their dedication to the past, present, and future of aerospace—died this past April.

Mr. Coffin, ninety-four, a charter member of AFA and a leader at both chapter and state levels in Pennsylvania, trained as a balloonist during World War I. He also served during World War II and was among the first Americans to enter Japan after its surrender. He spent much of his long membership in both the Brandywine and Metro Philadelphia Chapters encouraging young people to cultivate an interest in aviation.

Mr. Nolen, sixty-eight, won renown as a founder of the Confederate Air Force (CAF), described as a "flying educational museum," which has grown to 145 aircraft and 8,000 members. The organization started when Mr. Nolen and four friends purchased a surplus P-51 Mustang. The Texarkana, Tex., native learned to fly in 1939 and served as a USAAF flight instructor from 1942 to 1945. He was an avid photographer and took part in all phases of the CAF's operations. He was also a loyal member of the Ghost Squadron (Tex.) Chapter of AFA.

Mr. Littman, sixty-nine, will be remembered as a driving force in the Gen. Robert F. Travis (Calif.) Chapter, long considered one of AFA's best. His service to AFA included stints as chapter officer and president, state officer, national director, and national membership committee member. He spent thirty years in the Air Force, retiring as a colonel.

Arthur Littman

Coming Events

June 1–2, **Arizona State Convention,** Sierra Vista, Ariz.; June 7–9, **New Jersey State Convention,** Atlantic City, N. J.; June 8, **Missouri State Convention,** Whiteman AFB, Mo.; June 14–16, **Mississippi State Convention,** Biloxi, Miss.; June 15, **Georgia State Convention,** Atlanta, Ga.; June 21–22, **Ohio State Convention,** Youngstown, Ohio; June 22, **New Hampshire State Convention,** Pease AFB, N. H.; July 12–13, **Louisiana State Convention,** Bossier City, La.; July 13, **Kansas State Convention,** Wichita, Kan.; July 19–20, **Colorado State Convention,** Lowry, Colo.; July 19–21, **North Carolina State Convention,** MCAS Cherry Point, N. C.; July 19–21, **Pennsylvania State Convention,** Pittsburgh, Pa.; July 19–21, **Texas State Convention,** San Antonio, Tex.; July 21, **Delaware State Convention,** Dover, Del.; July 25–28, **Florida State Convention,** St. Augustine, Fla.; July 26–27, **Arkansas State Convention,** Hot Springs, Ark.; July 26–28, **Virginia State Convention,** Crystal City, Va.; July 27, **Michigan State Convention,** Wurtsmith AFB, Mich.; August 2–3, **Minnesota State Convention,** Hinckley, Minn.; August 3, **Indiana State Convention,** Bloomington, Ind.; August 3, **Mid-America Ball,** St. Louis, Mo.; August 15–17, **California State Convention,** Edwards AFB, Calif.; August 22–24, **Utah State Convention,** Ogden, Utah; September 6–7, **Washington State Convention,** Seattle, Wash.; September 6–7, **Wisconsin State Convention,** Milwaukee, Wis.; September 16–19, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.

Desert Storm personnel. Col. Joseph A. McNeil, vice commander of the 514th Military Airlift Wing, accepted the check on behalf of Operation Kind Heart.

Another member of the McGuire AFB family went on the road to spread the word about Operation Desert Storm. 1st Lt. Sandra Kearney spoke to the **Brig. Gen. Frederick W. Castle (N. J.) Chapter** (whose namesake was another onetime New Jersey resident who received the Medal of Honor) about her experiences in the Middle East. A C-141 pilot, crew controller, and aircraft commander for the 335th Military Airlift Squadron, AFRES, she expressed gratitude for and satisfaction about the "privilege" of participating in Desert Storm.

The state of Florida also proudly commemorates Major McGuire. Though born in New Jersey, he grew up in south central Florida, graduating from Sebring High School. Sebring will be home to the McGuire Memorial Plot, to include a six-foot stone shaft, McGuire's Medal of Honor citation, and a brief history of his life and career. National Vice President (Southeast Region) Roy P. Whitton, who heads the McGuire Memorial Fund, said that the fund will continue to serve local young people after the memorial is completed. Present at the unveiling were three of Major McGuire's boyhood friends, Allan Altwater, William Dutton, and Ike Hart, and Lowell Allen, Highlands County's only surviving World War I pilot.

Correction

The April 1991 "AFA/AEF Report" incorrectly stated Lt. Gen. Craven C. Rogers's job title. Until he retired on April 1, he was deputy commander in chief of US Central Command. We regret the error.

Have AFA News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■

Bulletin Board

Seeking information, photos, and correspondence from anyone stationed in **Thailand during the Vietnam War. Contact:** Richard Anderson, 631 Green Ave. SW, Massillon, OH 44647.

For a book, seeking contact with any 1951–54 members of the 27th, 37th, 49th, 57th, 74th, or 75th **Fighter-Interceptor Squadrons,** or 1951–52 members of the 132d or 134th Fighter-Interceptor Squadrons, who served at Dow, Ethan Allen, Griffiss, or Presque Isle AFBs. **Contact:** Bill Green, 1460 Persimmon Ln., Fairview, PA 16415.

Seeking information on **John Bell,** of Texas, who served in the US Air Force in 1944–45 and was stationed at Poynton, near Manchester, England. **Contact:** David Hulme, 34 Meltham Close, Heaton Mersey, Stockport SK4 3BD, United Kingdom.

Seeking a unit patch of the **4258th Strategic Wing,** which was based at U Tapao, Thailand, during the Vietnam War. **Contact:** Fred H. Fernandez, 1613 S. Laredo St., Aurora, CO 80017.

Seeking memorabilia from the **Air Corps Tactical School** during the years 1931 to 1940. I need informal school and student photos, graduation

announcements, and yearbooks for a display to be located at the Air Command and Staff College, Maxwell AFB, Ala. **Contact:** Maj. Brad Flinders, ACSC/DO, Maxwell AFB, AL 36113.

Seeking contact with people with a military background interested in a **military history exchange tour of the Soviet Union,** led by Professor John M. Thompson (California State University), hosted by the Soviet War Veterans' Council. Marshal of the Soviet Union Sergei F. Akhromeyev will personally receive the group. The tour is September 7–26, 1991. **Contact:** East-West International Tours, 909 E. Yorba Linda Blvd., Placentia, CA 92670.

Seeking contact with the next of kin for the following members of 765th Bomb Squadron, 461st Bomb Group, 15th Air Force: **Valden A. Barnson** from Ogden, Utah, **Bernard C. Freeman** from Vinita, Okla., **John A. Sanio, Jr.,** from Brooklawn, N. J., **Earl W. Kreps** from Pittsburgh, Pa. and **William L. McLain, Jr.,** from Montgomery Ala. **Contact:** Bob King, The Pentagon, Room 2E631, Washington, DC 20310.

Seeking **Technical Sergeant stripes** worn by Army Air Forces personnel during World War II. They were khaki with three stripes up and two down. **Contact:** Becca Tindall, 21501 Davis Mill Rd , Germantown, MD 20876.

Seeking contact with anyone who knew **1st Lt. Charles Robert Johnston and his crew,** of the 459th Bomb Squadron, 385th Bomb Group, 8th Air Force, stationed at Great Ashfield, England, from November 1943 until his B-17 was shot down on April 29, 1944. **Contact:** Charles R. Johnston, Jr., 1801 Valley Forge, Fort Collins, CO 80526.

Beginning collector seeks duplicate **patches** from USAF active-duty, AFRES, or ANG flying units. Either subdued or colored versions appreciated. **Contact:** Steve Preston, 1806 S. W. Third St., Lee's Summit, MO 64081-1705.

Seeking contact with members of **Class 43-2 Aircraft Maintenance Engineering Officer Aviation Cadet School,** Chanute Field, Ill. Also seeking contact with classmates from the B-29 Flight Engineer School, Lowry Field, Colo., and B-29 Flight Engineers who served at Alamogordo AAFB, N. M. **Contact:** Otto K. Mueller, 95 Franklin St., Cedar Grove, NJ 07009.

Seeking information on the whereabouts of **Sgt. Myron Theetge (or Theege),** drill instructor for Flight 16-C at Amarillo AAF, Tex., from August to November 1943. Also seeking information on two P-51 pilots who were POWs at a Luft Stalag near Ansbach, Germany, in February 1945. **Contact:** Walter M. Mayberry, P. O. Box 275, Harrison, AR 72601.

The Evergreen Wing of the Confederate Air Force is in the process of restoring a **Taylorcraft L-2** and would appreciate any information on the L-2 and its role in World War II. **Contact:** Col. Manfred Misztowt, 4500 176th St., S. W. #3, Lynnwood, WA 98037.

Seeking correspondence with **USAF pilots.** One day I would like to be an air force pilot. Please send me information on aviation and USAF aircraft. **Contact:** Ernest Flores Laxamana, Jr., #24A Interior, Magsaysay Village Subdivision, Tarlac, Tarlac, the Philippines.

Seeking information on members of **"E" Company of the Air Corps Recruit Detachment** at

Bulletin Board

Kelly Field, Tex., in the summer of 1941, especially John Connors, Lloyd "Toby" Cheek, "Christy," and "Church." **Contacts:** George Collins, Rte. 1, Box 1032, Niceville, FL 32578. Larry Craig, 2494 CR 213, Durango, CO 81301.

Seeking information on officers and airmen who served with the **414th Night Fighter Squadron** between February 1943 and December 1945. **Contact:** C. H. Bolender, 128 Randolph's Green, Williamsburg, VA 23186-6537.

The Heritage Museum Foundation of **Grissom AFB,** Ind., is seeking contact with members of the following groups who were stationed there from 1941 to the present: US Navy personnel stationed at NAS Bunker Hill, 319th Tactical Fighter Squadron/Wing stationed at Bunker Hill AFB, and 305th Bomb Wing stationed at Bunker Hill AFB/Grissom AFB. **Contact:** George "Bud" Fivecoate, P. O. Box 410, Galveston, IN 46932.

Seeking contact with **Capt. Francis J. Coffey, Capt. Art Kennedy,** and **Lt. Ron Wirtanen,** who were assigned to Hq. USAFE or the 7101st Air Base Wing and were residents of The American Arms in Wiesbaden, West Germany, in 1967–68. **Contact:** Ralph Melendez, Rte. 6, Box 207, Lucasville, OH 45648.

For an informal history of flathatting, hedgehopping, stunting, and buzzing, I'd like to hear **anecdotes of impromptu airborne feats** by Air Force pilots. **Contact:** Derek Nelson, 1106 Manchester Ave., Norfolk, VA 23508.

Seeking information on **Sgt. Frank Padilla** and his wife **Lucy,** who were stationed at RAF Burtonwood, England, in 1956–57. Sergeant Padilla served in Korea, and both were from Arizona. **Contact:** Leo McDonnell, 12 Saint Peter St., Tiverton, Devon EX16 6NU, England.

Seeking the whereabouts of **Thomas J. Imhof (or Imhoff)** whose last known duty station was Tachikawa AB, Japan, in 1969–71 and who served at McConnell AFB, Kan., in 1961–62. Also seeking **Marvin G. Joshua, Jr.,** and **Charles Berry,** who were stationed at Harmon AFB, Canada, in 1962–63. **Contact:** Bob Osterloh, 34 Kelly Leaf Dr., St. Charles, MO 63303.

Seeking members of the **62d Flight Squadron,** 56th Fighter Group (World War II), who have information on the FW 190 parked on the 62d's flight line at Boxted, England, in 1945. **Contact:** William Billings, Box 1149 RD 2, Columbia, NJ 07832.

Seeking contact with anyone who knew **Thomas Gillen,** USAF, declared MIA over Laos in 1970. **Contact:** Katherine Gillen, 1010 N. 26th St., Mesa AZ 85213.

Seeking the whereabouts of **Martin Carol Ellingson,** who served at RAF Burtonwood, England, in 1948–50. **Contact:** Mike Agnew, 30 Geneva Rd., Bramhall, Stockport, Cheshire SK7 3HT, England.

Seeking photographs, letters, and memorabilia relating to US radar and aircraft control and warning **(AC&W) systems** on Okinawa from 1944 to 1970. The 623d TCS is reactivated and is building a unit Heritage Hall. **Contact:** Capt. Phil Morgan, 623 TCS/DOO, APO San Francisco 96239.

Seeking the whereabouts of **Lt. J. J. McGee, Jr.,** whose last known address in 1943 was at the Glenn L. Martin–Nebraska Co., in Omaha, Neb. Lieutenant McGee was an operations officer and an Army Air Forces B-26 Marauder test pilot. **Contact:** Capt. W. Gene Vogel, USAF (Ret.), 118 Howard Ct., Panama City, FL 32404-8809.

If you need information on an individual, unit, or aircraft, or if you want to collect, donate, or trade USAF-related items, write to "Bulletin Board," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Letters should be brief and typewritten. We cannot acknowledge receipt of letters to "Bulletin Board." We reserve the right to condense letters as necessary. Unsigned letters are not acceptable. Items or services for sale or otherwise intended to bring in money will not be used. Photographs cannot be used or returned.—THE EDITORS

Seeking contact with anyone who served with the **856th Bomb Squadron,** 492d Bomb Group, based at North Pinkenham, England, during World War II. **Contact:** Mrs. Robert Morris, 3641 S. Tecumseh Rd., Springfield, OH 45502.

Seeking historical data, photographs, and patches from the **314th Fighter Squadron,** 324th Fighter Group, based in North Africa and Italy during World War II. **Contact:** Steve Yehle, 121 Margaret Cir., Enid, OK 73703.

Seeking contact with the man from Alabama who telephoned me concerning **William Mackey.** Please call again or write. **Contact:** P. M. Gahagan, 2660 N. 66th St., Wauwatosa, WI 53213.

Seeking contact with FAC pilots who were in the **20th Tactical Air Support Squadron** at Da Nang AB, Vietnam, from October 1967 to March 1968 and knew **1st Lt. James L. Badley. Contact:** Lynda Twyman Paffrath, 215 Castilian Way, San Mateo, CA 94402.

Seeking contact with servicemen who were associated with the base at **Ludham,** England, who would be interested in helping to preserve and restore the control tower there. **Contact:** Anthony A. White, Unit 8, Fenner Rd., Great Yarmouth, Norfolk NR30 3PS, England.

Seeking a **US Cavalry Sword,** model 1913, and Academy Cadet Officer's sword. **Contact:** E. DeGroff, 26 Palm Club, 1431 S. Ocean Blvd., Pompano Beach, FL 33062.

Seeking contact with anyone who was stationed at **Osan AB,** Korea, who could help me replace memorabilia lost in a fire. **Contact:** Mike Dunnagan, 2001 Umstead Rd., Durham, NC 27712.

Seeking information on the whereabouts of **SSgt. Hal Brock,** who was stationed at Hixon, Stafford, England, from 1943 to 1945. **Contact:** Mary Bentley, 4 Bargrave St., Bentilee, Buckwall, S-O-T, Staffs. ST2 OHG, England.

Seeking contact with members of the **50th Pursuit Squadron** who were stationed at Hamilton Field, Calif., and Reykjavik, Iceland, in 1941–44. **Contact:** Lt. David J. Burachio, USAF, 50FTS/DOTOS, Columbus AFB, MS 39701.

For a history of the **A-1 Skyraider** flown by USAF, Vietnamese Air Force, and USN personnel during the Vietnam War, I am seeking contact with former Skyraider pilots and ground crews who can contribute combat reminiscences, aircraft names and nose art, and photographs or slides. **Contact:** Daniel Medeiros, 5605 Valhalla Dr., Carmichael, CA 95608.

Seeking a copy of ***Hitch Your Wagon***, by Clayton Knight, the story of Col. Bernt Balchen, who served in the USAF in World War II. **Contact:** Richard Golding, 125 W. Parrish, Sequim, WA 98382.

Seeking anecdotes, reminiscences, and oral histories from members of the **6593d Test Squadron (Special)** or the **6594th Aerospace Recovery Group** for an AIAA paper on "Catch a Falling Star." Also interested in similar information from those who served in predecessor midair retrieval groups. **Contact:** Mike Ravnitsky, 8580 Magnolia Trail #220, Eden Prairie, MN 55344.

Seeking **wings** from World War I and World War II, medals, buttons, pocket watches, aircraft and parts, and European military souvenirs. **Contact:** Wendell Murphy, 1059 S. Broadway, Lexington, KY 40504.

Seeking information on the August 1988 fatal crash of **Lt. Bryan Miner,** an A-7D pilot of the 121st Tactical Fighter Wing, Ohio ANG. The crash occurred in southern Ohio during a training exercise with two other aircraft. The information will not be used for litigation. **Contact:** Don Goodenow, 3128 Sunnybrook Dr., Charlotte, NC 28210.

Seeking information on **Robert L. Spaulding** and **Glade A. Loy,** who were B-29 crew members with the 39th Bomb Group on Guam during World War II. They both lived in California after the war. **Contact:** Robert E. Laird, RR3, Box 4836, Chasanna Dr., Rutland, VT 05701.

Seeking contact with **Christopher and Ruth Mary Vear,** who were bank tellers at Lindsey AS and lived in Wiesbaden, West Germany, in 1967–76. **Contact:** Melodie Garfield, 35672 Date Ave., Yucaipa, CA 92399.

Collector seeks to trade Army and Air Force **patches.** Also, I would appreciate extra patches and unit histories or fact sheets for a Civil Air Patrol Squadron display. **Contact:** Chaplain Steve Bias, 2750 ABW/HC, Wright-Patterson AFB, OH 45433.

Seeking contact with former members of the **302d Tactical Reconnaissance Squadron** who served at Shaw AFB, S. C., in 1952–53; at Sembach AB, West Germany, in 1953–58; and at Laon AB, France, in 1958–59. **Contact:** Roger S. Wilkes, 8918 Taft Hill Ct., Sandy, UT 84093.

Seeking contact with American servicemen who were stationed in England during World War II and had contact with members of the **Women's Land Army. Contact:** Knighton Joyce, 37 Hilderthorpe Rd., Bridlington, Humberside YO15 3AZ, England.

Seeking information and pictures of **Army YO-55 (Ercoupe)** based at Wright Field and Chanute Field from 1941 on. Only one Ercoupe, serial number 41-18875, was purchased by the Army. I am restoring a 1940 Ercoupe to the YO-55 configuration. **Contact:** Maj. Keith Smith, USAF (Ret.), 5733 Green Meadow Dr., Agoura Hills, CA 91301.

Seeking the whereabouts of **A2C David John Stough,** who was stationed at RAF Burtonwood, England, between 1954 and 1960. **Contact:** The Rev. Michael Finlay, St. Margarets Vicarage, Orford, Warrington, Cheshire WA2 8DT, England.

Seeking information on **Sgt. Robert B. Kimble** of the 414th Bomb Squadron, 97th Bomb Group, 15th Air Force, who was missing in action December 3, 1944. I would especially like to contact his crewmates. **Contact:** Charles R. Kimble, 5820 Prince William, Louisville, KY 40207-4425.

Seeking information on and photographs of **patches. Contact:** Sergio Nol Zabala Peréz, Comando Fuerza Aerea, Departamento de Seguridad, Ofic. 305, CAN Avenida el Dorado, Bogotá, Colombia. ■

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Unit Reunions

A-1 Skyraider Ass'n
The A-1 Skyraiders will hold a reunion September 20–21, 1991, at the Menger Hotel in San Antonio, Tex. **Contact:** Reuben M. Ware, P. O. Box 633, Randolph AFB, TX 78148. Phone: (512) 828-2062.

AACS Alumni Ass'n
Members of the Airways and Air Communications Service will hold a reunion September 19–22, 1991, in Dayton, Ohio. **Contact:** Martin Whetstone, 1001 Lake Dr., New Carlisle, OH 45344. Phone: (513) 845-3673.

Azores Veterans
Personnel stationed at Lajes Field, Azores, between 1940 and 1950 (all services) will hold a reun on on September 26–28, 1991, at Wright-Patterson AFB, Ohio. **Contact:** Robert M. Watson, 4171 Rondeau Ridge Dr., Kettering, OH 45429-1325. Phone: (513) 299-2473.

C-7A Caribou Veterans
C-7A Caribou veterans will hold a reunion July 26–28, 1991. (Please send a self-addressed, stamped envelope for information). **Contact:** Nick Evanish, 210 48th St., Gulfport, MS 39507. Phone: (601) 863-8688.

"Gangway" Ass'n
Members of the 9th Air Force "Gangway" Association will hold a reunion September 20–22, 1991, in Colorado Springs, Colo. **Contacts:** Gen. Robert M. Lee, 2723 Fawn Grove Ct., Colorado Springs, CO 80906. Phone: (719) 579-9608. Jerry Stover, 4025 Druid Ln., Dallas, TX 75205. Phone: (214) 522-0227.

NATO Tigers
Members of the NATO Tigers are invited to participate in the International Air Tattoo '91, which will be held at RAF Fairford, England, July 17–21, 1991. The theme of this year's International Air Tattoo will be "Tiger Meet '91," so all Tigers are encouraged to attend. **Contact:** 53d Tigers, APO New York 09132. Phone: 49-6561-61-7053. DSN: 453-7053.

Pleiku AB Ass'n
The Pleiku AB Association and the 633d SOW will hold a reunion August 1–4, 1991, in Dayton, Ohio. **Contacts:** John Reiley, P. O. Box 724, Melrose, MA 02176-9998. Phone: (617) 322-0496 or (412) 339-2498 (Tom Rushnock).

Salinas AAB
All veterans who were stationed at Salinas AAB, Calif., will hold a fiftieth-anniversary reunion September 6–8, 1991. **Contact:** Harold Oberg, 3 Fairfax Cir., Salinas, CA 93901. Phone: (408) 422-1460.

Tuskegee Airmen
The Tuskegee Airmen will hold a reunion August 6–11, 1991, in Detroit, Mich. **Contact:** Harry Stewart, P. O. Box 21908, Detroit, MI 48221. Phone: (313) 496-5165.

7th Photo Recon Group
Members of the 7th Photo Reconnaissance Group will hold a reunion October 24–27, 1991, at the Delta Resort Hotel in Orlando, Fla. **Contact:** Col. George A. Lawson, USAF (Ret.), 4390 14th St., N. E., St. Petersburg, FL 33703. Phone: (813) 526-8480.

8th Air Rescue Squadron
Members of Strategic Air Command's 8th Air Rescue Squadron will hold a reunion September 27–29, 1991, in Colorado Springs, Colo. **Contact:** William A. Porter, 4416 Valencia Cir., Colorado Springs, CO 80917. Phone: (719) 596-0221.

9th Air Force Ass'n
The 9th Air Force Association will hold its first annual convention September 4–8, 1991, in Dayton, Ohio. **Contact:** Marvin Rosvold, 600 S. 13th, Norfolk, NE 68701. Phone: (402) 371-6633.

19th Bomb Group
The 19th Bomb Group will hold its regional reunion September 26–28, 1991, in Hampton, Va. **Contacts:** James A. Kiracofe, 274 Quinn Rd., West Alexandria, OH 45381. Phone: (513) 839-4441. Harry Carlson, 122 Dogwood Dr., Newport News, VA 23606. Phone: (804) 596-1397.

22d Bomb Group
Veterans of the 22d Bomb Group, 5th Air Force (World War II), which included the 2d, 19th, 33d, and 408th Bomb Squadrons, will hold a reunion September 19–22, 1991, in Hampton, Va. **Contact:** John E. Clark, P. O. Box 560967, Rockledge, FL 32956-0967.

32d Fighter Squadron
Members of the 32d Fighter Squadron who served in the Caribbean Air Force, 6th Air Force, and Caribbean Air Defense Command between 1941 and 1946 will hold a reunion September 27–29, 1991, in the Dayton, Ohio, area. **Contacts:** Paul N. Prass, 619 Butterfield Dr., East Lansing, MI 48823. Don L. Baker, 824 Bridlewood Rd., Copley, OH 44321.

33d Air Depot Group
The 33d Air Depot Group will hold a reunion September 13–15, 1991, in Fort Mitchell, Ky. **Contacts:** Herbert L. Cooper, 643 Reynosa Ct., Berea, OH 44017. Phone: (216) 234-9007. Robert W. Gocholl, 10280 Pendery Dr., Cincinnati, OH 45242. Phone: (513) 891-7742.

39th Bomb Group
Veterans of the 39th Bomb Group who served on Guam during World War II will hold a reunion August 15–17, 1991, in the Harrisburg, Pa., area. **Contacts:** James Wyckoff, 2714 E. Hayt's Corners Rd., Ovid, NY 14521. Phone: (607) 869-2574. Robert E. Weiler, 516 Canal Rd., Sarasota, FL 34242. Phone: (813) 346-0188.

Class 42-A
Members of Class 42-A (Kelly, Ellington, and Foster AAFs) will hold a reunion October 17–20, 1991, at the Sheraton-Gunter Hotel in San Antonio, Tex. **Contact:** A. R. Bredewater, 2 Royal Crest, New Braunfels, TX 78130. Phone: (512) 629-2697.

43d Air Service Squadron
The 43d Air Service Squadron, 5th Air Force, will hold a reunion September 18–20, 1991, in Lompoc, Calif. **Contact:** Elvis Stitch, 300 Amherst Pl., Lompoc, CA 93436. Phone: (805) 735-1451.

Class 43-E
Pilot Class 43-E will hold a reunion October 31–November 3, 1991, in Tucson, Ariz. **Contact:** Donald A. Conner, P. O. Box 14572, North Palm Beach, FL 33408-0572. Phone: (407) 622-6852.

49th Troop Carrier Squadron
Members of the 49th Troop Carrier Squadron, 313th Troop Carrier Group, will hold a reunion September 26–28, 1991, in Denver Colo. **Contact:** Elmer H. Munkvold, 8922 W. Cherry Ave., River Grove, IL 60171. Phone: (708) 452-9685.

64th Fighter-Interceptor Squadron
The 64th Fighter-Interceptor Squadron will hold a reunion September 20–22, 1991, at the Embassy Suites Hotel in Colorado Springs, Colo. **Contact:** Lt. Col. George Sewell, USAF (Ret.), 4876 W. Red Rock Dr., Larkspur, CO 80118. Phone: (303) 681-2478 or (303) 977-7759.

85th Bomb Squadron
Members of the 85th Bomb Squadron who served between 1940 and 1962 will hold a reunion August 17–21, 1991, at the Ramada Hotel–San Remo Casino and Resort in Las Vegas, Nev. **Contact:** G. Edward Watson, Jr., 2 Homestead Ave., Danbury, CT 06810. Phone: (203) 791-9073.

91st Troop Carrier Squadron
The 91st Troop Carrier Squadron, 439th Troop Carrier Group (World War II), will hold a reunion September 12–15, 1991, at the Green Oaks Inn and Conference Center in Fort Worth, Tex. **Contacts:** William A. McGlohen, 6413 Lansdale Rd., Fort Worth, TX 76116-1623. Phone: (817) 732-4330. Bill Rankin, 410 James Blvd., Signal Mountain, TN 37377. Phone: (615) 886-2926.

95th Bomb Group
The date announced in the April 1991 issue for the 95th Bomb Group reunion has changed. The reunion will be held September 9–20, 199l, in Reno, Nev. **Contact:** Frank Coleman, 9 Marlette Dr., Carson City, NV 89703. Phone: (702) 882-3398.

302d Tactical Recon Squadron
Members of the 302d Tactical Reconnaissance Squadron will hold a reunion in October 1991. **Contact:** Roger S. Wilkes, 8918 Taft Hill Ct., Sandy, UT 84093. Phone: (801) 943-0529.

306th Bomb Wing
The 306th Bomb Wing (McCoy AFB, Fla.) will hold a reunion November 6–10, 1991, in Cape Canaveral, Fla. **Contact:** Joe Demes, 1585 Mercury St., Merritt Island, FL 32953. Phone: (407) 452-4417.

306th/312th/316th FCS
Members of the 306th, 312th, and 316th Fighter-Control Squadrons will hold a reunion September 27–29, 1991, at the Park East Hotel in Milwaukee, Wis. **Contact:** Ray Allen, 480 W. Briar Ln., Green Bay, WI 54301. Phone: (414) 336-1114.

339th Fighter Group
The 339th Fighter Group, 8th Air Force (World War II), will hold a reunion September 11–15, 1991, in Cincinnati and Dayton, Ohio. **Contact:** Chet Malarz, 2405 Kings Point Dr., Atlanta, GA 30338.

340th Fighter Squadron
Members of the 340th Fighter Squadron, 348th Fighter Group, will hold a reunion September 19–22, 199, in Pittsburgh, Pa. **Contact:** Kenneth Evans, 280 Fernledge Dr., New Kensington, PA 15068. Phone: (412) 335-3208.

341st Fighter Squadron
The 341st Fighter Squadron, 348th Fighter Group, Fifth Air Force (World War II), will hold a reunion September 26–29, 1991, in Boston, Mass. **Contact:** Art Cronk, 32 Mulberry St., Trumbull, CT 06611. Phone: (203) 268-6579.

352d Fighter Group
Members of the 352d Fighter Group and the 1st Service Group will hold a reunion November 7–10, 1991, in Orlando, Fla. **Contact:** Richard J. DeBruin, 234 N. 74th St., Milwaukee, WI 53213. Phone: (414) 771-0744.

368th Fighter Group
The 368th Fighter Group, 9th Air Force (World War II), will hold a reunion October 3–6, 1991, at the Marina Marriott in San Diego, Calif. **Contacts:** Marvin Rosvold, 600 S. 13th, Norfolk, NE 68701. Phone: (402) 371-6633. Bill Wright, P. O. Box 2193, Rancho Santa Fe, CA 92067. Phone: (619) 756-2112.

380th Bomb Wing
The 380th Bomb Wing is hosting a reunion August 23–25, 1991, for FB-111A aviators. **Contact:** Maj. Hans J. Otten, USAF, PSC Box 111, Plattsburgh AFB, NY 12903. Phone: (518) 565-5855.

388th Bomb Group
The 388th Bomb Group will hold a reunion August 19, 1991, at the Holiday Inn in King of Prussia, Pa. **Contact:** Edward J. Huntzinger, 1925 S. E. 37th St., Cape Coral, FL 33904-5076. Phone: (813) 542-4807.

390th Bomb Group
Members of the 390th Bomb Group, 8th Air Force (World War II), will hold a reunion October 23–26, 1991, in Tucson, Ariz. **Contacts:** 390th Memorial Museum Foundation, P. O. Box 15087, Tucson, AZ 85708. Phone: (602) 996-5105 (Bob Waltz) or (602) 577-3909 (Al Buehler).

Readers wishing to submit reunion notices to "Unit Reunions" should mail their notices well in advance of the event to "Unit Reunions," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Please designate the unit holding the reunion, time, location, and a contact for more information.

407th Air Refueling Squadron
Members of the 407th Air Refueling Squadron, stationed at Malmstrom AFB, Mont., will hold a reunion August 17, 1991, in Great Falls, Mont. **Contact:** Si Dahle, 1273 Mulberry Ave., Atwater, CA 95301. Phone: (209) 358-0333.

454th Bomb Squadron
The 454th Bomb Squadron, 323d Bomb Group, 9th Air Force, will hold a reunion September 18–22, 1991, at the Clarion Hotel in New Orleans, La. **Contact:** Joe Havrilla, 1208 Margaret St., Munhall, PA 15120-2048. Phone: (412) 461-6373.

455th Bomb Squadron
Members of the 455th Bomb Squadron, 323d Bomb Group, 9th Air Force, will hold a reunion September 11–15, 1991, in Seattle, Wash. **Contact:** Leonard D. Metzger, 18409 64th N. E., Seattle, WA 98155-4703.

2875th Test Squadron
Members of the 2875th Test Squadron (formerly flight-test branch) stationed at Robins AFB, Ga., will hold a reunion October 25, 1991. **Contacts:** Capt. H. Alan Scheibe or Staff Sergeant Byers, 2875th Test Squadron (AFLC), Robins AFB, GA 31098-5990. Phone: (912) 926-3102.

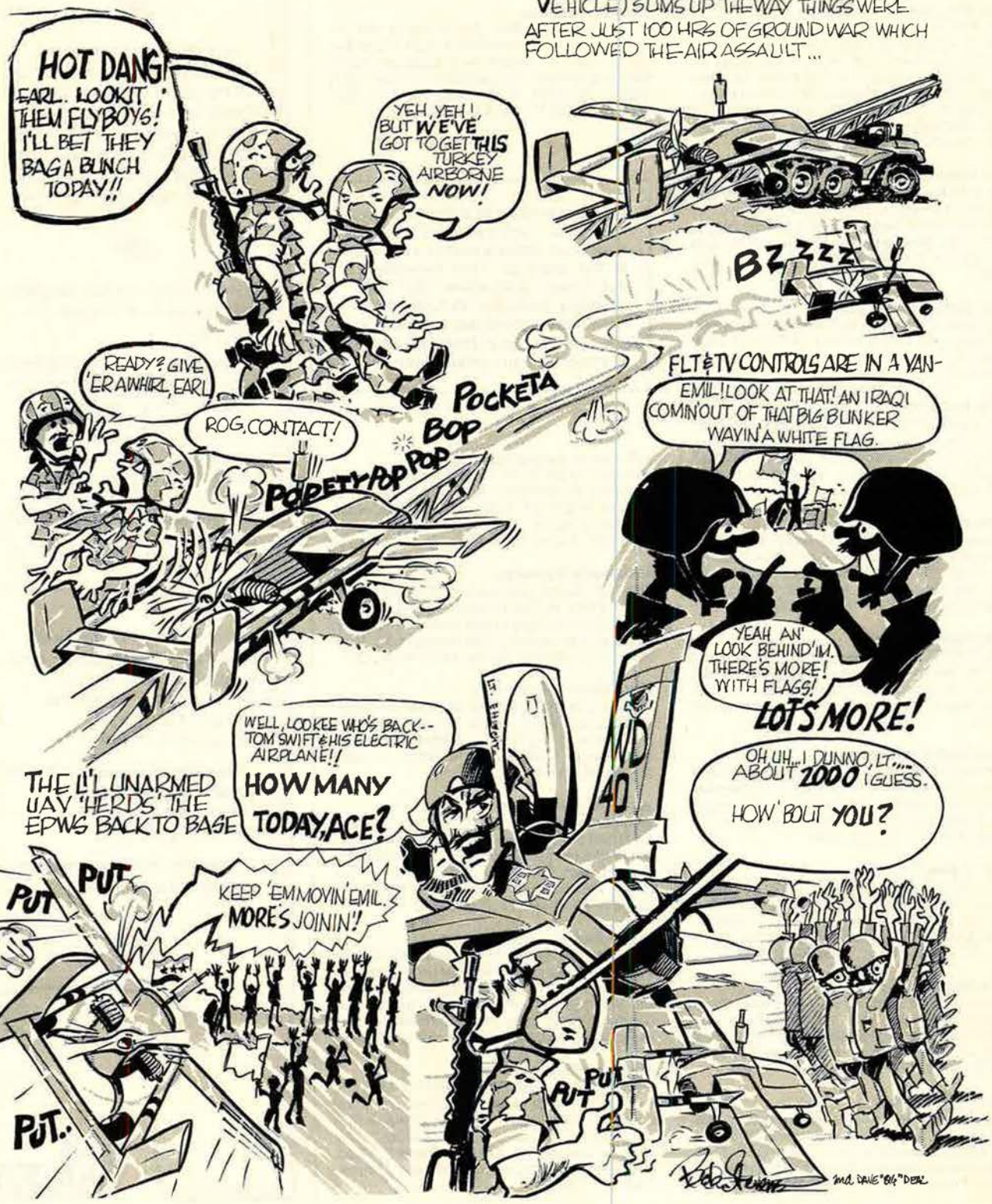
3308th Pilot Training Squadron
Students and instructors of the 3308th Pilot Training Squadron and ServAir Corp. stationed at Stallings AB, N. C., will hold a reunion November 1–2, 1991, in Kinston, N. C. **Contact:** Col. Charles B. West, USAF (Ret.), 429 Edinburgh Dr., Fayetteville, NC 28303. Phone: (919) 864-2439.

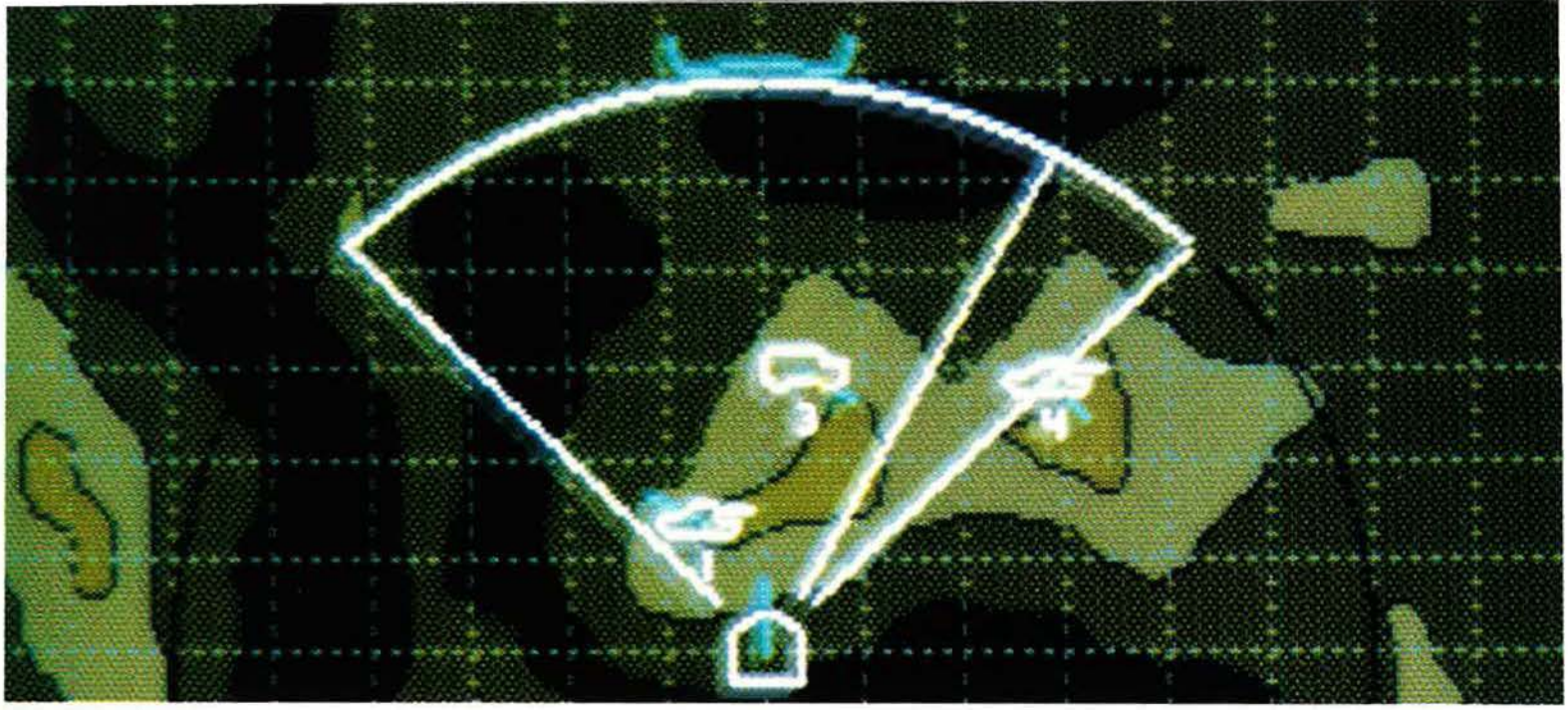
4060th Air Refueling Wing
Members of the 4060th Air Refueling Wing and the 71st and 341st Air Refueling Squadrons stationed at Dow AFB, Me., between 1954 and 1964 are planning to hold a reunion August 22–24, 1991, in Bangor, Me. **Contact:** Ralph B. Reed, RFD 1, Box 3655, Stonington, ME 04681. Phone: (207) 367-2794. ■

Bob Stevens'

"There I was..."

...FLAT ON MY BACK IN A HOSPITAL, RECOVERING FROM A STROKE WHILE THE SWIFTEST, MOST SUCCESSFUL AIR WAR IN OUR HISTORY BLAZED IN THE PERSIAN GULF. A *FAST* WAR? WHEN MY LIGHTS WENT OUT, THE US-LED COALITION WAS EYEBALL TO EYEBALL WITH SADDAM'S FORCES ACROSS A LINE IN THE SAND. WHEN I CAME TO, WE WERE MOPPING UP and THE IRAQIS HAD RUN OUT OF WHITE SHIRTS THIS STORY ABOUT A UAV (UNMANNED AERIAL VEHICLE) SUMS UP THE WAY THINGS WERE AFTER JUST 100 HRS OF GROUND WAR WHICH FOLLOWED THE AIR ASSAULT...





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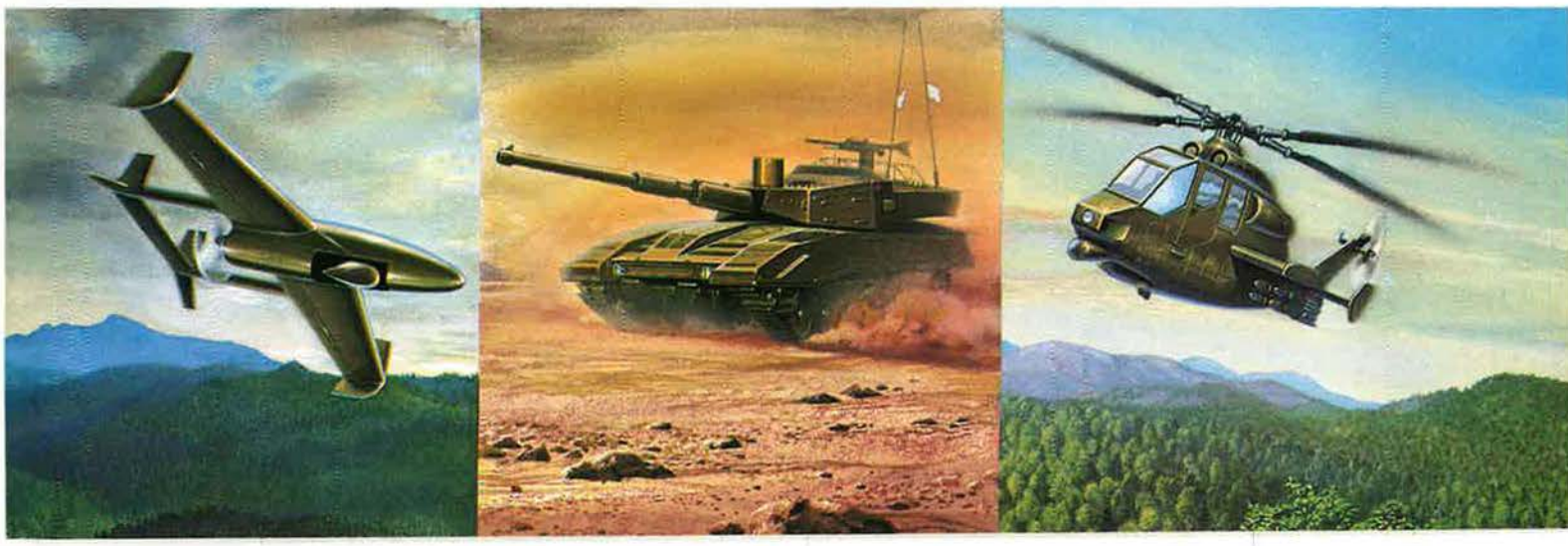

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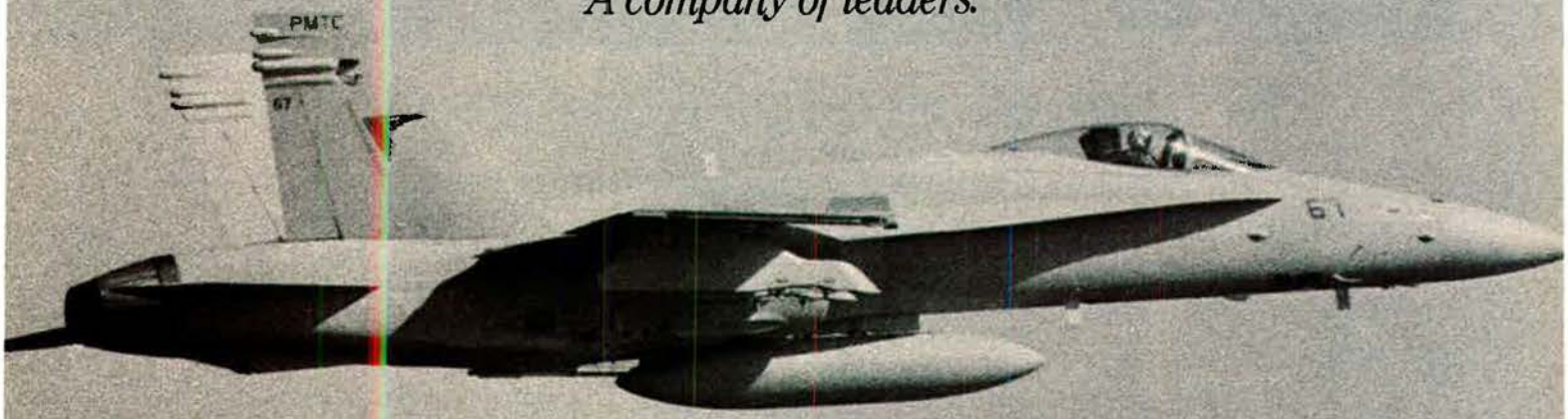

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