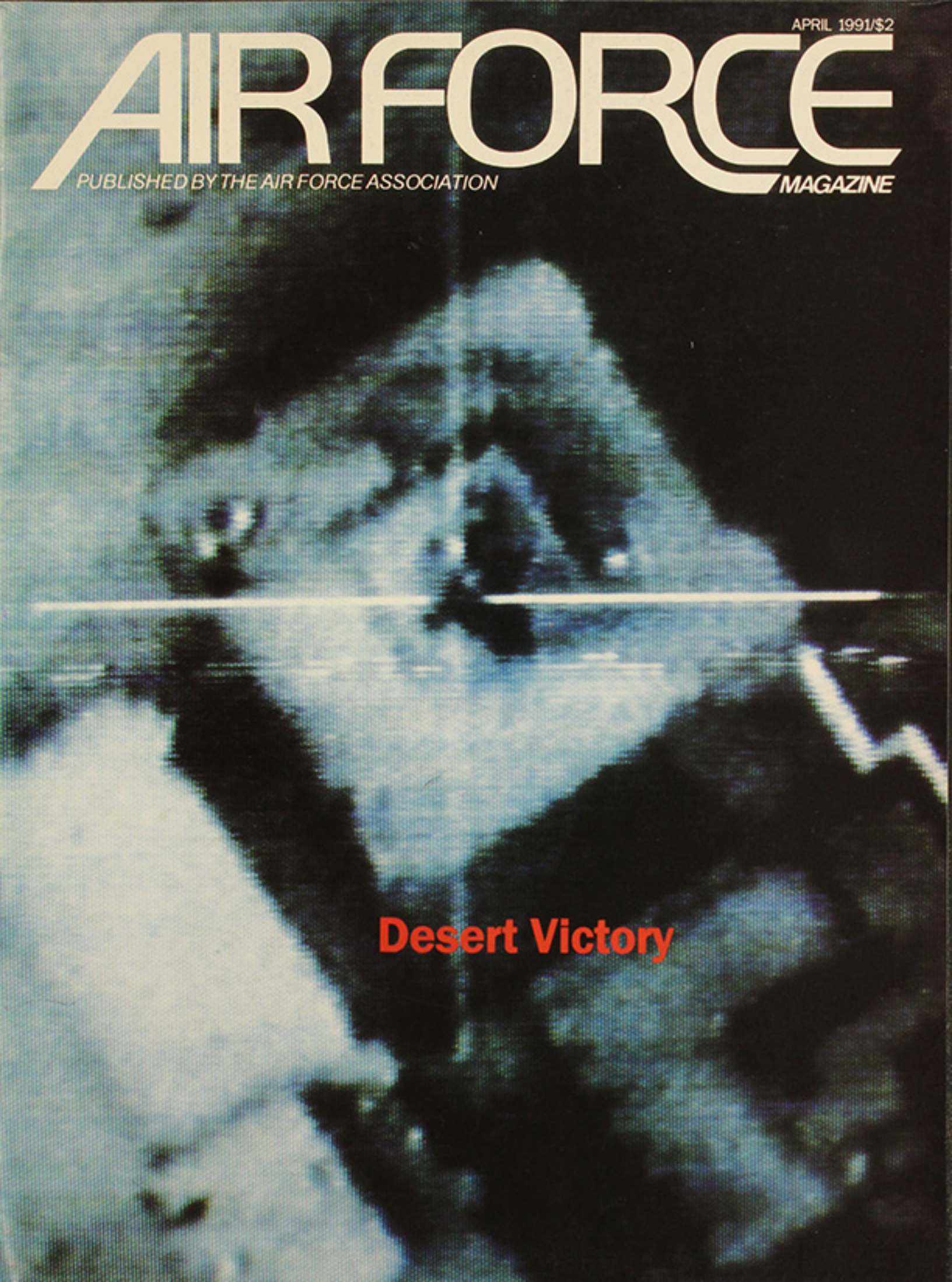
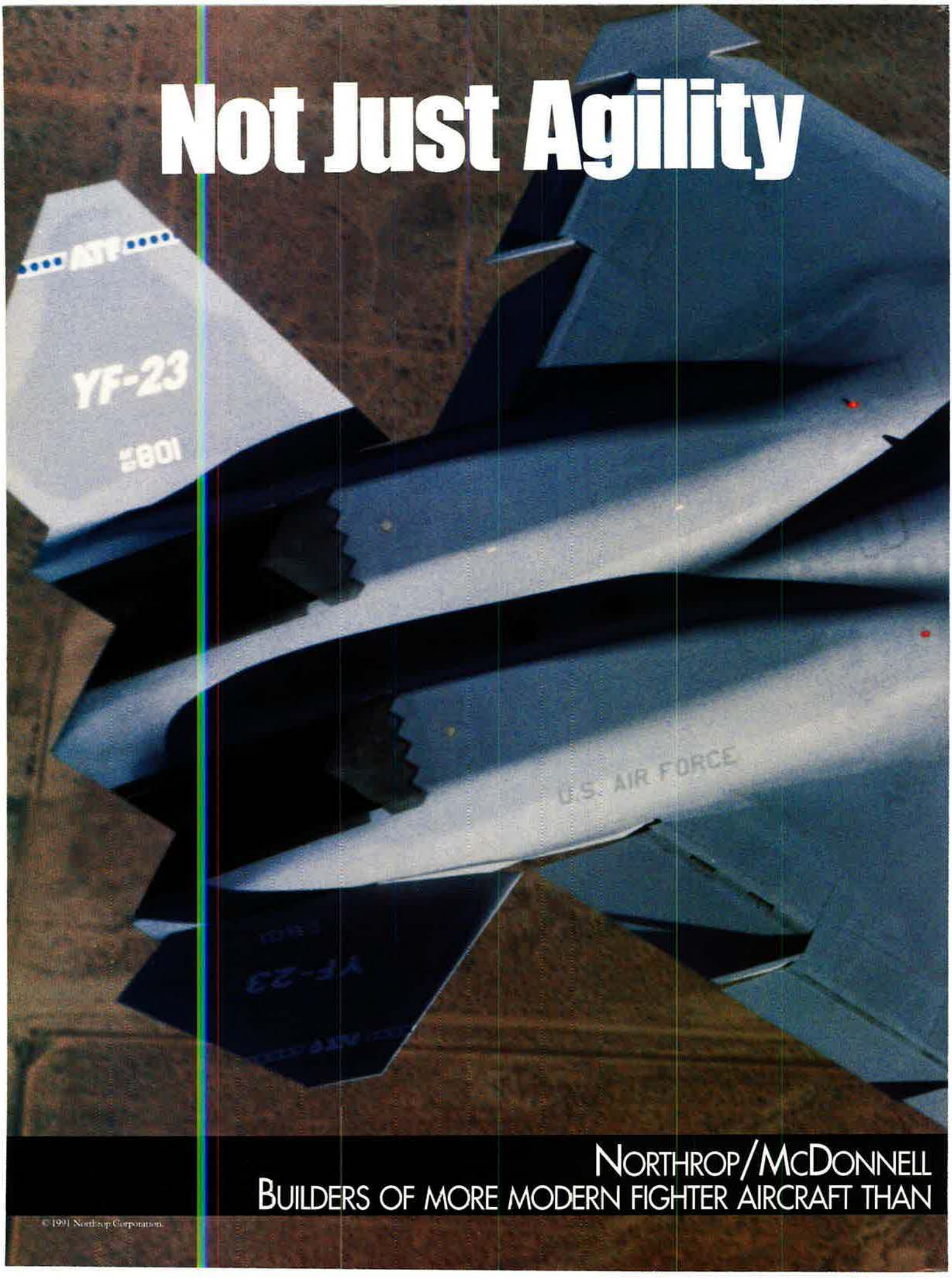
APRIL 1991/$2

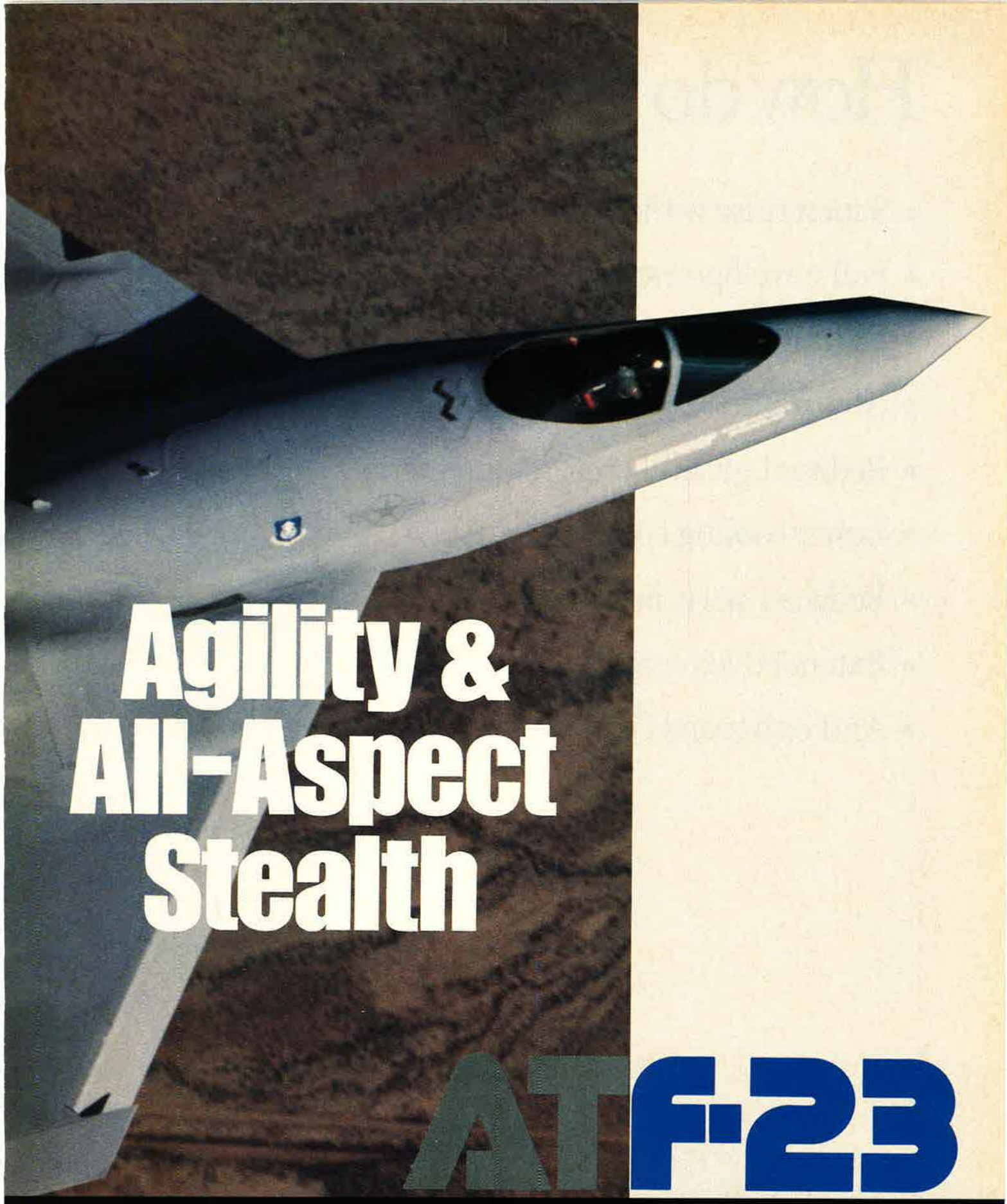
AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION



Desert Victory





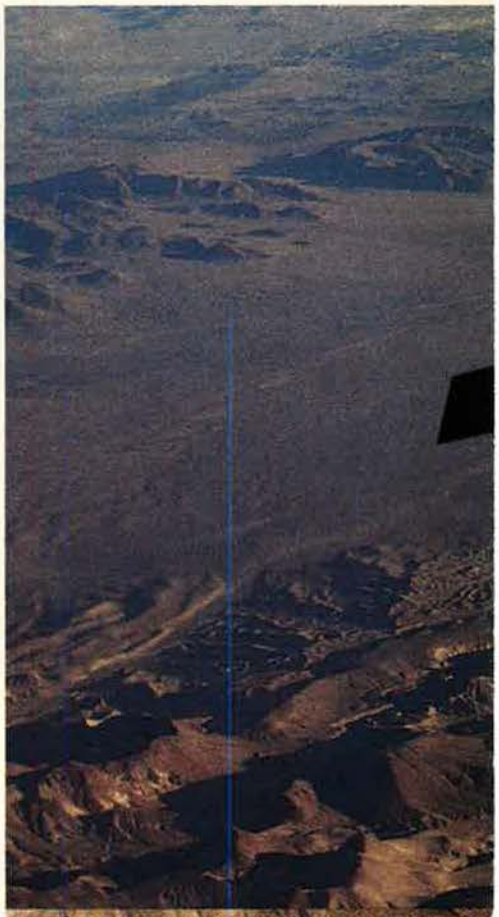
Agility & All-Aspect Stealth

ATF-23

DOUGLAS
ALL OTHER U.S. COMPANIES COMBINED

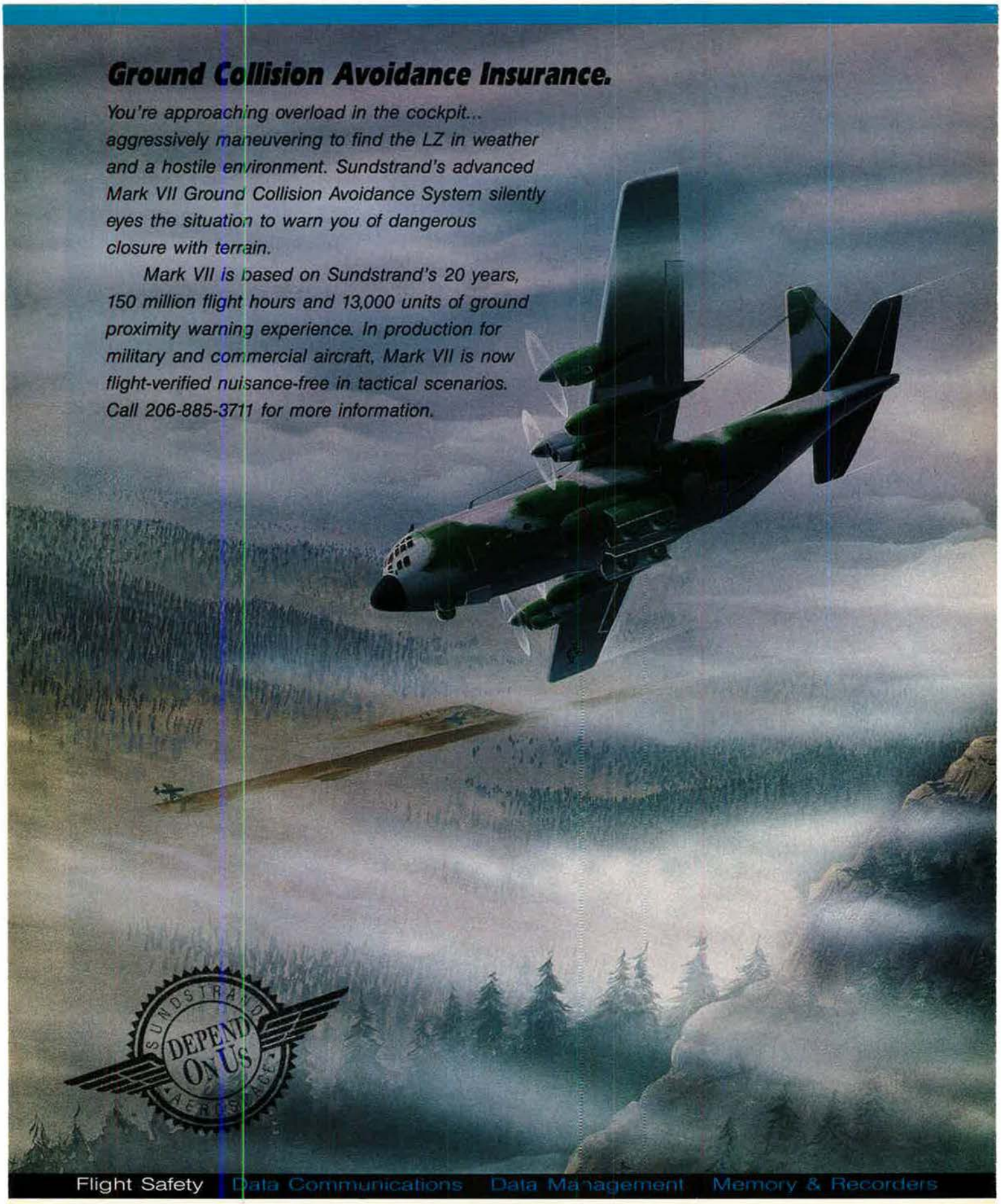
How do you get:

- Supercruise without augmentation
- Full envelope exploitation
- Significantly increased reliability
- No throttle restriction
- Reduced ground crew requirements
- Lower tooling costs
- Reduced parts inventory
- Extended loiter time
- And enhanced field repairability?



GE Aircraft Engines
Keeping the Promise

GE F120. The advanced technology engine that's proven it can meet or exceed ATF requirements.


Ground Collision Avoidance Insurance.
You're approaching overload in the cockpit... aggressively maneuvering to find the LZ in weather and a hostile environment. Sundstrand's advanced Mark VII Ground Collision Avoidance System silently eyes the situation to warn you of dangerous closure with terrain.
Mark VII is based on Sundstrand's 20 years, 150 million flight hours and 13,000 units of ground proximity warning experience. In production for military and commercial aircraft, Mark VII is now flight-verified nuisance-free in tactical scenarios. Call 206-885-3711 for more information.
SUNDSTRAND
DEPEND ON US
AEROSPACE
Flight Safety
Data Communications
Data Management
Memory & Recorders
Avionic Systems
SUNDSTRAND AEROSPACE
REDMOND, WASHINGTON 98073 Sundstrand Corporation

April 1991, Vol. 74, No. 4

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Departments

About the cover: Precision munitions and high technology proved their worth in the Gulf War. Strike camera footage from an F-117A shows a Baghdad communications center, which housed the Iraqi Defense Force headquarters, centered in the cross hairs.

Desert Victory

AIR FORCE Magazine (ISSN 0730-6784) April 1991 (Vol. 74, No. 4) is published monthly by the Air Force Association, 1501 Lee Highway, Arlington, Va. 22209-1198. **Phone** (703) 247-5800. Second-class postage paid at Arlington, Va., and additional mailing offices. **Membership Rate:** $21 per year; $48 for three-year membership. **Life Membership:** $300. **Subscription rate:** $21 per year; $25 per year additional for postage to foreign addresses (except Canada and Mexico, which are $8 per year additional). Regular issues $2 each. Special issues (USAF Almanac issue and Anniversary issue) $5 each. **Change of address** requires four weeks' notice. Please include mailing label. **POSTMASTER:** Send change of address to Air Force Association, 1501 Lee Highway, Arlington, Va. 22209-1198. Publisher assumes no responsibility for unsolicited material.

Editorial

By John T. Correll, Editor in Chief

Nitwitness News

THE ADAGE that there's no such thing as a stupid question took heavy damage in the Gulf War. Henry Allen said it perfectly in the Washington *Post* February 21: "The Persian Gulf press briefings are making reporters look like fools, nitpickers, and egomaniacs . . . dinner party commandos, slouching inquisitors, college spitball artists . . . a whining, self-righteous, upper-middle-class mob. . . ."

Let it be noted that much of the news coverage was very good, and some of it was excellent. Radio and television carried the briefings from Riyadh and the Pentagon, uncut and without commercial interruption. For the most part, their expert analysts really were experts. When reporters stuck to reporting the news, they generally did a commendable job of it.

Unfortunately, those qualities were often eclipsed by the arrogance, incompetence, and bias demonstrated by more than a few reporters, correspondents, and news show moderators.

Colman McCarthy of the Washington *Post* staked out the low ground in a February 17 column that sneered at US airmen as "fearless warriors" conducting an "aerial massacre" at small risk to themselves in "a coward's air war."

McCarthy, however, is an extreme example. Such diatribes must be factored out if one wishes to reach useful conclusions about why workaday journalism in the Gulf War deteriorated so often into Nitwitness News.

Some of it was the sheer incompetence and ignorance of amateur war correspondents. The defense world was deeply impressed by the unprecedented feat of a missile knocking another missile out of the sky, but when one of the Iraqi Scuds got through, a National Public Radio analyst yawned that "three out of four is not very good."

At times the comments from the amateurs were so dumb that they were funny, but the more important explanations of the Nitwitness News phenomenon lie in the prevailing psychology of the news media.

Contrary to popular belief, the working press is seldom consumed by a desire "to sell newspapers." Reporters may be motivated by idealism, dreams of a Pulitzer Prize, or a few extra minutes of airtime, but they cultivate an active disregard for circulation, advertising, and other economic considerations.

Who says there's no such thing as a stupid question?

Reporters like to envision themselves as champions of the public. Writing in *Newsweek* February 25, Walter Cronkite charged that "the US military in Saudi Arabia is trampling on the American people's right to know." According to the polls, the public figured the media had all the information they needed to report the war. That, Mr. Cronkite said, "can only be because the press has failed to make clear the public's stake in the matter."

Could it be instead that the public has not appointed Mr. Cronkite to determine its informational requirements and understands the situation better than Mr. Cronkite believes? As the Jacksonville, Fla., *Times-Union* asked in an editorial, "Why does a farmer in Nebraska or a cabbie in Manhattan need to know exactly how many A-10 Thunderbolts are stationed northwest of Jubayl?"

Given their chance to ask questions, reporters went mostly after speculation, irrelevancies, and excruciating detail. In one instance, they clamored for a description of the markings by which pilots recognized traffic on the ground as allied rather than enemy vehicles.

Columnists Jack Anderson and Dale Van Atta argue that media performance at the briefings was somehow a natural consequence of keeping reporters "corralled" in Riyadh and limiting press pools in the field to 100 or so, a ratio they compute at one journalist per 5,000 soldiers.

Whatever the forensic merits of that theory, pool reports and other sources were obviously providing the basic facts and a great many details about the war to anyone who wanted them.

As quoted by *Editor & Publisher,* house organ of the trade, David Lamb of the Los Angeles *Times* complained that "pool reporting tends to dilute individual creativity." In that, Mr. Lamb came close to spilling the beans.

The road to glory and airtime is not paved with the ordinary facts unless one has them before the other reporters do. A large portion of the 1,400-member media contingent in Saudi Arabia and their counterparts operating in the Pentagon and elsewhere wanted scoops and exclusives. They wanted to be creative.

The military and the media dislike and distrust each other. The hostility is deep-rooted and has grown steadily worse over the past twenty years.

Some reporters expected—and obviously wanted—to catch the military in lies or malfeasance. Many of the military officials expected sabotage from the media. Some of what we saw on television was sparks from that friction.

The Nitwitness News drill did not help that relationship. The military will almost certainly take it as confirmation of its suspicions. That's a shame, because the media are not a monolithic "They," and many reporters performed responsibly and well during the Gulf War.

What the media learned from the experience remains to be seen. ■

NEVER SAY 'SAY AGAIN' AGAIN.

COLLINS ATHS.

The Collins CP-1516/ASQ Automatic Target Handoff System (ATHS) helps ensure clear, quick, C^3I communications. It facilitates air/air and air/ground interoperability, and provides target steering cues on HUDs or CRT displays.

Instead of vulnerable voice communications, Collins ATHS uses digital data bursts to minimize jamming and to reduce enemy detection while speeding the transfer of accurate battle information.

The system uses any MIL-STD-1553B or ARINC 429 transceiver to resolve target location and exchange target information between force elements. It's totally transparent to the system architecture.

ATHS provides data for such HUD symbols as target I.D., range and steerpoint.

Now flying on U.S. Army OH-58D and AH-64s, the 10 lb. Collins ATHS can be easily integrated into aircraft and ground vehicles. And it's interoperable with TACFIRE and the Battery Computer System.

For more information contact: Collins Avionics and Communications Division, Rockwell International, Cedar Rapids, Iowa 52498. (319) 395-2208. Telex 464-421 COLLENGR CDR.

COLLINS AVIONICS

Rockwell International

...where science gets down to business

Tactical

Reconnaissance

Close Air Support

Defense Suppression

Surface Attack

Interceptor

USN Adversary

BUY AN AIRPLANE, GET A TOTAL AIR FORCE.

In these days of tightening defense budgets, air forces are demanding more from their aircraft programs. Pound for pound, dollar for dollar, no other fighter in history has delivered more than the F-16.

It simply performs more roles with more reliability than anything else that flies. No matter what the mission, air-to-air, air-to-ground, or air-to-surface. No matter what the weather, day or night. No matter what the tactic. One awesome force continues to set the standard in getting the job done.

The F-16.

GENERAL DYNAMICS

A Strong Company For A Strong Country

Letters

March Cover

I just received my March 1991 issue and promptly recognized the Wild Weasel pilot (or at least his aircraft) on the cover: my roommate from the Air Force Academy, Class of '72. However, Lt. Col. Carl Puels is the 81st Tactical Fighter Squadron's Operations Officer, part of the 52d Tactical Fighter Wing out of Spangdahlem AB, Germany—not the 35th Tactical Fighter Wing out of George AFB, Calif., as you stated, although he was stationed there in the early 1980s.

It was great to "see" him after receiving a letter from him after he completed more than twenty missions in support of Desert Storm. We are very thankful to Carl and the others in the coalition forces who were so successful in their efforts to free Kuwait.

Thanks for the opportunity to clarify the record.

Lt. Col. Ken Engebretson, USAF
Langley AFB, Va.

Assessing the Media

Thank you for the February 1991 editorial "The B-2 and Television" *[see p. 4]*. Your assessment of the media tactics concerning the military is right on. The media's coverage of Desert Storm has taken on the same distortion. They are still embellishing their reports with pejorative adjectives and reporting with relish any of the operation's problems. . . . I understand that a lot of Americans are beginning to feel that the press is a bit out of control.

Ernest H. Daniels
Riyadh, Saudi Arabia

Reforming the Academy

I have read with interest, and some amusement, the ongoing controversy regarding commissioning sources *[see "Academy Grads Heard From," February 1991 "Letters," p. 6]*. With a twenty-two-year career split equally between the enlisted ranks and the officer corps and a three-and-one-half-year tour of duty on the teaching staff of the Air Force Academy, I think I may bring a different perspective to the issues being so hotly argued.

The USAF personnel system may or may not give advantages to Academy graduates. I suspect that it does, but I can offer only anecdotal evidence in support of my belief. However, what is important is that there is a widespread perception in the Air Force that a "ring knockers" network exists and that it works to advance the career interests of Academy graduates.

If there is such favoritism, it seems unwarranted. As letter-writer Colonel Scott points out, there seems to be no correlation between commissioning source and job performance after graduation.

In the other letters, Captain Lyons tells us that commitment to a twenty-year service career should not be expected to be any greater among Air Force Academy graduates than those commissioned from ROTC or OTS and Mr. Keeling admits that the retention rate for Air Force Academy graduates is unacceptably low. He excuses that on the grounds that the "real" Air Force is a letdown for Air Force Academy graduates. What a joke! By the time he graduated in 1980, the USAF officer corps was permeated with Academy grads. Are we to believe that they lacked the drive, imagination, and intelligence necessary to shape the "real" Air Force to their liking? If they could not, it says a great deal about the shortcomings . . . of an Academy education.

Dealing with letdowns experienced in the real world is part of growing up. Back in the 1960s when I was an NCO, we just got on with the job, had a beer or two after work at the club, and listened on the jukebox to a chorus or two of "I Never Promised You a Rose Garden."

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

Captain Lyons gets to the nub of one of the root problems. He tells us that we cannot expect eighteen-year-olds to make a career-length commitment. Apparently they are too young to know what they are doing, and they don't know enough about the profession they are entering (or any other career opportunity). In short, in many respects they are still children. Does something happen to some of these children at the Air Force Academy that prevents them from growing up?

When I was teaching at the Academy, it was jokingly called "the best junior college in the country," a reflection of the large number of cadets who dropped out at the end of their second year, immediately before incurring a service obligation. I know nothing about the active-duty attrition rate, but the letters I read indicate it is alarmingly high.

Why not turn the service academies into graduate schools that offer entry-level professional officer training in the form of a master's degree in Military Science in an intensive, year-round, eighteen-month or two-year program? The academies would be educating significantly more mature persons who had surveyed the career opportunities available to college graduates and made an informed choice of a service career. The academies would no longer be indoctrinating children attracted by a "free" education and a viewing of "Top Gun."

Graduates of these reformed academies would be commissioned as regular officers. ROTC, if retained, would serve only the needs of the Reserve establishment. Officer Training School would be a standby program to be activated in a time of national emergency when the armed forces are undergoing a massive expansion. You could probably do away with Squadron Officer School.

This reform of the service academies might save a significant amount of money, end much of the controversy, preserve the service academies, increase officer retention rates, and lead to a more professional officer corps. Once Desert Storm is behind us, it is clear that the services will have to deal with deep budget cuts. This

AIR FORCE MAGAZINE
PUBLISHED BY THE AIR FORCE ASSOCIATION

Publisher
Monroe W. Hatch, Jr.

Associate Publisher
Charles E. Cruze

Editor in Chief
John T. Correll

Executive Editor
Robert S. Dudney

Senior Editor
James W. Canan

Aeronautics Editor
Jeffrey P. Rhodes

Associate Editor
Colleen A. Nash

Contributing Editors
John L. Frisbee
Brian Green
Bob Stevens
John W. R. Taylor

Managing Editor
Francine Krasowska

Assistant Managing Editor
Daniel M. Sheehan

Director of Production
Robert T. Shaughness

Art Director
Guy Aceto

Assistant Art Director
Sherryl Coombs

Research Librarian
Pearlie M. Draughn

Editorial Assistants
Amy D. Griswold, Grace Lizzio

Administrative Assistant
Wendy L. Rivera

Advertising Director
Charles E. Cruze
1501 Lee Highway
Arlington, Va. 22209-1198
Tel: 703/247-5800
Telefax: 703/247-5855

Director of Marketing Services
Patricia Teevan—703/247-5800

Assistant Director of Marketing Services
Elizabeth B. Smith—703/247-5800

AREA ADVERTISING MANAGERS
East Coast and Canada
By Nicholas—203/357-7781

Midwest
William Farrell—708/295-2305

West Coast
Gary Gelt—213/295-3050

UK, Benelux, France, Scandinavia, Germany, and Austria
David Harrison
Powers-Overseas Ltd.
46 Keyes House, Dolphin Square
London SW1V 3NA, England
Tel: (44) 71-834-5566
Telex: 24924 OPLIM G
Telefax: (44) 71-630-5878

Italy and Switzerland
Dr. Vittorio F. Negrone
Ediconsult Internationale S.A.S.
Piazzo Fontane Marose 3
16123 Genova, Italy
Tel: (010) 543659
Telex: 211197 EDINTI
Telefax: 10-566-578

BPA Circulation audited by Business Publication Audit

Letters

makes overhaul of USAF's archaic personnel system imperative. The Air Force Academy might be a good place to start.

Capt. John W. Page,
USAF (Ret.)
Seattle, Wash.

The Ramstein Crash

In "Desert Duty" in the February 1991 issue *[see p. 30]*, author Stewart M. Powell refers to the crash of a C-5A in Germany last August. As one of the survivors of the crash, I find it disturbing every time I read incorrect references to the crash in various periodicals. Mr. Powell incorrectly refers to thirteen Air Force Reservists who were killed. To correct the error, there were ten Reserve crew members, nine of whom were killed, and seven active-duty passengers, four of whom were killed.

I take nothing away from the sacrifice of the Reserve members, but I take offense at the consistent neglect of the sacrifice of the active-duty members, including the survivors, in the accident. It's a minor point in an otherwise good article, but because of my experience it's very personal.

Lt. Col. Frederick K. Arzt, Jr.,
USAF
McChord AFB, Wash.

Where's the B-1?

In response to "The B-2 and Television" in the February 1991 issue *[see p. 4]*, I believe you missed the boat a wee bit. Your points in the editorial are well taken, and I certainly am no supporter of the media. However, there have been doubts created by all of the "exotic" weaponry of late. The facts, as they are unfolding in Desert Storm, will lend a lot of credence to the so-called advanced technology weapons.

I am a dedicated supporter of airpower, the Air Force, and its personnel. Some of the people I know are operating in B-52s and other aircraft in the combat area. Others are guarding aircraft, preparing food, repairing aircraft, and operating refueling aircraft.

A lot of my friends from World War II and Korea, who are also members of AFA, are asking, "Where are the B-1s?" This aircraft has been beset with operating problems since its inception and acceptance. This aircraft, I thought, was the replacement for the B-52. However, the "old dog" B-52 is bombing the Iraqis twice daily in Desert Storm while the B-1s are sitting in the US. Will the B-1 ever fly in combat? Is it safe to fly in combat?

This is what I mean by "missing the boat." Doubts have been created about procurement for USAF and some of its weapon systems. Was the B-1 a horrendous mistake? What did it cost the taxpayer? What is it costing the taxpayer while it is sitting on the ground?

The American mind just is not ready to accept a $500,000,000 B-2 without a proper marketing program. I don't know if there is a good enough salesman to sell this program. If the media are negative about the B-2, then it's the fault of the Air Force and the manufacturer for not getting the story to the media and selling it to the public. We can either use the media to our advantage or have the media abuse the Air Force. The choice is ours.

John L. Bill
Powell, Ohio

• *The B-1B was exactly where it was supposed to be: sitting strategic alert, a mission that continued despite Desert Storm. Although the B-1Bs were on the ground with an engine problem, the Air Force said they were fully capable of flying a nuclear mission at any time, had it been necessary. Eventually the B-1B will have a conventional capability, but the preparations for that had not been completed, so it would not have been sent to the Gulf in any case.*

On your point about the B-2, it isn't as easy as you suggest to "use the media to our advantage."—THE EDITORS

Between the Scissor Blades

The January editorial "The Indictment of Airpower" *[see p. 4]* reminds me of the argument that went on for years between two guys who were trying to figure out which blade of a pair of scissors cut the paper.

That would have been an adequate reply to Dr. Jeffrey Record of the Heritage Foundation, who wrote the article "Into the Wild Blue Yonder: Should We Abolish the Air Force?" in *Policy Review.*

We in the Air Force must never lose sight of the two blades of the scissors. Despite the Air Force's overwhelming success, the war in the Persian Gulf will end only when the coalition's infantry occupies something—whether it is Kuwait or part of Iraq or all of Iraq.

Let's concentrate on doing our job better than we have ever done it before. It looks like we have a great start.

Lt. Col. Robert Kahn,
AFRES (Ret.)
Lafayette, Calif.

Age Is Relative

I couldn't help but smile at a statement in "The Russians in MiG Alley"

in the February 1991 issue *[see p. 74]*. It said that in 1951, "Soviet pilots . . . exacted a toll on the *aging* B-29s" (emphasis mine).

I was in one of the first B-29 groups formed in World War II (462d Bomb Group), and we received our first aircraft in late 1943, which made even the oldest B-29 less than eight years old during the Korean War, during which I served in another B-29 unit (22d Bomb Wing).

Desert Storm crews are flying twenty-four-year-old B-52s, fifteen-year-old FB-111s, ten-year-old A-10s, and F-4s that are fifteen years old or older. In fact, I'll wager that activated ANG F-16s are older than the "aging" B-29 of 1951.

Wouldn't these guys love the luxury of such "ancient" aircraft?

Brig. Gen. Alan H. Noyes,
Vermont ANG (Ret.)
Barre, Vt.

An Honor and a Pleasure

What an honor and pleasure it was to open the December 1990 issue and find my ANG unit, the 183d Tactical Fighter Group, so well written up *[see "The Guard Sets a Standard," by Bob Roskuski, p. 50]*. Although I retired from the 183d in 1977 when I reached mandatory retirement age, I still think of it as my unit. I had more than twenty-seven years in the 183d.

The 183d is not a unit that brags about itself. However, the successful deployment described in the article was just one of its many accomplishments. The 183d was one of the first three ANG units to receive the F-84F aircraft in the 1950s, and we kept it flying until the 183d became the very first ANG unit to be assigned the F-4 in 1972.

CMSgt. James A. Prokopp,
USAF (Ret.)
Springfield, Ill.

Mistaken Emphasis

To clear up a mistaken emphasis in "Bombardier" in the December 1990 issue, I would like to point out that the B-17 was *very* active in the Fifth and Thirteenth Air Forces in the Pacific in 1942–43. Full transition to the B-24 was made in the late summer of 1943. "Valor" by John L. Frisbee in the same issue bears this out, describing how B-17s in the Pacific pioneered skip bombing.

My personal knowledge comes from my flying thirty-two missions as the original bombardier on Ken McCullar's crew in the 63d Squadron, 43d Bomb Group, from August 1942 to February 1943. Major McCullar was then transferred to the 64th Squadron as commanding officer, and after many more low-level missions he was killed on takeoff on April 12, 1943. Luckily, I finished my tour of duty in the 63d Squadron.

Col. Robert H. Butler,
AFRES (Ret.)
Fayetteville, N. C.

Women in Combat

I am writing in response to "Twisted Logic," by Lt. Col. (Dr.) Robert W. Feldtman, AFRES, which appeared in "Letters" in the November 1990 issue *[see p. 13]*. Doctor Feldtman expressed his opinion that women should not be allowed in combat roles. He closed his remarks by quoting "Women in Combat" *[see June 1990 issue, p. 76]*, which said, "However greatly USAF women's opportunities have expanded, they are still barred from the all-important combat specialties." His final question was, "To *whom* [emphasis his] are they important, and why?" Those combat specialties are important to me. Although I'm sure I cannot speak for all women, I am equally sure that there are others who feel as I do.

I do not believe that the standards should be lowered. I believe that the Air Force has made many mistakes in its attempt to integrate women into service. Women have not asked for "favors." Lowering the standards on our behalf does not help our cause. Instead, it acts as a sort of reverse discrimination that makes it even more difficult for us to earn the credibility and respect we are due. And, as generations of men have been quick to point out, it has a negative impact on combat effectiveness.

The combat specialties in all services should be reviewed with physical qualifications in mind. Suitable minimums should be established for each specialty, and candidates who meet the standards should be allowed to serve in that specialty, regardless of gender.

If a person has all the strength, intelligence, skill, endurance, and coordination required to do a job, to foreclose that opportunity because of gender is the same as denying it because of the color of eyes or skin.

Perhaps this country is not socially or emotionally prepared to deal with the implications of such a policy. But let's stop pretending that the physical differences between women and men have anything to do with it.

Capt. Barbara M. Wenzel,
USAF
Wichita, Kan.

Loring's Exploits

When I read John Frisbee's account of Charles Loring's exploits *[see "Valor: Sacrifice at Sniper Ridge," January 1991 issue, p. 88]*, I could not help but think of Japanese World War II kamikazes. At Johnson AFB, Japan, during the Korean War, headquarters had a baka bomb displayed in front of it. We all wondered at the deliberate sacrifice of life. "Baka" in Japanese meant "stupid." It was a human-guided bomb. But Loring does the very same thing as the kamikazes and gets a Medal of Honor!

Does our perception of the deed only depend on who does it?

Col. George Bernhard, Jr.,
USAF (Ret.)
Columbus, Ohio

Your article on Maj. Charles Loring and his sacrifice at Sniper Ridge really rang my memory chimes.

My first assignment as a new second lieutenant after completing the Avionics Maintenance School at Lowry AFB, Colo., in early 1952 was to the 80th Fighter-Bomber ("Headhunters") Squadron of the 8th Fighter Bomber Wing at K-13 (Suwon AB, South Korea) as the avionics maintenance officer for the squadron.

Even though I was a second lieutenant, Major Loring frequently sought, accepted, and respected my advice about bomb types, flight characteristics of the various weapons being employed, and especially the A-4 gunsight and G-30 radar on the F-80s. This system was considered to be rather sophisticated at that time. Major Loring frequently talked with me about my Air Force career and offered excellent counsel and sound advice.

Major Loring, in addition to being a professional pilot, an outstanding example, and an extremely brave and dedicated airman, was also a warm and close friend of mine. I vividly recall that tragic day, November 22, 1952, when the news of his sacrificial effort that ended in his death was received at the 80th Squadron. We were devastated to a man. I continue to hold him in high esteem in my memory and consider him to be a key factor in my successful Air Force career.

Col. Edward H. Curtis,
USAF (Ret.)
Arlington, Tex.

Mathematically Impaired

In the November 1990 issue in the "Aerospace World" department on p. 27, there is an item about Pioneer 10. The distance of Pioneer 10 on September 22 was fifty astronomical units (fifty times 93,000,000 miles) from Earth. A straight computation would be 4,650,000,000 miles, close enough to the distance stated in the item. The item goes on to say that it takes thirteen hours and forty-seven seconds for Pioneer 10's radio signal to reach Earth at the speed of light.

If light travels at 186,000 miles per second, the radio transmission should have reached Earth in six hours, fifty-six minutes, and thirty-eight or thirty-nine seconds—possibly even a shorter time if based on the 4,647,809,899 miles stated in the item.

Lt. Col. Richard W. McCullough,
USAF (Ret.)
Sacramento, Calif.

A Distinct Embarrassment

In reference to "They Wanted Wings," by Bruce D. Callander, which appeared in the January 1991 issue *[see p. 80]*, I wish to comment on a particular type of wings.

The aerial gunner's wings were a distinct embarrassment. Far from incorporating a projectile (a power symbol), they had, of all things, what can only be described as a .22 short cartridge (which calls to mind little boys shooting at cans). To add to the disgrace, they had stylized wings attached. How humiliating. Those of us who wore them were the objects of much hilarity. I realize that incorporating a projectile might cause the gunners' wings to be confused with a bombardier's wings (which incorporated a bomb), but why not crossed machine guns? Anything but a .22 short!

Lt. Col. Thomas M. Conrow,
USAF (Ret.)
Seattle, Wash.

Open Canopies

With reference to the photograph by TSgt. Rose S. Reynolds, USAF, and the accompanying caption on p. 33 of the February 1991 issue, I believe I have spotted an error.

Perhaps the words "prepares for takeoff" should have been substituted for the words "takes off." The canopies of the F-111 are both in the full open position. Normally, these canopies would be in the closed, secured position immediately prior to and during takeoff.

Michael L. Sher
New York, N. Y.

First Kill in Korea

"The Russians in MiG Alley," which appeared in the February 1991 issue, states that the first MiG-15 was shot down by a US F-86 Sabre pilot on December 17, 1950. Not so.

On November 8, 1950, 1st Lt. Russell J. Brown shot down the first MiG-15. Lieutenant Brown was flying an F-80C over Sinuiju, Korea, as number two man in a flight of four from the 16th Fighter Interceptor Squadron. This action was the first jet-vs.-jet combat victory in history.

Lt. Col. Donald D. McComb,
USAF (Ret.)
Clarinda, Iowa

• *During the editing process, the sentence referring to the* F-86's *first kill of a MiG-15 (not the first kill overall) was changed, rendering it incorrect.*—THE EDITORS

Erratum

The caption on p. 107 of "AFA/AEF Report" in the March 1991 issue incorrectly reported Brig. Gen. Ellwood P. Hinman's job title. He has been director of the Secretary of the Air Force Personnel Council since September 1989.

Capitol Hill

By Brian Green, Congressional Editor

Proving Ground

Desert Storm confirmed the value of stealth and precision guided munitions and demonstrated the need for airlifters and bombers.

Desert Storm served as a proving ground for stealth, precision guided munitions, and a host of other Air Force technologies, according to testimony by Air Force Secretary Donald B. Rice and Chief of Staff Gen. Merrill A. McPeak before the House Armed Services Committee (HASC). The Gulf War also confirms the continued need for heavy bombers and heavy airlift capability. The Air Force budget request for Fiscal Years 1992 and 1993 continues to emphasize these capabilities.

The F-117A Stealth fighter, which made up just 2.5 percent of the coalition air forces in the Gulf region, covered thirty-one percent of the targets in the first twenty-four hours of Desert Storm. "It's not just that it allows us to operate with virtual impunity in the face of modern, sophisticated air defenses, but it also allows us to operate with far less supporting force than . . . nonstealthy aircraft require," the Secretary said. When mated with precision munitions, a notional force of six F-117s and two tankers provides the same capability against a given set of targets as does a standard force package (nonstealthy aircraft with nonprecision munitions including air escort, defense suppression, and tanker support) about ten times the size.

Secretary Rice also noted that Desert Storm commander Gen. H. Norman Schwarzkopf twice asked for additional B-52 bombers, underlining the value of strategic bombers in a conventional conflict. While the B-2 will cost several times more than an F-117, it will be stealthier and have better range and payload than the F-117, B-52, or B-1B. "The B-2 gives us clearly more capability per dollar than we get out of the F-117," the Secretary said.

Other winners in the Gulf War: the global positioning system (GPS), which proved its value to "troops in the featureless desert"; Joint STARS, an airborne radar system that detects fixed and moving ground targets, which was "proven in combat"; the Air Force emphasis on reliability and maintainability, which led to a ninety-two percent mission capable rate throughout Desert Storm and helped the Air Force to fly three-fourths of all US sorties throughout the war; and the C-17, which, had it been in the inventory, could have moved two additional brigades and twelve tactical squadrons to Saudi Arabia in the first twelve days of the deployment.

DPA Revival Sought

The Senate passed by voice vote a controversial bill to revive the Defense Production Act (DPA), which critics contend would establish an industrial policy—a path the Administration vigorously opposes.

The DPA, which expired in October 1990, was used regularly by the Pentagon to expedite defense production in order to meet the demands of Operation Desert Shield. The Pentagon now uses authority provided by the National Security Industrial Responsiveness Executive Order, signed by President Bush in January, to make sure its orders are met on a timely basis. While DoD demands have been satisfied, the Executive Order does not provide legal protection to industries that must defer execution of commercial contracts in order to meet their defense obligations. The DPA provided this protection.

The new Senate legislation is virtually identical to a bill that died in the Senate during the final hours of the last congressional session. Opponents in the Senate, including Sen. Phil Gramm (R-Tex.), concurred with White House and Pentagon concerns. The contentious provisions authorize the President to "limit production of critical components or technology items to domestic sources" and to help establish or promote such domestic sources. They also require the President to establish a procurement policy that would "ensure at least a minimum percentage [of critical components and technology items] are domestically sourced and available."

House action on a similar bill is expected, pending completion of hearings.

Arms-Control Bets

The Air Force, in its planned cutbacks of strategic forces and reduced budget requests for strategic modernization, appears to be betting that strategic arms-control agreements can be reached with the Soviet Union. Secretary Rice and General McPeak, in their HASC testimony, defended the substantial reductions.

Their testimony comes against a backdrop of congressional apprehension about the prospects for a Strategic Arms Reduction Treaty (START) agreement and expressions of caution by Secretary of Defense Dick Cheney. At a recent Senate hearing, Sen. Strom Thurmond (R–S. C.) expressed the view that "the START talks are on the verge of collapsing." Sens. David Boren (D-Okla.), Frank Murkowski (R-Alaska), Sam Nunn (D-Ga.), and John Warner (R-Va.), the Chairmen and ranking minority members of the Senate Intelligence and Armed Services committees, respectively, have noted with concern "indications . . . that progress in completing the START Treaty has slowed significantly."

While neither Secretary Cheney nor Chairman of the Joint Chiefs of Staff Gen. Colin Powell shares Senator Thurmond's deep pessimism, both indicate an acute awareness of recent difficulties. Secretary Cheney sees no slowdown in Soviet strategic programs. Reflecting the same caution, General Powell argued that "wherever the START negotiations take us, we must have strategic forces second to none."

Secretary Cheney maintained that "setbacks in arms control demonstrate the spillover effects of Soviet domestic unrest and the resurgent role of the military." The Secretary, however, remains "hopeful" that meaningful arms-control agreements with the Soviets will be concluded. ■

Washington Watch

By James W. Canan, Senior Editor

How to Command and Control a War

The Iraqis operated blind, their aircraft and radar out of action. The coalition had superb intelligence and used it with stunning effectiveness.

Midway through Operation Desert Storm, the crew of an Air Force F-15E fighter on a Scud-busting bomb run into Iraq did something highly unusual. They blew an Iraqi helicopter out of the sky, not with an air-to air missile but with a laser-guided bomb.

The Ripleyesque incident was perhaps the Gulf War's most offbeat example of the prowess of the F-15E and of precision guided munitions. It also demonstrated the importance of airborne surveillance, air traffic control, and air battle management to the rousing success of the allied air campaign and spotlighted the Airborne Warning and Control System's vital role in all that.

An Air Force E-3 Sentry AWACS plane set the stage for the helicopter's downing. The AWACS crew spotted the Iraqi French-made Gazelle on radar and vectored the F-15E to it. The encounter was evidence of airborne command, control, communications, and intelligence at its best. AWACS was a linchpin of the elaborate C³I set-up on which US Central Command and its air component, Central Air Forces (CENTAF), bet the farm.

The allied coalition won big. Its ground juggernaut, led by US Army and Marine Corps armored, mechanized, and airborne divisions, swept "through, over, and around" Iraqi defenders, in the words of the Army's Gen. H. Norman Schwarzkopf, CINCCENTCOM. His troops overpowered, outflanked, and cut off the enemy in one of the swiftest, surest tactical tours de force in the history of warfare. Allied planes, mostly American, attacked Iraqi tanks and other rolling stock with abandon, running up shooting-gallery scores.

The number of enemy casualties and capitulators ran into the hundreds of thousands. Allied forces suffered relatively few killed and wounded. Control of the air made all else possible.

On fulfillment of the United Nations resolution demanding Iraq's withdrawal from Kuwait, and amid indications that Saddam Hussein would soon surrender despite his de usions of derring-do, President Bush announced a cease-fire on February 28.

In the afterglow of a military victory that may have exorcised the cemons of the Vietnam War and that raises hopes for new ways out of old Mideast miasmas, the talk was of human bravery and skill and of the marvelous technology of US-made weapons that had worked far better than all but their most ardent proponents could have expected. The contributions of command, control, communications, and intelligence were not exactly on everyone's lips. Nonetheless, C³I had been the key to carrying the day.

Powell's Prediction

Gen. Colin Powell, for one, always knew how crucial C³I would be. Late last December, during the "line in the sand" Desert Shield defensive operation and the stirring up of Desert Storm, the Chairman of the Joint Chiefs of Staff declared, "From where I sit, command and control is the key to our success to date and will be the key to our success if we go to war."

Proof came fast. Shortly after the war began, Gen. Ronald W. Yates, commander of Air Force Systems Command, told a Washington audience that "events in the Middle East are proving that C³ is critical to the conduct of combat operations . . . that are giving Saddam Hussein much more than he bargained for."

General Yates noted that intelligence is taken for granted as an integral part of C³. He added, "We also hear the term 'battle management' a lot when we talk about C³. That implies a kind of calm, boardroom style of warfighting. What commanders in the Gulf are really dealing with are dispersed forces in an environment where the fog and friction of war exacerbate every problem. The job of C³ is to pierce the fog and minimize the friction."

Lt. Gen. Gordon E. Fornell, commander of Systems Command's Electronic Systems Division (ESD) at Hanscom AFB, Mass., made that very point in addressing an Air Force Association symposium in Orlando, Fla., two weeks into the Gulf War. "Never before has the spotlight shone so brightly on the element of warfare known as command and control," he declared. "The demand for enhancing our command and control [in Desert Storm] has been ravenous."

No wonder. The C³ challenge for CENTCOM, which ran the war, was massive. The allied coalition put together by the Bush Administration was the largest multinational assemblage of military forces since World War II. Communications among and within those large, diverse forces had to be absolutely clear so that there could be no mistaking anyone's intentions and actions. Timeliness of communications was a major problem, given the diversity of equipment and languages among coalition forces.

Most of those problems were magnified for CENTAF in its stewardship of the air campaign. USAF Lt. Gen. Charles A. Horner, CENTAF commander, had fewer forces to coordinate amid the multinational mixture. Even so, communications among, and control of, the various allied air arms—including those of the four heavily committed US military services—had to be all the more timely and precise, because things happened fast, furiously, and far and wide in the air campaign.

The "Number One Priority"

In war, C³ cuts both ways, so CENTCOM concentrated from the start on crushing Iraqi commanders' capacity for spreading and getting the word. Said General Fornell, "As Desert Storm began, our commanders emphasized again and again that targeting Saddam Hussein's command and control network is a number one priority."

Indeed, the first order of business

for allied attack aircraft, spearheaded by USAF's stealthy F-117As, was to bomb communications facilities around Baghdad. They scored big.

That was the beginning of the end for Iraq. Allied attack planes kept after command and control targets for weeks on end while broadening their horizons. Their success had a great deal to do with the ultimate downfall of the Iraqi army, which was rendered incapable of coordinated action in the face of the fierce allied onslaught that tore it apart in late February.

From start to finish, the allied air campaign went like clockwork, despite its unprecedented complexity and intensity, and AWACS was a big reason why. The attributes of air surveillance, air traffic control, and air battle management that AWACS brought to that campaign—all under the rubric of C³I—contributed mightily to its victorious conclusion.

The Air Force's fledgling Joint Surveillance and Target Attack Radar System also did a standout job of surveillance and battle management as a last-minute starter in Desert Storm. Joint STARS planes quickly validated the Air Force's long-standing claim that the system, designed to detect and doom targets on land, would do for ground war what AWACS does for air combat.

Two E-8A Joint STARS planes in the flight-test phase of the system's development program were rushed to Saudi Arabia and into operation just before the shooting began last January. On the lookout for tank columns and truck convoys on the move behind enemy lines, the Joint STARS planes quickly proved their worth and drew high praise from all hands.

"We will not ever again want to fight any kind of combat without a Joint STARS kind of system," Gen. Merrill A. McPeak, Air Force Chief of Staff, declared at the AFA symposium in Orlando.

The Air Force had long since come to that conclusion about AWACS. Without it, Desert Storm's intricate air campaign would have been inconceivable. CENTAF's Air Tasking Order, or frag order, was the blueprint for that campaign. Air traffic control was crucial to making it all work, and that's where AWACS came in.

The ATO, a 600-page computer printout that was revised every day, specified where each allied air unit should go, what it should do, and when—down to the minute. With more than 2,000 airplanes coming and going around the clock, coordination was king.

US Marine Corps Brig. Gen. Richard I. Neal, CENTCOM's deputy director of Operations, called CENTAF's orchestration of the air campaign and its comings and goings "incredible."

"It's unbelievable what these young airmen—male and female—are doing on a twenty-four-hour basis at CENTAF," General Neal continued. "A fantastic job. They've got aircraft at every altitude on multiple missions. They've got refueling going on, AWACS looking for enemy threats, all kinds of things, and they have to keep all those patterns separate [yet with] synergistic effect."

Mind-Boggling Effort

"Watching them work at Central Command Air Force is mind-boggling. We talk about air traffic control problems in the states, and we have them, but they're nothing like what's going on over here, especially at night. It makes [problems of] LAX [Los Angeles], Dallas, and Atlanta [airports] combined pale in comparison."

Communications made everything click.

"In the desert, we've assembled the largest tactical communications network ever built," said AFSC's General Yates during the war.

He noted that modern gear and techniques enabled unprecedented ease of communications among US Air Force, Army, Navy, and Marine Corps units in Desert Storm and that this "allows us to use a single Air Tasking Order for all services for the first time ever."

Moreover, said General Yates, "new equipment enables the Air Force Tactical Air Control Center to disseminate the allied ATO to all coalition forces faster and to more locations than at any time in history. All of this is being accomplished with about 3,000 communications personnel in theater."

General Yates cited AWACS and Joint STARS as standouts among "the systems that are redefining C³ in modern warfare" by virtue of their accomplishments in Desert Storm.

Despite early indications that the Iraqi Air Force had fled the fight for keeps, AWACS crews kept constant watch for the enemy on their radar consoles. They had eyes for targets of opportunity, such as the ill-fated Iraqi reconnaissance helicopter, possibly also an airborne command post.

That incident took place almost four weeks into the war. By then, coalition air forces, led by the US Air Force, could just about do as they pleased. They had clinched air supremacy in

all sectors and were averaging 2,500 sorties a day—half combat, half support. In preparation for the ground war to come, they had begun concentrating less on strategic targets, more on tactical targets in Iraqi-occupied Kuwait and in southern Iraq.

The Hard Work Begins

General Horner said at that juncture that "the 'gee whiz' phase is over" in the air campaign and that "the hard work has begun." The ability of allied air forces to respond with alacrity in support of allied armies would soon be tested, once those armies went on the offensive as a multifaceted maneuver force.

The allied ground assault began on February 24 and quickly shaped up as a blitzkrieg. Coalition armies made short work of dug-in Iraqi troops. Those troops had taken a beating from the air, and they surrendered by the tens of thousands without putting up much of a fight.

By the end of February, the war was over. Airpower, applied relentlessly but selectively from start to finish, made victory possible. That much was indisputable.

General Horner, boss of the coalition air campaign, was asked at one point which weapons deserved special praise for pivotal performances. He named the Air Force F-117A Stealth fighter and the Navy Tomahawk missile, both of which spearheaded the first waves of air strikes against strategic targets around Baghdad, and the Army Patriot missile, which saved the day against Iraqi Scuds. The questioner asked why he had omitted AWACS.

General Horner replied that he valued AWACS highly and had no intention of slighting it, but that it had been around for a while. "The reason I tend to overlook AWACS is because we've been using it over the past ten years, and I've grown accustomed to it," the CENTAF commander said.

The Air Force began operating AWACS in 1977 and went to Saudi Arabia with the system a few years later at the height of the threat from Iran across the Persian Gulf. Saudi crews have been flying Saudi-owned E-3s for several years.

Often called the "flying nerve centers" of Desert Storm, AWACS planes, orbiting at about 29,000 feet, can keep track of as many as 250 planes at one time over a 58,000-square-mile area and can relay such data as their positions, headings, and speeds to friendly air, sea, and ground commanders and, via communications satellites, to the Pentagon.

The Air Force had been improving AWACS planes right along at a more or less measured pace. Then it got an urgent work order for certain refinements to selected planes.

"Desert Shield precipitated an immediate upgrade to AWACS aircraft on alert in Saudi Arabia," General Fornell told his AFA audience. "The day after Saddam invaded Kuwait, we were asked to develop a new sensor to improve the AWACS' combat capability."

Allied commanders anticipated that Desert Storm's final phase on the ground would make exceedingly difficult demands on C³. Coordinating the coalition's armies and their support from the air could make or break the whole campaign.

That same day, ESD awarded a contract for the sensor, its characteristics secret, and went on to install it in seven front-line AWACS planes within two months.

Rave Reviews

"The new sensor received rave reviews from the operational crews," said General Fornell. "It is saving lives, and eight more are on the way."

He noted that ESD "also did a quick fix to enable the Saudi fleet of E-3s to communicate with the US fleet in a jammed environment. We built radio racks and cable harnesses so that Have Quick radios could be installed in the Saudi aircraft as fast as they became available."

Have Quick ultrahigh-frequency radio sets, each embodying seventeen black boxes and sophisticated software, are powerful and very difficult to jam. They were installed in USAF's thirty-four AWACS planes as part of a modernization program that ESD undertook about ten years ago. In it, five TV displays for radar were added to each Sentry aircraft, making fifteen such consoles all told. Each set displays images in five colors, a major improvement over the monochromatic displays formerly in place.

Many more AWACS modernizations, aimed at improving radars, electronic support measures, and communications and navigation gear, are in the works. The standout performance of AWACS planes in Desert Storm should sweeten the pot for those upgrade programs.

Ditto for Joint STARS, a success story on every count. The Air Force and the Army, its partnership patrons, had not expected the system to be ready for operational service until 1997, assuming that it would survive defense budget cuts and some misgivings here and there about cost. The big break for Joint STARS—and, as it turned out, for allied ground forces in Desert Storm—came when General Schwarzkopf saw the results of the system's flight tests in Europe.

Those results were stunning, and the CINCCENTCOM sent for the prototype E-8As. The planes were made ready for war and arrived in Saudi Arabia just in time for its outbreak. Their deployment marked the first time that the Air Force had ever put a major weapon system into operational service—into combat operations, at that—halfway through its development.

Like AWACS planes, the E-8 Joint STARS aircraft are Boeing 707s converted to carry radar, signal processors, and all the attendant electronics. Grumman Aerospace, the prime contractor, builds the plane's electronic innards. Norden Systems builds the radar that is the aircraft's reason for being. E-8s fly courses behind friendly lines while their radar operators reconnoiter troop and vehicle movements beyond and on battlefronts.

General Fornell told how the Joint STARS prototypes were transformed from test planes into warplanes in almost no time. "General Schwarzkopf issued the deployment order on December 18, the day before the contractor was to shut down for the traditional Christmas break. What happened next is a testament to true teamwork."

Three Short Weeks

"Everyone—Tactical Air Command, Grumman, Norden Systems, and the [ESD] program office—worked around the clock over three short weeks to create the [Joint STARS] concept of operations, train a multicommand crew, and complete and install an extraordinary number of upgrades on both aircraft, bringing them to the same combat capability," said General Fornell.

Each plane's synthetic aperture radar and voice communications were

"significantly improved," and "key data links to and from ground station modules were added, along with a JTIDS [Joint Tactical Information Distribution System] capability, a limited ECCM [electronic counter-countermeasures capability], and a self-defense system," General Fornell explained.

Preparation of planes and crews for combat flying was intense. "Flight checkouts and crew training were an around-the-clock operation," the General said. "We logged nearly the same number of hours—nearly 100—in those three weeks as had been flown during the whole [European] theater demonstration."

Joint STARS enabled allied air and ground commanders to see the big picture on the ground throughout occupied Kuwait and as much as 200 kilometers behind the forwardmost Iraqi units all along the front. This did wonders for CENTCOM's confidence as the ground war loomed.

Allied commanders anticipated that Desert Storm's final phase on the ground would make exceedingly difficult demands on C³. Coordinating the coalition's armies and their support from the air could make or break the whole campaign.

CENTCOM was better prepared for that difficult job than it had been just two months earlier.

Last December, about the same time that General Schwarzkopf called for Joint STARS, the Air Force delivered to CENTAF two spanking new ABCCCs —airborne battlefield command and control centers—for deployment, in capsule form, aboard EC-130E aircraft. Each capsule housed fifteen computer consoles for operation by CENTAF's airborne battle staff.

That staff's job was to see to it that allied air units carried out CENTAF's ATO for close air support and to revise that ATO, if necessary, on the fly.

Revisions included adding targets for attack aircraft with leftover ordnance and calling for additional strikes on targets that had survived the first time around.

General Fornell explained the major difference between the latest ABCCC and prior models: The ABCCC "now has the ATO on an optical disk" instead of in a paper document "the size of a phone book." This means that the ATO "can be searched and sorted any number of ways," thus giving the staff a far better understanding of the entire situation in the air and the ability to adjust airpower much more quickly in keeping with that big picture.

Of all the means of enhancing command and control that the Air Force came up with for Desert Storm, one put into place just before it started was at least as important as all others.

Last December, CENTAF issued "an urgent and compelling requirement" for new equipment that would show the big picture of all air actions everywhere in the theater at any given time, said General Fornell. He continued, "To do this, we [ESD] took a new system we had just developed for TAC and produced a stand-alone version capable of tracking 1,200 aircraft from data obtained from AWACS and from ground radar systems."

The system was installed in CENTAF's Tactical Air Control Center, source of the all-important allied Air Tasking Order, and was operational within a month of CENTAF's request.

Talk about the nick of time. Ten days later, General Horner watched as nearly 700 Air Force planes took off and headed into combat. The ATO had come alive. Desert Storm had begun. ■

WILLIAM THE CONQUEROR AND AIR SUPERIORITY

In 1066 one of the most decisive battles in the history of the world was fought. William, Duke of Normandy, ventured an invasion of England in the face of a formidable opponent. But one of the reasons that gave him the confidence to try such a risky undertaking was that he had a recently invented technological edge that the English did not.

That edge was the stirrup.

While the English rode to the battlefield, they fought on foot; conventional wisdom being that the horse was too unstable a platform from which to fight. But the Norman cavalry, standing secure in their stirrups, were

Bayeux Tapestry, Anon. C. 1077, Bayeux, France

able to ride down the English, letting the weight of their charging horses punch their lances home.

This technological edge led to the conquest of Britain. Without it, William might never have attempted such a perilous war. And this very ad might have been written in Anglo-Saxon.

There are two lessons here, lessons that have been repeated endlessly throughout history. The first is that technological differences can lead to the rise or downfall of great civilizations. The second is that, emboldened by such advantages, a potential adversary may risk war.

The laws of history have not changed. In our own time we find ourselves jockeying for the technological edge. In a world where technology is constantly changing, we need the latest in air power. This is where America's Advanced Tactical Fighter comes in. A culmination of the most far-reaching technology in history, the ATF will effectively check a potential imbalance in air defense, and so preserve stability.

If, almost a millennium ago, the English had had some effective counter to the Norman cavalry, William might have had second thoughts about crossing the Channel. Applying that timeless lesson today, we know that defenses such as the Advanced Tactical Fighter will give second thoughts to anyone thinking that now is his chance.

Lockheed
Giving shape to imagination.

Aerospace World

By Jeffrey P. Rhodes, Aeronautics Editor

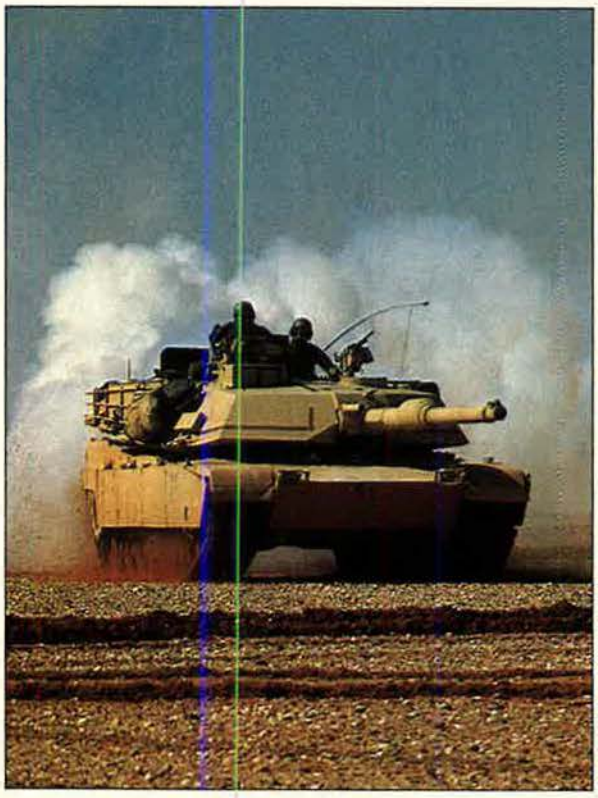
★ "I have . . . directed Gen. Norman Schwarzkopf, in conjunction with coalition forces, to use all forces available, including ground forces, to eject the Iraqi army from Kuwait," stated President Bush in an address to the nation on February 23. The long-predicted ground war to liberate Kuwait began at 8:30 p.m. Eastern Standard Time, ninety minutes before the President spoke.

The President had given Saddam Hussein a noon (EST) deadline to comply with United Nations resolutions ordering Iraq to leave Kuwait. When that deadline passed, he ordered the ground war to begin. Secretary of Defense Dick Cheney said in a press conference immediately after the President's speech that February 23 had been the planning date "for some time now" and that General Schwarzkopf felt that coalition troops would be ready by that date.

More than 200,000 coalition troops poured into Kuwait and southern Iraq.

—USAF photo by Sgt. Greg Ford

Coalition air forces flew thousands of sorties to weaken Iraqi ground forces before the ground phase of Operation Desert Storm. Once ground fighting began, mission emphasis shifted to supporting infantry and armored units. This bombed-up and newly refueled A-10 from the 23d TFW, England AFB, La., is preparing for another strike.



—USN photo by PH1 DeWayne B. Smith

The ground war in Operation Desert Storm lasted only 100 hours. Coalition forces surrounded Kuwait and cut off an Iraqi retreat. Armored units (at left, a US M1A1 main battle tank) often covered more than thirty miles a day, bringing to mind Gen. George S. Patton's dash across Europe in World War II.

Resistance was minimal, and more than 20,000 Iraqi prisoners of war had been taken after the first two days of fighting. Armored units moved almost thirty miles a day, and British Prime Minister John Major announced that Kuwait City had been retaken on the fifth day of fighting.

Coalition casualties were extremely light during the initial assaults, and in fact more soldiers (twenty-eight) were killed in a Scud missile attack on a barracks in Dhahran, Saudi Arabia, than on the front lines. On February 25, the Iraqi missile launched toward Dhahran was in the process of breaking up on its downward trajectory, but the warhead section fell on the barracks and set the building on fire.

The aircraft flown to provide cover to the ground troops proved indispensable. The pace of the air war continued unabated, and coalition air strikes weakened the Iraqi defenses before the ground assault began. In addition to its high-technology weapons, the Air Force used older, TV-guided AGM-65 Maverick missiles with great effect to destroy Iraqi tanks. Army and Marine Corps attack

helicopter crews also provided cover to the troops and attacked targets.

One significant milestone in the ground war: US servicewomen routinely saw front-line combat service for the first time. Unlike in Operation Just Cause in Panama, where some women were placed in combat situations more by accident than by design, the Army went into battle with women piloting UH-60, CH-47, and UH-1 helicopters.

US air losses as of February 20 totaled thirty-six aircraft: twenty-three fixed-wing aircraft lost in combat, five fixed-wing aircraft in noncombat accidents, and eight helicopters all lost in noncombat mishaps. None of the fixed-wing losses came as a result of air-to-air engagements.

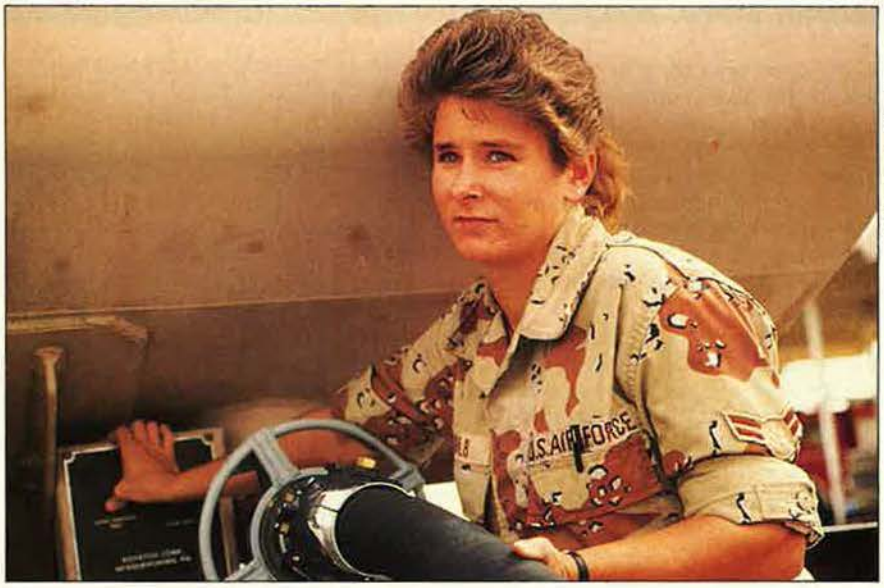
Army aircraft losses were one AH-64A Apache and two AH-1 Cobra attack helicopters and one UH-60 Black Hawk and two UH-1 Iroquois utility helicopters. Marine Corps combat losses were two AV-8B Harrier II V/STOL attack aircraft and one OV-10 Bronco observation aircraft. Marine noncombat losses were one AV-8B, one AH-1J, and one UH-1. Navy combat losses were four A-6E Intruder attack aircraft, one F/A-18 Hornet, and one F-14 Tomcat. Navy noncombat losses were one A-6E and two F/A-18s.

The Air Force lost fifteen aircraft, thirteen in combat and a B-52 and an F-16 in noncombat accidents. Its combat losses were two F-15Es, four F-16s, three A-10As and one OA-10A, one F-4G, one AC-130, and one EF-111A. The loss of the EF-111A was the first wartime or peacetime loss of a Raven since the aircraft were converted to standoff jamming platforms starting in 1977.

On the other side of the air battle, as of February 22, pilots from the 33d Tactical Fighter Wing at Eglin AFB, Fla., had shot down fifteen Iraqi aircraft, which was tops among coalition air forces. Another Iraqi aircraft flew into the ground while being pursued by a 33d TFW fighter.

Overlooked by many was Secretary Cheney's declaration of an airlift emergency on January 18, activating Stage II of the Civil Reserve Air Fleet. This call-up brings a total of seventy-nine passenger aircraft and 108 civilian cargo aircraft into the military airlift fold. Most of the CRAF passenger aircraft were not needed, but the civilian transport aircraft in use totaled 129.

In a related action, E-Systems was awarded a $20.6 million contract increase on January 31 for an aeromedical suite shipset to reconfigure a commercial Boeing 767 for aeromedical evacuation.



—USAF photo by SSgt. Victor Owens

Women played such a considerable role in Operation Desert Shield that US military thinking could be altered forever. They performed all manner of tasks during the operation, including flying helicopters into battle. Here A1C Jennifer Kolb, a refueling operator from the 363d Supply Squadron Fuels Management Branch at Shaw AFB, S. C., refills her R-9 refueling truck during the fighting.

Anniversaries

- *April 11, 1911:* The Army's first permanent flying school is established at College Park, Md.
- *April 27, 1911:* Signal Corps Aeroplane No. 2, a Curtiss Model D, and Aeroplane No. 3, a Wright Model B, are accepted at Fort Sam Houston, Tex. The planes, ordered only weeks before, are "off-the-shelf" purchases.
- *April 2, 1931:* Grumman and the Navy Bureau of Aeronautics sign a $73,975 contract for the XFF-1, the prototype of the sea service's first production fighter to have retractable landing gear and an enclosed cockpit.
- *April 16, 1946:* The first captured German V-2 rocket to be assembled in the US is successfully launched by the Army at White Sands Proving Grounds in New Mexico.
- *April 2, 1951:* The Air Force's new major command, Air Research and Development Command, assumes the functions of research and development of new weapons. Establishment of ARDC, formed in 1950 as part of the Air Staff, breaks off Air Materiel Command's weapons development function into a separate organization.
- *April 6, 1951:* The Labor Department announces that employment in aircraft and parts plants increased by 100,000 people in the first six months of the Korean War.
- *April 11, 1951:* President Harry S. Truman relieves General of the Army Douglas MacArthur of all of his US and United Nations commands in the Far East. This follows public differences of opinion between Truman and MacArthur over the conduct of the Korean War and General MacArthur's making political pronouncements without consultation with or approval from the Administration or the Joint Chiefs of Staff.
- *April 1, 1961:* Air Force Systems Command's Aeronautical Systems Division is established at Wright-Patterson AFB, Ohio. Since its inception, the "Bicycle Shop" has overseen the development of more than forty aircraft and missiles of all types.
- *April 12, 1961:* The Soviet Union stuns the world with the first successful manned space mission. Soviet Air Force Lt. Yuri Gagarin lifts off from the Tyuratam launch site aboard Vostok 1, a modified SS-6 ballistic missile. His 108-minute flight completes one Earth orbit, and he is promoted to major before landing safely at Smelovka, USSR.
- *April 12, 1971:* The Air Force announces the first use of the 10,000-pound ultraheavy BLU-82/B bomb. The conventional bombs, nicknamed "daisy cutters," can clear an area of jungle up to 110 feet in diameter.
- *April 12, 1981:* After a hiatus of nearly six years, the US returns to manned spaceflight with the first launch of the space shuttle. Astronauts John Young and Navy Capt. Robert Crippen put the orbiter *Columbia*, the world's first reusable spacecraft, through its paces on a two-day mission that ends with a runway landing at Edwards AFB, Calif.
- *April 15, 1986:* Operation Eldorado Canyon—air strikes against Libya in response to state-sponsored terrorism—is carried out by Air Force and Navy aircrews.

★ The next nine months will be crucial to the future of the Bell-Boeing V-22 Osprey as the tilt-rotor aircraft goes through the final stages of its flight test program. A number of activities must be completed before the Defense Acquisition Board meets in December to determine if the program should proceed into initial production.

Most of the work will continue flight envelope expansion. By early February, the four V-22 prototypes now flying had accumulated nearly 360 flight hours on 304 flights, and handling qualities and aeroelastic stability are meeting specifications. Performance has been good but not completely to specifications. The V-22 did meet the Navy's requirement of 275 knots at 3,000 feet on a day when temperatures reached ninety-one degrees Fahrenheit, however.

Vibration was excessive, particularly at the pilot's feet and seat, but relatively minor fixes have corrected the problems. After installation of pendulum absorbers on the rotor hubs, weights on the fins, and the vibration suppression system that is used on the Bell AH-1W helicopter, the vibration was brought below the specification requirement. Weight of the aircraft is a problem, but a number of changes that will save weight have been identified for inclusion on production aircraft.

The number four V-22 Osprey flight test aircraft prepares for takeoff from the deck of USS Wasp (LHD-1). The V-22's wing has been rotated into position, and the rotor blades are about to be unfolded. Completion of initial shipboard compatibility trials last December was an important milestone in the aircraft's development.

The next major step will be meeting Development Test Milestone IIC. Test pilots at the Naval Air Test Center at NAS Patuxent River, Md., will put the aircraft though such tests as flying at night, carrying external sling loads, flying under instrument flight rules, landing on slopes and in confined areas, and optimizing the plane's automatic flight-control system.

Close on the heels of DT IIC will come the Osprey's first operational test with Marine Helicopter Squadron HMX-1 at Quantico, Va., where line Marine aviators (and line mechanics as well) will operate the aircraft in a realistic environment. The fifth V-22 prototype, set to fly by April, will be nearly production-configured, and this aircraft will play a major role in the Operational Test IIA trials. These tests must be completed ninety days before the DAB meets in December.

The final major Osprey task to be accomplished this year is the release of $365 million for long-lead items needed for initial production. Secretary of Defense Cheney, who is trying to kill the V-22 program because he sees it as unaffordable, can defer this money indefinitely. However, Congress can, under specific conditions, order the money to be released.

The first long-lead items that would need to be bought include transmissions and landing gear. As an indication of what "long-lead" really means, if the order for V-22 landing gear were to go out today, it would be seventy-five weeks before the first shipset arrived at the factory.

★ The 102d Congress has virtually the same percentage of members who served in the armed forces as its

predecessor had, although both houses continue to show a slight decrease in members who are veterans. Sixty-six of 100 Senators have seen military service, and 210 of 440 (47.7%) members of and delegates to the House of Representatives have spent time in uniform.

The 101st Congress had sixty-seven Senators who served in the military, while 217 (49.3%) members and delegates of the House were veterans. Members who were veterans in the 100th Congress totaled sixty-nine in the Senate and 218 (49.5%) in the House.

Of the sixty-six Senators with service time, thirty-three were in the Army (including the Army National Guard or Army Reserve), fifteen (22.7%) in the Navy (including the Naval Reserve), nine (13.6%) in the Marine Corps (including the Marine Corps Reserve), eight (12.1%) in the Air Force (including the Air National Guard, Air Force Reserve, and AAC/AAF), and three (4.5%) in the Coast Guard.

Two Senators served on active duty in one branch and in a reserve component of a different branch at a different time and are counted twice. One Senator is still in the Naval Reserve.

On the House side, 104 (49.5%) of the 210 veterans were in the Army (including the Army National Guard or Army Reserve), fifty-one (24.2%) in the Navy (including the Naval Reserve), thirty-six (17.1%) in the Air Force (including the Air National Guard, Air Force Reserve, and AAC/AAF), twenty-one (10%) in the Marine Corps (including the Marine Corps Reserve), and three (1.4%) in the Coast Guard.

Five Representatives served on active duty in one branch and in the reserve component of another branch at another time and are counted twice. Ten Representatives are still serving in one of the reserve components.

Twenty-two Senators served during the World War II years, and eight were in the armed forces during the Korean War years, although they may not have seen combat. Nine Senators saw combat in Vietnam.

Sixty Representatives were under arms during World War II, and thirty-one were in uniform during the Korean War, although they may not have seen combat. Nine Representatives saw combat in Vietnam.

★ **PURCHASES**—Air Force Systems Command's Aeronautical Systems Division exercised a $72.6 million contract option with **Chrysler Technologies Airborne Systems** on February 4 for five additional **C-27A Short Takeoff and Landing intratheater transports** for Southern Command. This brings the total order to ten aircraft. The C-27As, Aeritalia G.222 medium airlifters modified to meet Air Force requirements, will fill the airlift gap between CH-47 helicopters and C-130s in Central America, SOUTHCOM's operating area. After assembly in Naples, Italy, the aircraft will be flown to Chrysler's plant in Waco, Tex., where they will be fitted with new communication and navigation gear. The first C-27A will be delivered to Howard AFB, Panama, by September. A contractor logistic support contract was awarded concurrent with the initial award last August.

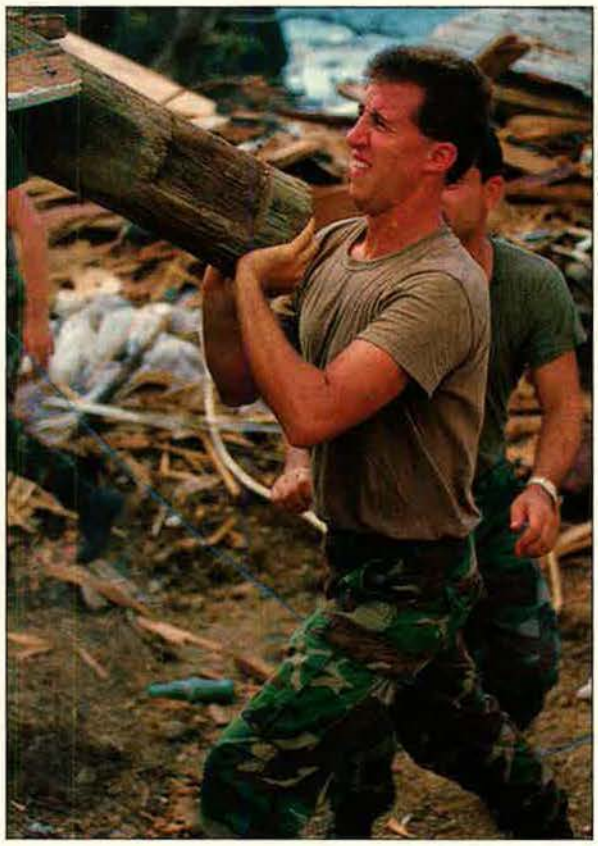
Reflectone was awarded an $8 million Loral Defense subcontract on January 17 to build an **MC-130H Combat Talon II simulator** as part of the Special Operations Forces Aircrew Training System. The Talon II simulator will feature electrical control load-

The C-27A intratheater airlifter for Southern Command will be a modified version of the Aeritalia G.222 STOL transport (here, coming in for a landing on a dirt strip). The C-27s will fill the airlift gap between CH-47s and C-130s in Central America.

ing, synchronized digital aural cues, and a fully digital communication system. Software for the simulator will be written in Ada, the Department of Defense's standard computer language. The simulator will provide a full mission rehearsal capability and will be equipped with an Evans & Sutherland ESIG-4000 visual system. The simulator will be delivered in 1992.

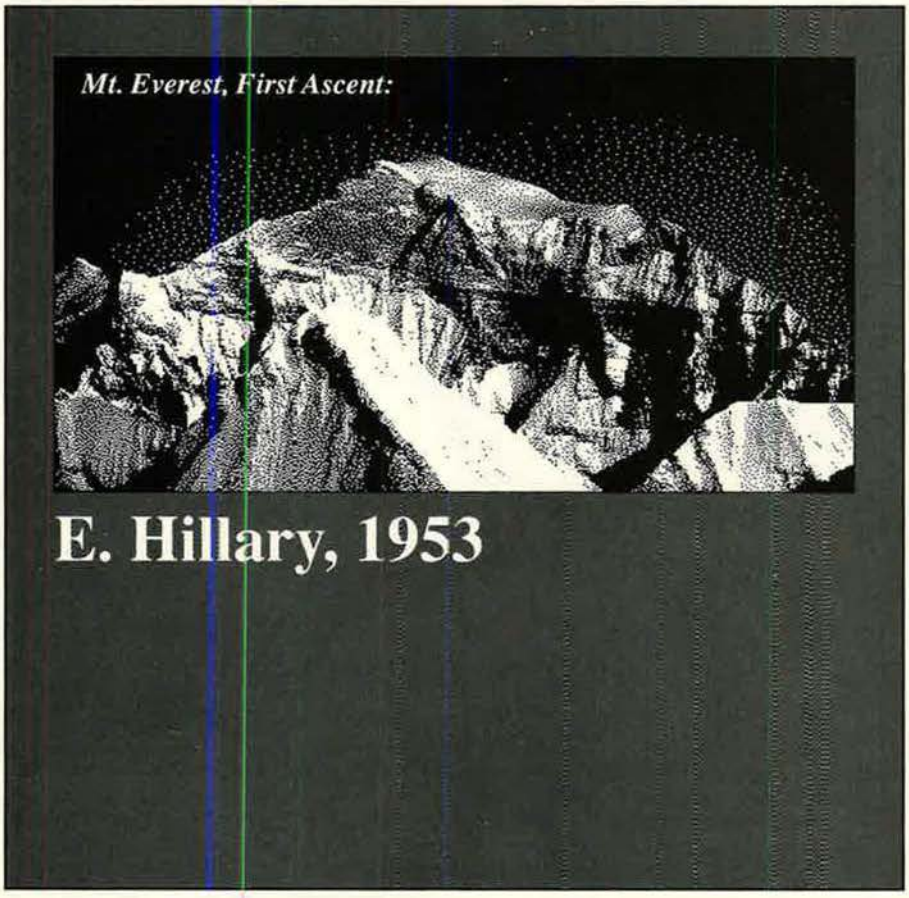
McDonnell Douglas received a $253.9 million Naval Air Systems Command contract for 240 BGM-109 **Tomahawk sea-launched cruise missiles** for FY 1991. The contract, which also includes spares and support, represents sixty percent of the yearly buy. **General Dynamics,** the missile's developer, received a $188.5 million contract for 160 Tomahawks. The Pentagon's FY 1992 supplemental budget includes a request for $545 million for 400 additional Tomahawks to replace the 300 or so missiles fired during the early stages of the Persian Gulf War.

The X-30A **National Contractor Team** received a $502.6 million ASD contract on February 1 for continued development of the **National Aerospace Plane.** The award calls for the five-company National Contractor Team (General Dynamics, McDonnell Douglas, Pratt & Whitney, and Rockwell's North American Aircraft and Rocketdyne divisions) to refine critical technologies for production of advanced composite materials and structural components, complete the X-30 design in time for a systems design review in 1993, construct and test the developmental ramjet/scramjet engine, and research the handling of slush hydrogen as a fuel. After the systems design review, ASD will decide whether or not to build the two X-30s. If they are built, the hypersonic, single-stage-to-orbit aircraft are expected to begin flight test in 1997.



—USAF photo by Sgt. Todd Surdez

Sgt. Richard Tartella and SMSgt. Carlos A. Miranda of the 633d Transportation Squadron, Andersen AFB, Guam, load debris on a truck. Members of the squadron spent four days during the Christmas season helping the village of Umatac, Guam, clean up after Typhoon Russ.



Hughes ($9.6 million), **Westinghouse** ($9.5 million), and **Unisys** ($8.6 million) were awarded Air Force System Command's Electronic Systems Division contracts on February 1 for technical analysis and support for the first five months of the **Peace Shield reprocurement effort.** One contractor will be selected on June 30 to complete the Peace Shield project. Peace Shield is a ground-based air defense and command and control system for the Royal Saudi Air Force. A portion of the original $1.6 billion Peace Shield contract with Boeing was terminated for default on January 10. The contract was terminated for "failure to deliver supplies and services within the time specified" and for "failure to

make progress so as to endanger final operational capability." Boeing is planning to appeal the termination order.

Texas Instruments received a $273 million Naval Air Systems Command contract on January 31 for the FY 1991 buy of AGM-88 high-speed anti-radiation missiles **(HARMs).** The contract calls for a total of 1,488 HARMs to be delivered by October 1993. The contract combines the purchases for the Navy (1,320 missiles), Air Force (120), and a Foreign Military Sales buy for Spain (forty-eight).

Martin Marietta received a $125.9 million Air Force contract in late February for sixty-five more Low-Altitude Navigation and Targeting Infrared for Night **(LANTIRN) targeting pods.** The LANTIRN system, which consists of a navigation pod and a targeting pod (designated AN/AAQ-13 and -14, respectively), is designed for use on Air Force F-15E and F-16C/D aircraft and was used to great effect in the Persian Gulf War. The contract brings the total order to 561 navigation pods, 506 targeting pods, and twenty-six sets of computerized test equipment. Deliveries are expected to be completed in 1994.

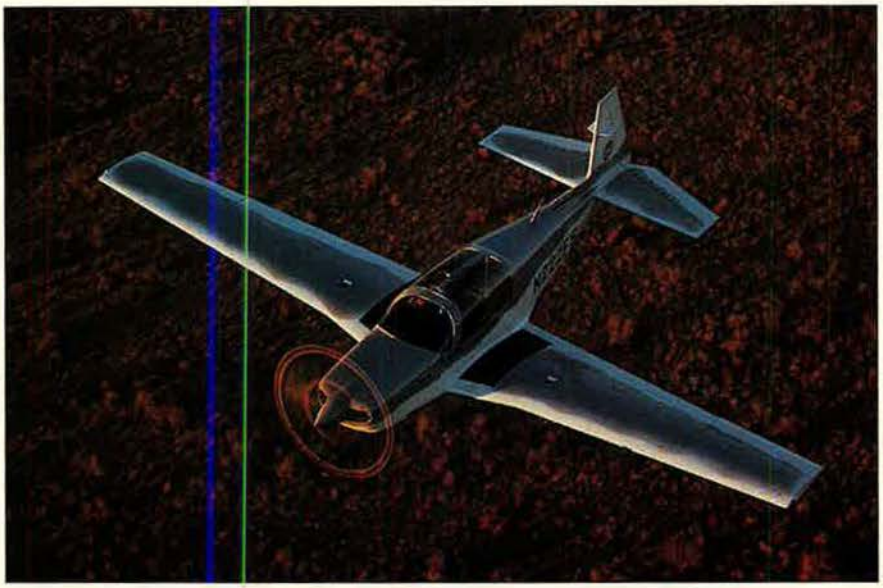
★ **DELIVERIES—McDonnell Douglas** delivered its first operational AGM-129A advanced cruise missile **(ACM)** to the Air Force in ceremonies at the company's Titusville, Fla., plant on January 29. The ACM will replace the AGM-86B air-launched cruise missile in Strategic Air Command service, and the stealthy AGM-129 will have greater range and accuracy than its predecessor. McDonnell Douglas was brought on as second-source ACM producer in 1987. Competitive ACM procurement with General Dynamics will begin with the FY 1992 buy.

★ **MILESTONES—The second Rockwell/MBB X-31A** Enhanced Fighter Maneuverability Demonstrator **was flown for the first time** January 19. Dietrich Seeck, Messerschmitt-Bölkow-Blohm's chief test pilot, was at the controls for the seventy-minute flight, which started and ended at Rockwell's facility at Air Force Plant 42 in Palmdale, Calif.

In a related note, the **first X-31A was flown with its thrust-vectoring paddles for the first time** on February 14. Rockwell chief test pilot Ken Dyson was at the controls during the 1.1-hour flight, also made from Plant 42. It was the aircraft's tenth flight, and the paddles were not moved. The X-31 is the first international X series aircraft. The two aircraft will be used to demonstrate advanced maneuvering concepts for greater fighter effectiveness. Most of the advanced testing will take place at the Naval Air Test Center at NAS Patuxent River, Md.

The number two **Grumman X-29A** Forward Swept Wing Demonstrator **set one and tied another Ames-Dryden Flight Research Center record** in late January. The X-29 flew five times on January 25 to set a single-day record for most sorties. The aircraft flew nine times between January 21 and January 25 to tie the one-week record set by the Advanced Fighter Technol-

As a show of support for US service members overseas, R. J. Reynolds Sports Marketing had five race cars painted to honor each of the services and the Coast Guard at the Daytona 500 auto race on February 17. NASCAR Winston Cup driver Mickey Gibbs drove the "Air Force" Pontiac to a seventeenth-place finish at Daytona.



Mooney Aircraft demonstrated its candidate for the Air Force's enhanced flight screening program in ceremonies at the company's Kerrville, Tex., plant on February 6. The Mooney EFS, a variant of the company's ATS general aviation trainer, is one of several aircraft the Air Force will evaluate for the EFS program.

ogy Integration F-16 in 1983. The second X-29 is now being used in a high angle of attack test program and has been flown successfully at attitudes as high as sixty-seven degrees. The X-29's fifth hop on January 25 was its seventy-eighth flight.

Mooney Aircraft rolled out and demonstrated its **candidate for the Air Force's enhanced flight screening program** in ceremonies on February 6 at its plant in Kerrville, Tex. Called the Mooney EFS, the aircraft is a fully aerobatic, FAR Part 23–certified variant of the company's ATS general aviation trainer. It is stressed to +6 Gs and −3 Gs and features side-by-side seating, stick controls, and a large sliding canopy for maximum visibility. It has a rate of climb of 1,500 feet per minute and a maximum cruise speed of 207 mph at sea level. This aircraft is one of several that Air Training Command and ASD will evaluate for the EFS program this spring. A winner will be selected in December. The Air Force plans to buy 125 aircraft to replace the Cessna T-41. Deliveries to the Air Force Academy and to Hondo, Tex., are scheduled to begin in May 1992.

Production testing of the first Have Quick A-Nets communications system on an operational Boeing E-3 Sentry Airborne Warning and Control System (AWACS) aircraft **was successfully completed** on February 1. The Have Quick A-Nets antijam, frequency-hopping radios are an important addition to the Sentry; previous versions of Have Quick would have interfered with the E-3's other communication equipment. The new radios are designed to be compatible with existing Have Quick equipment in other aircraft. They will also prevent degradation of emanations from other E-3 subsystems and prevent their own signals from being degraded because of the operation of the other radios. The Have Quick A-Nets system provides both air-to-air and air-to-ground UHF communications. The new system was designed and developed by Boeing.

The **first test of the Army's** Exoatmospheric Reentry Vehicle Interceptor Subsystem **(ERIS)** was **successfully carried out** on January 28. The ERIS vehicle was launched from Kwajalein in the Pacific. It intercepted an inert intercontinental ballistic missile warhead high over the atoll and destroyed it by kinetic energy. The target was an LGM-30B Minuteman I ICBM launched from Vandenberg AFB, Calif., 4,200 miles away from the test area. The ERIS vehicle was launched atop modified Aries II booster rockets. The vehicle uses a Texas Instruments long-wave infrared seeker to find the heat traces of a warhead while it is outside the atmosphere. Using reaction jets, the vehicle then maneuvers for the intercept. Three further tests are planned. The ERIS interceptor is made by Lockheed.

★ NEWS NOTES—SAC's fleet of Rockwell B-1B bombers began returning to flight status on February 6. The bomber fleet had been grounded since December 20 because of two

Index to Advertisers

An innovative radar antenna that can look forward, back, or to the side virtually instantaneously may soon be performing reconnaissance for the U.S. Air Force. The electronically scanning antenna (ESA), built by Hughes Aircraft Company, can position its broader beam faster than conventional antennas because it is a phased-array radar antenna that scans the radar beam electronically instead of mechanically. As a result of four years of successful testing in Europe, during which time an ESA was mounted in a United States Air Force TR-1 reconnaissance plane, the Air Force plans to install ESAs in the U-2R and TR-1 aircraft of its advanced Synthetic Aperture Radar Systems -2 fleet.

State-of-the-art air defense systems built by Hughes protect more than one billion of the free world's population. The Air Defense Ground Environment (ADGE) systems, designed by Hughes for 23 nations, network operations centers, ground-based and airborne sensors, surface-to-air missile bases, and air bases into real-time command and control systems. ADGE systems identify all aircraft approaching their nation's borders, display the aircraft's altitude, speed, and course, and electronically interrogate the aircraft to determine its identity. Future ADGE systems will include a new distributed architecture that will allow them to use more mobile and transportable elements, as well as off-the-shelf commercial computers, for more cost-effective operation.

Display technology from fighter aircraft may make driving easier for wearers of bifocal eyeglasses. The technology, developed by Hughes and known as Virtual Image Display, replaces the speedometer, gauges, and warning lights in a typical car instrument panel with a projected image created by a sophisticated set of mirrors and lenses. This image appears to be behind the dashboard, approximately six feet away from the driver, eliminating the need to shift from distance vision to near vision when reading the instrument panel. Drivers with bifocals may be able to drive and read the instruments without their glasses.

Gunners in U.S. Army M1 Abrams tanks are able to see and pinpoint targets day or night using laser rangefinder and thermal imaging systems produced by Hughes. These systems are also being applied to advanced fire control and air defense systems employed by other Free World Countries. Deliveries of the systems have passed the 8,000 mark, and over the 10-year life of the program, unit prices have decreased nearly 50 percent as the result of significant increases in production efficiency.

Technology which allows small satellite earth stations to transmit and receive data, voice, and video information in complete privacy helps smaller companies enjoy the advantages of satellite communications services. Hughes has established and is operating earth station facilities which can be shared among many users as the central control point for their independent networks. When combined with Very Small Aperture Terminal (VSAT) stations using advanced transmission techniques, Hughes' shared hub facilities allow companies to quickly and cost-effectively establish their own private, customized, satellite-based business communications networks.

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

HUGHES

Subsidiary of GM Hughes Electronics

Senior Staff Changes

RETIREMENTS: L/G Anthony J. **Burshnick;** B/G Joseph K. **Glenn;** M/G Michael C. **Kerby.**

CHANGES: M/G Joseph A. Ahearn, from Dir., Engineering & Services, DCS/L&E, Hq. USAF, Washington, D. C., to Civil Engineer, Hq. USAF, Washington, D. C. . . . **B/G Charles C. Barnhill, Jr.,** from Cmdr., US Forces Azores, and Cmdr., 1605th Military Airlift Support Wg., MAC, Lajes Field, Azores, to Dir., Transportation, DCS/Log., Hq. USAF, Washington, D. C. . . . **M/G John L. Borling,** from DCS/Ops., and Dep. Dir., Ops., STRACOS, Hq. SAC, Offutt AFB, Neb., to Dir., Operational Requirements, DCS/P&O, Hq. USAF, Washington, D. C. . . . **B/G Fredric N. Buckingham,** from Vice Cmdr., 21st AF, MAC, McGuire AFB, N. J., to Vice Cmdr., Warner Robins ALC, AFLC, Robins AFB, Ga., replacing B/G William M. Douglass.

B/G William M. Douglass, from Vice Cmdr., Warner Robins ALC, AFLC, Robins AFB, Ga., to Dir., Maintenance, DCS/Log., Hq. USAF, Washington, D. C. . . . **B/G Ralph E. Eberhart,** from IG, Hq. TAC, Langley AFB, Va., to Dir., Prgms. & Eval., Hq. USAF, Washington, D. C. . . . **B/G Henry M. Hobgood,** from Dir., Manpower & Organization, DCS/P&R, Hq. USAF, Washington, D. C., to DCS/Personnel, Hq. TAC, Langley AFB, Va., replacing Col. John M. Desmond . . . **M/G James W. Hopp,** from Dir., Log. Prgms., DCS/L&E, Hq. USAF, to Dir., Supply, DCS/Log., Hq. USAF, Washington, D. C.

B/G John J. Kelly, Jr., from Cmdr., Air Weather Service, MAC, Scott AFB, Ill., to Director, Weather, DCS/P&O, Hq. USAF, Washington, D. C. . . . **Gen. John M. Loh,** from Vice Chief of Staff, USAF, to Cmdr., TAC; CINC, US Air Force Atlantic, USLANTCOM; and Dir., TAC Combat Ops. Staff, Hq. TAC, Langley AFB, Va., replacing retiring Gen. Robert D. Russ . . . **B/G Frank K. Martin,** from Chief of Security Police; Cmdr., AFOSP; and Ass't IG for Security, Kirtland AFB, N. M., to Chief of Security Police, Hq. USAF, Washington, D. C. . . . **B/G (M/G selectee) Robert W. Parker,** from Senior Mil. Advisor to Dir., ACDA, Washington, D. C., to Cmdr., OSIA, Washington, D. C. . . . **L/G Leo W. Smith II,** from Principal Dep. Ass't Sec'y of the Air Force, Financial Mgmt. (Resource Mgmt.), Hq. USAF, Washington, D. C., to Vice CINC, Hq. SAC, Offutt AFB, Neb., replacing retiring L/G Donald O. Aldridge. ■

catastrophic engine failures in less than three months. The primary fix is the installation of a new retaining ring on the first-stage fan blades on the General Electric F101-GE-102 engines. The new ring, made of Inconel 718 steel instead of the original stainless steel, is approximately 2.5 times as strong as the original, and the change in material improves fatigue strength and corrosion resistance. After installation, each of the B-1's four engines is run on a test stand. Maintenance crews are also performing eddy current inspections to check for further cracks in the blades. Each B-1 will be cleared for flight as its refits and inspections are completed. It is expected to take three months to complete the process for all ninety-seven B-1Bs.

Under the provisions of the Base Closure and Realignment Act of 1990, the studies recommending closure of seven Air Force bases have been rendered void. Secretary Cheney had recommended closing Los Angeles AFB, Calif., Bergstrom AFB, Tex., Eaker AFB, Ark., Myrtle Beach AFB, S. C., Davis-Monthan AFB, Ariz., England AFB, La., and Wurtsmith AFB, Mich., but under the new law, base closure actions must be accomplished through an independent Defense Base Closure and Realignment Commission, not through any arbitrary or unilateral action. The law requires that all bases be considered equally. Secretary Cheney is scheduled to submit a list of possible base closures (expected to include the original seven bases) to the commission by April 15.

The **ninth test of the GBU-15-I was successfully carried out** at Eglin AFB, Fla., on January 24. This test of the GBU-15-I, which combines the accuracy of the GBU-15 with the penetration capabilities of the improved 2,000-pound bomb, was the first flight conducted from an F-15E. The weapon was released while the aircraft was flying at Mach 1.05 and was guided 10.75 miles by the weapon systems officer to score a direct hit against a concrete-and-steel-reinforced target. Three more tests are planned in the weapon's full-scale development program.

Secretary of the Air Force Donald Rice announced on February 4 that he had ordered **actions to reduce the Air Force's corporate headquarters and remove layers of management across commands.** Air Force Communications Command will be redesignated as a Field Operating Agency, and the Air Force Reserve's numbered air forces and fifteen of the nineteen Air

Divisions will be eliminated. More than 8,600 positions will be eliminated (including those dropped in the previously announced merger of Air Force Systems and Logistics Commands) from the Air Force's Pentagon and field management organizations. Most Separate Operating Agencies and Direct Reporting Units will be reclassified as Field Operating Agencies, saving 2,400 positions, and one of every six Air Force general officer billets will be eliminated. The civilian work force is expected to decrease by 28,000 slots.

★ **DIED**—Retired Air Force **Brig. Gen. (Dr.) Theodore C. Marrs,** credited with conceiving and implementing the Total Force policy that makes the National Guard and Reserve coequal partners with the active forces, last December 17 of unreported causes at his home in Albuquerque, N. M. He was seventy-two. During his career, he served under five secretaries of defense and was appointed Deputy Assistant Secretary of Defense for Reserve Affairs under President Nixon in 1970. He also served as a special assistant under President Ford.

Retired Air Force **Lt. Gen. Joseph F. Carroll,** the organizer of the Air Force Office of Special Investigations and the first director of the Defense Intelligence Agency, on January 20 of pneumonia in a nursing home in Alexandria, Va. He was eighty. He served as AFOSI head from 1948 to 1958 and then served as deputy commander in chief of US Air Forces in Europe. He was appointed as Air Force Inspector General in 1960. He headed DIA from 1961 to 1969.

Edward S. Taylor, founder of the Gas Turbine Laboratory at the Massachusetts Institute of Technology, on February 2 of an apparent heart attack at his home in Lincoln, Mass. He was eighty-eight. He was a leading figure in the development of reciprocating and gas turbine engines, and many of his students from his forty-one-year academic career went on to become leaders in the aerospace industry. Among his many awards were the Sylvanus Albert Reed Medal (for his invention of a vibration absorber for reciprocating aircraft engines) and the Robert F. Goddard Award (for his contributions to aircraft propulsion).

Paul F. Bikle, head of NASA's Ames-Dryden Flight Research Center from 1959 to 1971 and a record-setting sailplane pilot, on January 19 of complications from a heart attack at his son's home in Salinas, Calif. He was seventy-five. While director of Ames-Dryden, he oversaw such research programs as the X-15, the XB-70, and the lifting body aircraft. His early career included flight test work on the Boeing B-29. He set the world sailplane altitude record of 46,267 feet near Lancaster, Calif., on February 25, 1961, and the mark stood for nearly twenty years.

Eastern Air Lines, one of the oldest commercial carriers in the US, on January 18 from bankruptcy and high fuel prices. It was sixty-four. Started as Pitcairn Aviation in 1926, the airline was formed around the New York–Atlanta airmail route. Eddie Rickenbacker, America's leading ace of World War I, served as manager, part owner, and later chief executive officer of the airline for nearly twenty years during the 1930s and 1940s. Eastern lost money every year after the US airlines were deregulated in 1978 and declared bankruptcy in March 1989. Efforts to reorganize proved partially successful, but losses mounted, and high fuel prices resulting from the Persian Gulf War proved too much for the carrier. Its assets—aircraft, routes, and airport gates—are now being liquidated. ■

At least forty percent of the smaller tactical force will be multirole fighters. Stealth, reliability, and precision will be critically important.

Twenty-Six Wings

By John T. Correll, Editor in Chief

AS PART of the first US military demobilization ever conducted with a war in progress, the tactical air forces will shrink to twenty-six combat-coded fighter and attack wings, eleven of them in the Guard and Reserve, by 1995.

The reduction is from a 1990 level of thirty-six wings (twelve of which were Guard and Reserve). The tactical air forces topped out in 1988 with thirty-eight fighter wings, short of the forty once envisioned.

The cut, announced by the Pentagon February 4, came as no real surprise. It was a predictable extension of budget policies on which the Administration and Congress agreed last summer. Air Force planners had already begun figuring out how to organize and equip the remaining wings.

Senior officials provided a preview, based on a "notional" twenty-six-wing lineup, at an Air Force Association symposium in Orlando, Fla., January 31–February 1.

The smaller force must become more versatile. It will rely less on specialized and single-purpose aircraft. Multirole fighters will predominate in the tactical fleet. Support troops will be cross-trained to perform or assist in additional jobs.

The distinction between "tactical" and "strategic" units will fade as the force evolves toward composite wings, trained and outfitted for multiple missions.

"We are in a sense moving from a period in which we are a garrison air force, with a very large forward presence overseas, to a period in which we are more of an expeditionary air force, where the emphasis will be on rapid reaction with [continental US]–based forces," Gen. Merrill A. McPeak, Air Force Chief of Staff, said in Orlando.

The Air Force will press hard for continued modernization of aircraft and weapons. With earlier convictions reinforced by the success of the F-117 fighter in Iraq, USAF probably will go for all the stealth technology it can get to penetrate hostile airspace and achieve tactical surprise.

General McPeak said that the force would be "Johnny One-Note" on reliability and maintainability as it builds combat packages of varying sizes to operate far from home with less support and fewer equipment breakdowns.

—USAF photo by SSgt. Scott P. Stewart

Stealth will be an important characteristic in future Air Force fighters (opposite, a stealthy Lockheed F-117A). While accounting for a single-digit percentage of the fighter force, F-117s were used on a double-digit percentage of the deep interdiction raids in Operation Desert Storm because of their unique capabilities.

The smaller, expeditionary-style force will need to make every shot count in the target area, both for operational reasons and because it will carry a limited supply of munitions. "The answer is to have fewer munitions that are delivered with great precision," General McPeak said.

Eighty Percent Solutions

In some areas, though, the Air Force will accept "eighty percent solutions," or options that deliver a little less capability for a lot less money. For suppression of enemy air defenses, for example, it will hang AGM-88 HARMs (high-speed antiradiation missiles) and electronic countermeasures (ECM) pods on F-16s.

Under less constrained budgets, there might have been a specialized successor to the F-4G Wild Weasel aircraft for defense suppression, but an "F-4G-like" capability with podded F-16s is adequate and more affordable, said Brig. Gen. Richard B. Myers, deputy chief of staff for Requirements at Tactical Air Command.

Aeronautical Systems Division hit upon another "eighty percent solution" when it began an urgent search last October for proximity fuzes for 105-mm howitzers on AC-130 gunships deploying to the Persian Gulf.

"We found that an existing Army fuze and a British-made fuze could both do the job," said Lt. Gen. Thomas R. Ferguson, ASD commander. "The British fuze, shell combustion, was fifteen percent more effective, but cost eight times more to buy. We bought the Army fuze. The decision was made January 4. The units were shipped on the seventh and were in theater for use on the tenth."

Some statistics will actually look better as the drawdown proceeds. The smaller force will achieve several such indexes of quality by backing into them.

Average age of aircraft in the tactical fleet will diminish, for example, but the more youthful numbers will mainly be the result of retiring the A-7s, most of the A-10s, and older model F-111s.

Similarly, the electronic warfare pod shortage will end soon. "That's not because we're buying more ECM pods or radar warning receivers," General Myers said, but "because the force structure is drawing down and we're able to take pods that were flying on A-7s, for instance, and move them over to the force that is left."

The Air Force thinks it has a sound case for continued force modernization, citing the Gulf War as proof that good equipment is worth the investment. Opposition is expected, however, from factions using that same battlefield evidence to argue that current systems are good enough and that no further improvements are needed.

One proposal, already floated, is to cancel the Advanced Tactical Fighter (ATF) and make do with an upgrade of the F-15. Had the Air Force followed similar logic in the 1960s, says Maj. Gen. Joseph W. Ralston, USAF director of tactical programs, it would have gone for an F-4 upgrade rather than develop the F-15.

"I would not want our combat forces in southwest Asia today to be fighting the air battle with an upgraded F-4, and I don't want our people in the year 2015 to be trying to fight the air battle somewhere around the world in an F-15," he said in Orlando.

A graying of the tactical force seems inevitable, despite modernization plans and retirement of older assets. It would take about 150 new aircraft annually to sustain a twenty-six-wing force without age creep, General Ralston said. The new defense program calls for procurement of only seventy-two fighters for the Air Force in the next *two* years.

Modernization by Stages

Elements of the tactical fleet will be replaced in order of average age, according to General Ralston.

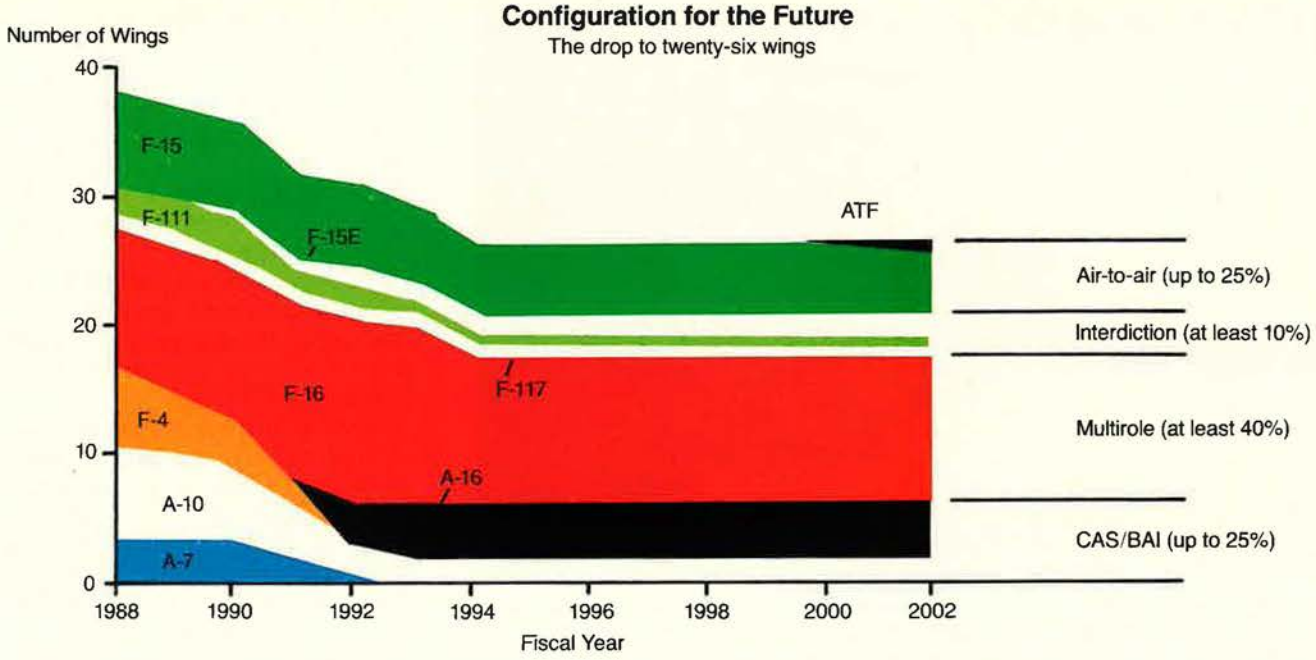
Air-to-ground fighters are the oldest, with an average age of thirteen years at present. They will get attention first, followed by air-superiority aircraft (current average age, eleven years) and then multirole aircraft (current average age, six years).

—USAF photo by SSgt. Charles M. Reger

Just as the F-4 would not have been as effective in the air-to-air combat arena as the F-15 (above) was in Operation Desert Storm, the F-15 will not be as effective as the Advanced Tactical Fighter will be in the next conflict. The F-111 (top) carries the bulk of the deep-strike role now but will be replaced by the F-15E.

Configuration for the Future

The drop to twenty-six wings



CAS/BAI. The close air support/battlefield air interdiction fleet currently consists of A-7s, A-10s, and F-16s. Perhaps a fourth of the twenty-six-wing tactical force will be fighters specialized for CAS/BAI.

The long-running battle with advocates of the "Mudfighter"—a slow, simple, heavily-armored successor to the A-10—is finally over. The primary CAS/BAI aircraft of the future will be an F-16 variant, the F/A-16, which test after test showed to be the best choice all along and which was the one proposed by the Air Force.

Some 350 F-16s (three-year-old "Block 30s") will undergo the F/A-16 modification, which includes a 30-mm gun pod, improved data modem, Pave Penny laser target tracking, and other features including forward-looking infrared (FLIR) sensors.

Reversing somewhat on previous intentions, the Air Force will now keep a couple of wings of A-10s for use in areas where enemy defenses have been suppressed. Modifications already in progress include a digital computer gunsight and other improvements. The A-10 may also get FLIR and other modest night-fighting features.

Interdiction. Four models of the F-111 provide the bulk of the interdiction force today, supplemented by half a wing of stealthy F-117s and just under a full wing's worth of long-reaching F-15Es.

As its numbers increase, the F-15E will become the interdiction workhorse. The F-117s will stay because they're too good to let go.

Of the F-111s, however, only the newest ones will be retained. A variant of the Navy's now-defunct A-12 aircraft was to have replaced them eventually, and the Air Force does not know yet how it will adjust to cancellation of that program. "It's premature to close out any alternative right now," General Ralston said.

Interdiction aircraft are forecast to be around ten percent of the tactical fleet.

Air Superiority. The F-15 will rule the air until the ATF begins replacing it in 2002. Upgrades to the F-15 under the Multistage Improvement Program continue, and it will soon add a powerful new weapon, the AIM-120 Advanced Medium-Range Air-to-Air Missile.

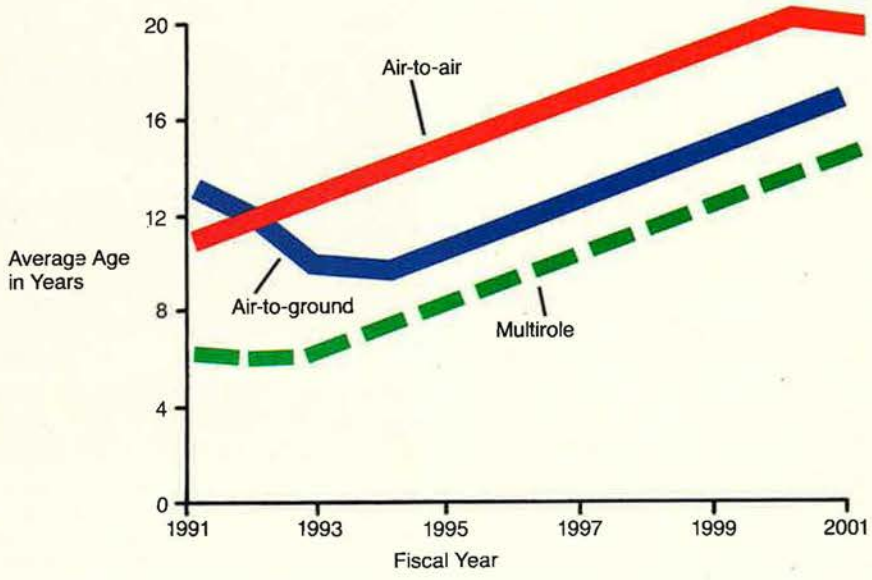
Competition for the ATF contract is almost over. The winner is to be selected this month from two competing prototypes.

Air-superiority fighters could account for "up to twenty-five percent" of the twenty-six-wing force.

Multirole Fighters. The last of the

The Graying of the Fleet

Average age (in years) of components of a twenty-six-wing tactical force



—© Randy G. Jolly/Arms Communications

The F-15E, while dedicated primarily to the deep interdiction mission, retains the air-to-air combat capability of its predecessors. Aircraft that can perform multiple missions will be a requirement in the downsized fighter force of the future. A force of twenty-six fighter wings can't afford too many single-mission aircraft.

F-4s will go soon, leaving the multirole mission exclusively to the F-16. At least forty percent of the tactical force will be multirole aircraft.

Some time after the turn of the century, when modernization of the air-superiority fleet with the ATF is well along, the Air Force will probably begin replacing the multirole F-16s, some of which will be more than twenty years old by then.

Specifications are not yet determined for a follow-on multirole fighter, but it would almost certainly have stealth features. Given the size of the multirole force to be replaced, affordable cost will be important, too.

Tested in Combat

For the most part, the first weeks of the Gulf War "served to reinforce our current training concepts, doctrine, and acquisition plans," said Lt. Gen. Jimmie V. Adams, USAF deputy chief of staff for Plans & Operations at the time of the Orlando symposium, now promoted and commanding Pacific Air Forces.

"We've had to call some audibles at the line of scrimmage, and I'm sure that some changes will flow from this experience, but I believe the changes will lead to modification, not overhaul," he said.

Force effectiveness, General McPeak said, derives from a successful combination of equipment, concepts, and people. Iraq also had some very presentable weapons, but it makes a difference who is flying, fixing, and controlling them.

Squadrons in the Gulf were getting three sorties a day from their aircraft, roughly triple the rate achieved in Vietnam. Despite hard flying and other complications, the in-commission rate for aircraft was often ten percent better than when they sat on the ramps back home in peacetime, said Lt. Gen. Henry Viccellio, Jr., USAF deputy chief of staff for Logistics & Engineering.

Public attention concentrated on combat airplanes and weapons, tending to overlook supporting capabilities behind the battlefield results.

For example, General Viccellio said, "we've been talking about 'suitcase testers' for years, and we're finally seeing results. The small mobile tester supporting our F-15E squadrons—known as METS—was set up and repairing parts within ninety minutes of arrival, in a 110-degree-plus hangar and using a very uncertain power source."

Never in any war have commanders had such comprehensive radar intelligence of the enemy's situation in the air and on the ground. The E-3 Sentry Airborne Warning and Control System (AWACS), which provides data on the air battle, has again demonstrated its value.

Its ground-surveillance partner, the E-8A Joint STARS (Joint Surveillance and Target Attack Radar System), made its combat debut in the Gulf before development was complete. Two E-8As, with mixed military and contractor crews, each flew ten or twelve hours a day, looking 200 kilometers into the battle zone to watch enemy traffic and other activity.

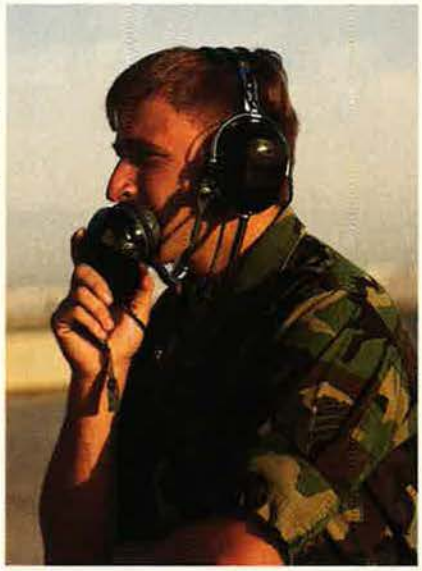
"We have come a long way, considering that the House Armed Services Committee originally zeroed this year's funding, saying the requirement for Joint STARS is no longer valid," Lt. Gen. Gordon E.

The US will never fight another war without the battle-management capabilities of the E-3 Airborne Warning and Control System or the E-8A Joint Surveillance and Target Attack Radar System (shown here during flight test). The two E-8A aircraft were deemed so critical that they were taken out of development testing and sent to the Middle East.

—USAF photo by TSgt. Perry Heimer

The Air Force's "Global Reach, Global Power" roadmap calls for fighters to be rapidly deployable (this 363d Tactical Fighter Wing F-16 calls Shaw AFB, S. C., home, but here prepares to take off from Saudi Arabia on the second wave of attacks against Iraq), but sustainable for longer periods with fewer parts and people.

—USAF photo by TSgt. Hans Deffner



Fornell, commander of Electronic Systems Division, said.

"We will never again want to fight any kind of combat without a Joint STARS kind of system," General McPeak added.

The Air Force went into the Gulf War with good electronic systems that have performed very well, but Joint STARS was not the only one rushed into use on an abbreviated schedule.

"We were caught in the midst of an upgrade program for the Tactical Air Control System," General Adams said. "We had a lashup, in theater, of a mix of old systems and prototype systems and some new production systems. They put it together and made it work, and it's much better than what we had before."

Global Reach, Global Power

The Air Force will adjust its planning in light of budgets and Gulf War experience, but so far, the "Global Reach, Global Power" roadmap published last year remains valid.

If the economies and operational imperatives required of a smaller force blur the distinction between strategic and tactical employment, that will only accelerate a process that was already under way.

The Vietnam War, General McPeak said, saw "B-52s doing close air support and the bulk of the 'strategic' effort, up around Hanoi, being flown by the [F-105] 'Thud.' We have an almost exact duplicate of that situation in Desert Storm today, with the strategic campaign being conducted entirely by fighter aircraft and the B-52s being used to attack troop concentrations essentially."

The idea of composite wings, streamlined and versatile, has been bubbling actively in the Pentagon for the past several years. Such a wing, General McPeak said, "notionally would have F-15Es, F-16s, F-15Cs, tankers, AWACS, and perhaps some kind of a connection with B-52s," although the heavy bombers might be stationed at a different base. The purpose of such a wing "would be to go to any spot on Earth quickly and conduct immediate air operations."

The force will be organized and equipped to meet a range of potential adversaries in places that may not become apparent until conflict is imminent.

"Technology makes Third World countries first-rate military powers," Gen. Robert D. Russ, commander of Tactical Air Command, reminded the Orlando audience. In the past ten years, he said, "the Soviets have sent over 3,000 SAMs, over 20,000 artillery pieces, over 8,000 tanks, self-propelled guns, and some 2,600 modern fighters" to the Third World, and smaller nations also have West European and US equipment.

Tactical air forces, he said, "must be capable of countering high-quality systems throughout the world, and they must be designed not just against Soviet hardware but against Western hardware as well."

Europe is no longer so overwhelming a factor as it once was in decisions about US force structure and weapons, but it is still a leading consideration.

NATO has not completed revisions to its strategy following the "London Declaration" by the North Atlantic Council last year, but Gen. Robert C. Oaks, commander in chief of US Air Forces in Europe, said that, clearly, "NATO will field smaller forces that stress mobility and versatility."

Speaking to the Orlando audience by video and telephone hookup, General Oaks predicted that "our wartime force structure and balance will look much as it has in the past, with two significant changes. We will have fewer forces operating on fewer bases, and a much larger portion of the wartime force structure will be deployed forces from North America, increasing the relative reliance on strategic airlift."

The C-17 airlifter, he said, is a must for tactical airpower.

"The threat is changing, reducing, and moving to the East, but we should not assume it is going away," General Oaks concluded. "Long term, there is every reason to expect that the Soviets or the Russians or whatever distills out of the turmoil in the USSR will have a smaller, modernized, and much more effective military than we see today." ■

These are informal vignettes from the Gulf War, recounted by the troops who fought it.

—Photo by Mark Peters, DoD/Sipa Press

Voices From the War

By Stewart M. Powell

AN F-117A Stealth fighter fired the Air Force's opening shot of the war against Iraq, dropping a pinpoint-accurate, laser-guided, 2,000-pound bomb through the roof of the general communications building in downtown Baghdad and into its communications center.

The single fighter targeting the facility operated with impunity over the Iraqi capital before Baghdad's air defense system detected follow-on attacks by conventional allied aircraft. "The city was lighted up, with cars still in the streets," recalled Col. Klaus J. Klause. Within hours, "Baghdad was blacked out, and they were sending up their heavy antiaircraft fire. We could see the lights of their flak twinkling all over the place."

Pilots given the highly sensitive task of striking high-value Iraqi targets participated in unusually detailed mission planning beforehand, including a review of floor plans to focus pilots' bombing priorities on key rooms.

Col. Alton C. Whitley, commander of the 37th Tactical Fighter Wing, based at Tonopah Test Range Airfield, Nev., said planes from his

—USAF photo by SSgt. Robert Jackson

Concentration, dedication, and determination were hallmarks of Desert Storm. The faces of the F-4G Wild Weasel pilot opposite and the 4th TFW F-15E maintainers above reflect all of those qualities—attributes that made possible the relentless hammering of Iraq with remarkably light coalition losses.

squadrons carried out thirty sorties against eighty Iraqi targets in the opening hours of Desert Storm. Vivid videotape of the attack on the communications building adjacent to the Tigris River showed the bomb slide precisely through the center of the roof of the multistory building before exploding.

Desert Storm threw hundreds of American flyers into their first combat missions, often under the tutelage of commanders who had seen action in Vietnam. For younger pilots, learning to work in the stress of combat was unforgettable.

Colonel Whitley told his pilots what to expect. "It would seem a little bit like fear," he told his men, "perhaps a little bit like anxiety. But not to worry, because we are well equipped."

Going into targets in Iraq, including Baghdad, pilots hunkered down in their high-tech cockpits. "You get as small as you can get," said Colonel Klause. "You sit down low in the cockpit, concentrate on the gauges, and don't look out."

One 37th TFW pilot, who identified himself as "Greg," dodged a storm of antiaircraft fire after the relatively calm first-in, first-out missions over Iraq the first night. "There's always what we call the 'golden BB'—the aimed or unaimed bullet that you run into because there are so many bullets," recalled the 1973 Air Force Academy graduate. "They fired more bullets than I thought were ever made in the history of the world."

—Photo © Dennis Brack/Black Star

Maintainers pulled off daily miracles in the nightmarish conditions of the Saudi desert. Capt. Brad Gallup of the 1st TFW's 71st TFS and his crew shot for a seventeen-minute turnaround, eight minutes better than TAC's wartime standard, to get "more planes able to get back out at [the enemy] again and again."

When a target was hit and the trip home began, the relief was palpable. "Coming off the target and knowing you're safe is one of the most exhilarating feelings I ever felt," the pilot said. "It's such a feeling of relief: I made it through a spot I didn't believe I was ever going to go into."

An American woman mailed a teddy bear named "Jeronamo" to "Any Service Member, Saudi Arabia." The stuffed toy animal quickly got more action than the sender bargained for.

SSgt. Brad Bowers, crew chief for an F-117A Stealth fighter known as "Invisible Thunder," assigned to the 37th TFW, decided to give the bear the ride of its life. "I thought I'd fly it around, then send it back to her when it's all over [and] let her know where it's been," the crew chief said.

The tan, eight-inch toy flew over Baghdad in the map case inside the cockpit on the allies' first mission.

—Photo by Mark Peters, DoD/Sipa Press

Col. Merrill "Ron" Karp (left), commander of the 35th TFW, congratulates Col. George "John Boy" Walton after the latter's first, highly successful Wild Weasel mission over Iraq. Colonel Walton, characterized by Colonel Karp as "fearless," knew that despite initial successes, the time to "buckle down" was just beginning.

Day of the Weasels

Waves of F-4G Wild Weasels led the way into Iraqi-held territory for follow-on ground attacks by US Air Force and Navy attack planes at the outset of Desert Storm. "The Weasels keep the SAMs off the guys," said Col. Merrill "Ron" Karp, commander of the 35th TFW, George AFB, Calif., which flew missions out of an undisclosed country in the Persian Gulf region. "The F-15s keep the MiGs off us, and the jamming planes deal with the radars."

Selected to lead the Weasels into combat was Col. George "John Boy" Walton, a veteran whom Colonel Karp selected for the job because Colonel Walton had "respect for the enemy" but was "fearless."

Upon returning from his first mission over Baghdad, a visibly drained Colonel Walton described in detail

the antiaircraft firestorm US warplanes dodged over Baghdad. "I saw one of the most fantastic fireworks demonstrations I've seen since years ago," he said. "Baghdad lit up like a Christmas tree."

With his face still creased from his oxygen mask, he sounded a sober note of determination, knowing the kind of antiaircraft fire that awaited his squadron on subsequent missions. "Now we have to buckle down and prepare," Colonel Walton said. "It's not over. We just have to keep the pressure on until the President says, 'Lay off.'"

The predawn assault that opened the war was "the scariest thing I've ever done," said British Tornado pilot Flt. Lt. Ian Long. "It was absolutely terrifying. You're frightened of failure, you're frightened of dying. You're flying as low as you dare, but high enough to get the weapons off. We saw some tracers coming off the target down our left side. We tried to avoid that. As the bombs come off, you just run—run like hell."

"Like New Year's"

The months of waiting ended for American forces in Saudi Arabia at midnight EST (8:00 a.m. Saudi time) on January 15—the deadline the United Nations set for Iraqi withdrawal from Kuwait. Aircrews with the 53d TFS greeted the milestone at their air base with applause, cheers, and a dose of gallows humor.

"We rang it in like New Year's," said Capt. Mike Elliott. "The official 1991 Iraqi calendar had just come to an end."

What Elliott meant was that the custom-made calendars prepared by the aircrews had dates only up to January 15—and a menacing blank thereafter. Tiny bomb bursts marked the spaces where the remainder of that week should have been. In the space where the following Sunday should have appeared, there appeared the words "Black Sunday."

The squadron marked the day with a group photo of forty pilots before they all headed out for the high-tempo, high-risk operations. "Organizing forty pilots is a contradiction in terms," quipped Lt. Col. Randy "Bigs" Bigum, the squadron commander.

The pilots were confident. As Capt. Mike Miller, an F-15C pilot, put it, Saddam Hussein is "not going to have a country after this thing."

Others marked the deadline's passing more quietly. SSgt. Mike Thomas set his watch alarm to go off at 8:00 a.m., the hour the deadline took effect. An engine was turning when his alarm went off, so it wasn't until a few minutes later that he realized the deadline had passed.

"I just had to stop and collect my thoughts," he recalled. "Is today the day?"

Confirmation that Desert Storm had started came not from President Bush or Defense Secretary Dick Cheney but from Col. Ray Davis, chief maintenance officer at an F-15 base in Saudi Arabia.

"This is history in the making," the officer told two combat correspondents.

Their report was filed at 2:27 a.m., January 17, 1991, Saudi time. It announced that "the war with Iraq began early Thursday morning as a squadron of US fighter-bombers took off from the largest US air base in central Saudi Arabia."

"The first [planes] took off at 12:50 a.m.," Colonel Davis told the correspondents. "We've been waiting here for five months. Now we finally got to do what we were sent here to do."

The two-man F-15E crews walked soberly to their aircraft to board their planes for what was for most their first combat mission. "They know what the targets are," Colonel Davis said at the time. "It's pretty much mechanical."

—USAF photo by TSgt. Perry Heimer

F-15s "Splash" Four

One contest less than two weeks into Desert Storm was an exhibition of US professionalism. The engagement between two F-15Cs flying combat air patrol about sixty miles south of Baghdad and four Iraqi warplanes took barely eighteen minutes on Super Bowl Sunday, January 27.

"When I realized I was about to engage them, time just seemed to

—USAF photo by SrA. Chris Putnam

Sights of the unforgiving terrain (above, a Saudi F-5 and USAF F-15s over Iraq) underscored the importance of refueling (top, an F-16 tanks up from a KC-135). One pilot described the "tightness" he felt 200 miles from friendly territory, and another said running out of gas (or hitting the ground) was "the biggest threat."

slow down," said a laid-back pilot nicknamed "Coma," flying for the 53d Tactical Fighter Squadron, 36th TFW, Bitburg, Germany. Like many other pilots, he withheld his true name to prevent reprisals against his family back home.

The slow-motion perception of combat was a phenomenon common to pilots during the air campaign that started Desert Storm on January 17.

The two US F-15Cs, piloted by Coma and "O.P.," had been aloft four hours and had just come off midair refueling when they got a call from an E-3 Airborne Warning and Control System (AWACS) aircraft.

Hostile aircraft were approaching. The US interceptors flew toward the advancing Iraqi planes, picking them up on their radar at eighty miles. At forty miles, the Iraqis inexplicably turned tail, only to be pursued by the F-15Cs.

"It seemed like they were unaware that we were there," said O.P. The US warplanes, flying above 27,000 feet, broke off radar contact and began to stalk their prey at 5,000 feet.

The F-15Cs dived on their targets. The Iraqi warplanes hit the deck, dropping as low as they could go. "From this point on, we just closed in on them," O.P. said.

The US pilots fired radar-guided AIM-7 Sparrow missiles and heat-seeking AIM-9 Sidewinders. Two MiG-23s went down.

The F-15Cs turned to track the two other Iraqi warplanes, a MiG-23 and Mirage F.1, downing the planes with Sidewinders. The two Iraqi planes hit the desert in plumes of flame.

Preparation had been more demanding than combat, said O.P., carrying a purple Teenage Mutant Ninja Turtle scarf given him by his six-year-old son. "We train to a much tougher threat."

Ground crews for F-15s flying combat air patrol over Iraqi-held territory worked night and day to improve on the "hot pit" turnarounds designed for the workhorse warplanes.

One maintenance crew with the 1st TFW from Langley AFB, Va., repeatedly tried to—and sometimes did—beat the twenty- to twenty-five-minute wartime standard for refueling, reloading, and rechecking an F-15 and then returning it to action.

Capt. Brad Gallup, assistant officer in charge of a maintenance crew with the "Ironmen" of the 71st TFS, said his team always shot for the seventeen-minute turnaround. That way, he said, "we'll have more planes able to go back out at them again and again."

In combat with Iraqi MiG-29s or Mirage F.1s, it was a contest of technology. "It's more my machine and how well I can run it vs. another guy," explained Capt. Steve Adams. "You don't look at it as beating that man. You look on it more as beating that machine."

Capt. Steve Tate had never flown a combat mission when the flight leader for aircraft from the 1st TFW was assigned to fly combat air patrol over Baghdad at the outset of Desert Storm. Suddenly, beneath Captain Tate's patrolling flight of planes, a French-built Mirage F.1 dashed down the runway of an Iraqi airfield and headed skyward to challenge American aircraft.

At 3:15 a.m., barely an hour into Desert Storm, Captain Tate fired a Sparrow missile at the Iraqi plane, piloted by one of Baghdad's elite French-trained airmen. The plane, he said, vanished in "a huge fireball."

—USAF photo by SrA. Chris Putnam

Munitions crew members from the 33d TFW load a Sidewinder onto an F-15, just one of the many types of munitions available to Desert Storm pilots. Crew members were nonchalant about keeping up with the astonishing 2,000 combat sorties per day. "It's like a 7-Eleven," said one. "The pilots can get any bomb they like."

Airborne Graffiti

Air Force ground crews scrawled a variety of messages on missiles and bombs bound for Iraqi targets as they readied American aircraft for missions over Iraqi-held territory. At an air base in Saudi Arabia used by two squadrons of F-117A Stealth fighters, the handwritten messages were typical.

"For all you do," said one, "this bomb's for you."

Said another, "We care enough to send the very best, from the US."

Writing something personal for Iraqi forces serving under Saddam Hussein "just makes you feel better," said A1C Gina Maskunas, who scrawled the message derived from a greeting card television advertisement.

"It's just a way of expressing yourself [and] of taking your aggressions out," said Sergeant Bowers.

Sergeant Bowers said that so many messages adorned bombs to be carried by the stealth aircraft that, at one point early in the campaign, the weapons began to look pretty scruffy. "It looked like a New York City bathroom in the subway with all the graffiti," he said.

As MSgt. Jerry Grace sees it, the job of the ground crews preparing ordnance for outbound aircraft is to have just about everything ready to go on a moment's notice.

"It's like a 7-Eleven," says the Air Force veteran. "The pilots can get any bomb they like."

Maj. Russell Richardson has responsibility for readying bombs for

F-111F pilots flying missions against Iraqi targets from an air base in southwest Saudi Arabia. "We've only had two duds in three days," Major Richardson said seventy-two hours into Desert Storm.

Staying ahead of demand is the key task for the BB stackers. During the six weeks before the air campaign began, as many as thirty-one aircraft each day delivered bomb parts to the air base that was handling the needs of the three squadrons of F-111Fs.

Even before the first bomb was dropped, Major Richardson's crew assembled enough bombs for two days of around-the-clock operations. As Sergeant Grace put it, "We haven't had any complaints."

BUFFs and Warthogs

America's aging fleet of B-52 bombers, which entered service in the 1950s as part of a round-the-clock nuclear deterrent, handled a variety of Desert Storm missions, including attacks on the exposed positions of Iraq's elite 150,000 Republican Guards. Twenty-six bombers, moved from the Indian Ocean island of Diego Garcia to Oman at the outset of the operation, attacked Iraqi military targets day after day with routine payloads of 60,000 pounds of 2,000 pound bombs and smaller ordnance.

The Commander in Chief of US Central Command, the Army's Gen. H. Norman Schwarzkopf, said it was hard to assess bomb damage against Iraqi forces but that the impact of 2,000-pound bombs on his position in Vietnam many years ago was something he'd never forget.

"I was [accidentally] bombed by B-52s one time in Vietnam. They were coming toward us. They did a marvelous job of dropping all their bombs, and then one rack hung up and it released over my position.

"Being an infantryman, I certainly wouldn't want to be under that type of attack."

The fleet of ungainly, often-disparaged A-10 close air support aircraft, popularly known as Warthogs, earned high praise for their performance during the campaign against Iraq's elusive Scud-B mobile missile launchers, used to terrorize civilian populations in Saudi Arabia and Israel.

—Photo by Rob Taggart, DoD/Reuters/Bettmann

—Photo by Andy Clark, DoD/Reuters/Bettmann

The A-10 made a household name for itself during Desert Storm. The disparaged "Warthog" had the dangerous task of searching for the militarily negligible but politically potent Scud missiles used by Iraq to try to draw Israel into the war. The durable A-10 can sustain a lot of damage (bottom) and still be able to return to base.

Finding the disguised mobile launchers was like "trying to find a semitrailer in Los Angeles," said Capt. Becky Colaw, who serves with the 354th TFW, based at Myrtle Beach AFB, S. C.

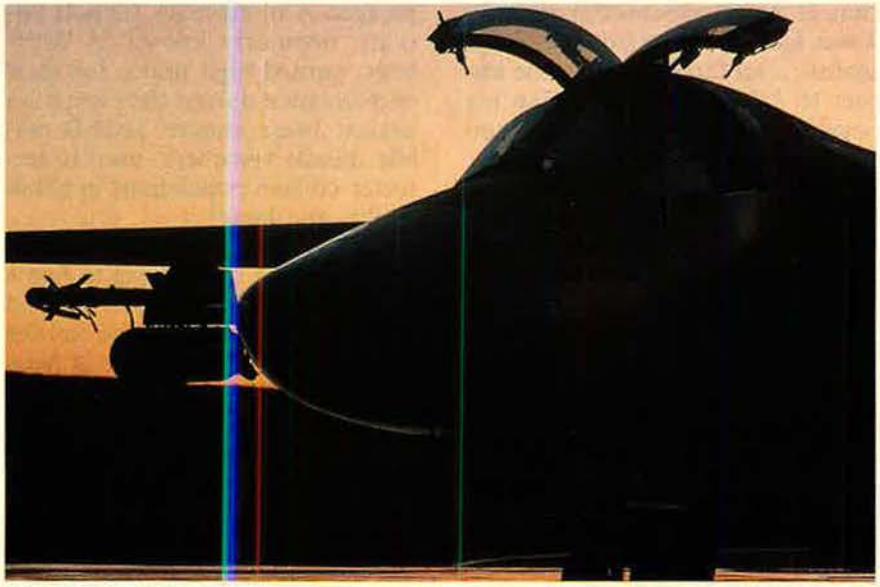
The long-duration aircraft loitered over Iraqi territory, waiting for a signal from overhead surveillance aircraft and satellites to target newly found Scud-B missile launchers. Pilots quickly tried to "walk that cat back" to the area where the missile was fired, explained Col. Ervin C. "Sandy" Sharpe, the commander of the wing, who also commanded a huge forward air base a few minutes flying time from Kuwait.

The pilots' motto? "Eyeball," Colonel Sharpe said. "That's how they find [the launchers]. The guy who finds it puts whatever ordnance he has on it. If there is still some left, whatever other aircraft are in the area are called in, until all the ones we have found in a particular area are destroyed."

The air campaign against Iraqi targets encountered unusually cloudy weather in the opening ten days, with more than a week of poor visibility obscuring targets assigned to a variety of strike aircraft. Squadrons of F-15Es became the workhorses called in to handle a variety of daylight and nighttime missions.

Cloud cover thwarted bombing missions by F-16A strike aircraft for several days, forcing many frustrated F-16 pilots to return to base with ordnance still on board. "We wish the weather was a little bit better so we can go in and do our job," said Capt. Ted Limpert, an F-16A pilot for the Air National Guard's 138th TFS, based at Hancock Field near Syracuse, N. Y.

Capt. Deane "Dawg" Pennington, a pilot with the ANG's 157th TFS, echoed this feeling. It was a definite letdown, he said, to "fly all that way when the pressure is on, getting tensed up a little bit, to get to that point where you're crossing enemy territory and then to have the weather become a big factor where



—USAF photo by SSgt. Charles M. Reger

Though the world's press was agog at the accuracy of the F-117 Stealth fighter, USAF had other weapon systems in the Gulf that provided similar precision. F-111s, such as this one, were used to attack Iraqi airfields. F-111 pilot Col. Tom Lennon, assigned to attack a maintenance hangar, said, "We put our bomb right through the side door."

you couldn't get in and find the target area."

Iraq's barrages of Scud-B missiles on Saudi Arabia barely interrupted the busy schedule of takeoffs and landings under way at US air bases. F-15 pilot 1st Lt. Steve Kirik was preparing to take off when he spied what quickly became a routine interception of an inbound Scud by a Patriot antimissile missile.

"I'm sitting in my jet getting ready to go," said the pilot. "I looked over at my port engine, and there [the Patriot] was. It jumped off the ground, snaked back and forth a couple of times, and then boom. It was pretty spectacular."

For a unit that had been guarding a major air base since the first hours of the US reinforcement in Saudi Arabia last August, the first combat "intercept" of an enemy missile by a Patriot was finally a chance to put the training—and waiting—to good use.

"We didn't expect [the missile] at that moment," said Army Lt. Col. Leroy Neel of Houston, Tex., commander of the Patriot battalion. "It was there. We reacted properly, and it was gone."

Wins and Losses

Capt. Tony Mattox experienced a double first in Desert Storm. He flew his first combat mission in an aircraft that had never seen combat. Both the pilot and the A-10 Thunderbolt II performed admirably.

"I've been training for years and I was dad-gum glad to be part of it," Captain Maddox said. "I mean we go for months just drooling to get a chance to shoot live weapons in peacetime. Yesterday we went out and shot more live weapons than I had in my entire career."

Discovering that a comrade was lost in combat often came just as the "fog of war" was lifting. Col. Hal Hornburg, commander of the 4th TFW Provisional, based at Seymour Johnson AFB, N. C., recalled the way his pilots learned that the F-15E wing had lost its first warplane.

"The pilot was coming off the target. He was seen," Colonel Hornburg recalled. "He made a radio call that he was coming off target, and then, as the formation regrouped after hitting the target and they checked in to make a roll call, he wasn't heard from."

Intense surface-to-air missile activity reported in the area at the time, as well as antiaircraft artillery fire, apparently claimed the two-man plane.

"We all feel bad that we have an airplane missing," Colonel Hornburg said, "but at the same time, no one has lost his focus that we still have a job to do. I see fire in their eyes."

For all the munitions illuminating the night skies over Iraq and Kuwait, with the allies bombing Iraqi targets and the Iraqis unleashing a firestorm of surface-to-air missiles and antiaircraft artillery fire, an unseen war raged as well.

"There's still a lot of war going on," explained Lt. Col. Dennis Hardziej, commanding officer of the 390th Electronic Combat Squadron of EF-111 Raven aircraft based at Mountain Home AFB, Idaho. "It's not just 'waltz in and waltz out.'"

Iraqi activity in the early stages of the air war pressed US assets, forcing commanders to husband valuable resources for attack aircraft entering only the most densely protected sites. "There are a limited number of EF-111s in the region," Colonel Hardziej said, "and there are always more missions than aircraft."

F-111F fighter-bombers from the 48th TFW, based at RAF Lakenheath, UK, carried out pinpoint bombing missions with Pave Tack target-acquisition systems against many of the forty-four Iraqi airfields targeted for early interdiction.

"I went against a maintenance hangar," recalled Col. Tom Lennon, the 48th's wing commander, who led a wave of fifty-three F-111Fs into Iraq and led a flight of six aircraft against a large Iraqi airfield. "We put our bomb right through the side door."

Colonel Lennon, a veteran of 390 combat missions in southeast Asia, spent just forty minutes in Iraqi airspace on his first mission. The early minutes of combat are crucial for hardening aircrews, settling nerves, and giving pilots and weapon systems officers confidence in their training, the veteran pilot said.

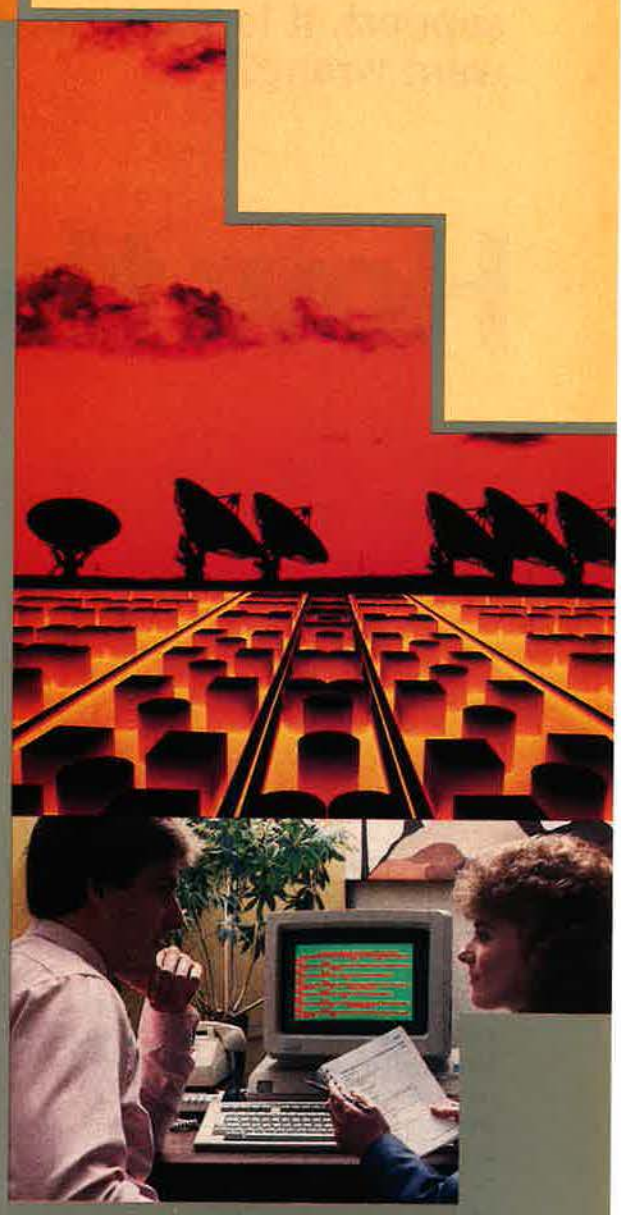
"I told [my pilots] the biggest threat is hitting the ground or running out of gas," said Colonel Lennon.

Capt. Matt Warren flew his first combat mission under Lennon's leadership. "Just being over enemy territory—knowing we were 200 miles from friendly territory—the only way out is to fly out or punch out—it's a tightness." ■

Stewart M. Powell, national security correspondent for Hearst Newspapers, has reported on defense and foreign policy in Washington and London for ten years. He was in Saudi Arabia throughout Desert Storm. His most recent article for AIR FORCE *Magazine was "Long Haul in the Middle East" in the March 1991 issue.*

Command & Data Processing

Three Decades of Proud Service to the Space Community



GE has been an integral part of the Air Force Satellite Control Network since its inception. For thirty years, GE has developed, operated, maintained and managed sophisticated Command and Control ground systems for the Air Force, NASA and other government agencies. GE fully understands the needs and requirements for the Command and Data Processing Program. We are ready to apply our full range of capabilities to the C&DP Program.

Committed through a Heritage of Excellence

C&DP

GE Aerospace

It was the Navy's top aviation priority. It had Pentagon and congressional support. It looked trouble-free. What went wrong?

How the A-12 Went Down

By David Montgomery

ON A chilly Saturday last January, Defense Secretary Dick Cheney headed to the Pentagon to meet with a small band of senior officials, including Navy Secretary H. Lawrence Garrett III. The capital was in the throes of Persian Gulf war fever, but this January 5 session focused on another crisis: what to do about the Navy's A-12 aircraft, which was at least $1 billion over budget, 8,000 pounds overweight, and eighteen months behind schedule.

Secretary Garrett argued for a federal bailout to rescue the plane. Others demurred. After six hours of discussion, Secretary Cheney dropped a bomb: He would reject a bailout. He would kill the A-12 outright.

The Secretary's summary execution of the A-12 abruptly ended the saga of a plane that, six months earlier, enjoyed broad congressional support and appeared problem-free. The stealthy, carrier-based attack plane had been naval aviation's top priority since 1984. What caused it to nosedive from preeminence to oblivion?

Investigators and officials place the blame on four factors:

- Overly protective Navy officials, who didn't want to endanger the plane by pointing out problems. A Pentagon analyst first detected a possible cost overrun two years ago, but the Navy program manager continued to describe the A-12 as being on track until after a major Pentagon review last year.
- A "don't-rock-the-boat" segment of the Pentagon bureaucracy, which was aware of the problems but apparently reluctant to buck its superiors to press its case. In one incident, a report noting A-12 problems was tucked away and forgotten.
- Overly optimistic A-12 contractors, who miscalculated the extent of the technical difficulties in producing such a plane and shielded the problems from the government. An inquiry by Navy Deputy General Counsel Chester Paul Beach found that General Dynamics and McDonnell Douglas discovered "increasing cost and schedule variances" but did not alert the Navy in a timely fashion.
- Excessive secrecy, which blanketed the project and prevented examinations that might have brought problems to light. Officials assigned to Secretaries Cheney and Garrett were kept away, standard reporting

procedures were abandoned, and information was transmitted verbally rather than in writing.

Secretary Cheney's kill order, unveiled January 7, rocked the defense community. It left the Navy struggling to find a successor to its A-6 jets and worsened the woes of the aerospace industry. The disaster forced the resignation of Under Secretary of Defense for Acquisition John Betti and the sacking of two Navy admirals and a captain. It effectively ended the Air Force's program to develop a derivative of the A-12 to replace F-111 and F-15E aircraft.

Suspicion and Ambition

A-12 development began early in the 1980s. In January 1988, the Pentagon awarded General Dynamics and McDonnell Douglas a contract worth $4.8 billion for full-scale development, including production of eight prototypes. It later added contracts of $1.2 billion for Lot 1 production of six aircraft and $200 million in long-lead funds for Lot 2.

Plans called for production of 858 aircraft. First, the Marine Corps opted out of the program, reducing the planned buy; then, due to tight budgets, Secretary Cheney pared the buy to 620 in April 1990, though he continued to endorse the program.

Until last June, the A-12 appeared to be in good shape. According to the inquiry conducted by the Navy, however, the program fell into trouble almost from the outset. At the heart of the crisis were technological challenges inherent in creating such an advanced aircraft.

The biggest problem, say officials, stemmed from the difficulties of creating and applying highly advanced composite material in the radar-evading stealth plane. The two contractors had inadequate experience with this material to carry out the project smoothly and with a minimum of delay.

Evident mutual suspicion between the two contractors compounded the problem. One Pentagon analyst who studied the issue said the two A-12 contractors appeared loath to share sensitive technology to further the A-12 program. The reason: They were competitors on another project—the program to build the Air Force's Advanced Tactical Fighter. (That project pits a team of Lockheed, General Dynamics, and Boeing against Northrop and McDonnell Douglas.)

Evident mutual suspicion between the two contractors compounded the problem.

"There were technologies that could have helped in the overall [A-12] effort, but they weren't willing to share those," said the analyst. "If you have a technological advantage, how willing are you to share that if . . . it could help you in some other program?"

An overly ambitious schedule exacerbated the problem. Under the original timetable, the contractors planned first flight for June 17, 1990. They mapped out a design-to-assembly schedule of only nine months, far shorter than the fourteen months normally allotted for such an effort.

Workers in top-secret areas of plants operated by General Dynamics in Fort Worth, Tex., and by McDonnell Douglas in Saint Louis, Mo., would spend four and a half months on subassembly. Sections would be shipped to Tulsa, Okla., for final assembly.

According to the report, the manufacturers were only feeling their way along. They lacked proper tooling, missed key target dates at various steps in the development process, and were forced to issue "stop work orders" because of engineering problems. Delays in the arrival of parts further delayed production.

"Evidence of Trouble"

When the program manager's production oversight team assembled in the summer of 1989 to begin working toward a first flight in June 1990, the contractors should have had a firm design in hand for their manufacturing elements. "Hard" (production-quality) tooling should have been on the assembly floor by September 1989.

Instead, Navy counsel Beach said, "there was early evidence of trouble affecting the production schedule. The amount of engineering effort required by the design of the airframe . . . was the first indicator that first flight of June 1990 would slip. By then, the first flight date of June 1990 was likely unattainable due to lack of ample tooling and parts flow."

Late release of engineering design drawings delayed other development stages. "In addition to the tooling problems," said Beach, "further delays in initial fabrication of the composite, sheet metal, and machined parts pushed back the initial load dates for assembly jigs and fixtures."

Somewhere along the line, the contractors began to see that they had made a gigantic mistake in taking on the program under a fixed-price contract, which the Navy had imposed in an effort to get a grip on weapons costs. It was too inflexible to allow for unforeseen costs, say industry and Pentagon officials, even though such costs are inevitable when contractors are working on the frontiers of technology.

Moreover, the aerospace contractors, who had sustained financial setbacks because of government defense cuts, were under pressure from upper management to maximize cash flow. They relied heavily on progress payments given at various points in the development process, Beach said.

"Such pressure would create an incentive to be optimistic," since progress payments would be reduced if the contractor or the government estimated an overrun, said the Navy lawyer.

Beach also said that the progress payments were poorly scrutinized by the government. In one instance, the Navy signed off on three contract line items, even though work on each was not yet complete. Payments were also approved for work that was substantially below requirements, Beach said.

Consequently, the contractors, with approval by the Navy, "fostered the illusion that internal program milestones had been successfully passed" when critical elements of the contract "had, in fact, only been pushed downstream."

The technical and schedule problems set the stage for the eruption of fatal political problems in 1990. Secretary Cheney had been a strong supporter until early last summer, when he learned of major difficulties leading to cost overruns and delays. These had not been detected during a nineteen-week-long Major Aircraft Review (MAR) of the A-12 and three other planes: the Air Force's B-2, C-17 transport, and Advanced Tactical Fighter (ATF).

A Clean Bill of Health

Following the MAR—and as a direct result of it—Secretary Cheney appeared before Congress and on several occasions gave the A-12 a clean bill of health.

Later, Pentagon probes showed that the program at that time had been floundering and no one had thought to let the Defense Secretary in on the secret. This outraged the Defense chief when he heard of it, and it set the stage for his January 5 kill order.

Investigations by Beach and by Defense Department Inspector General Susan Crawford indicate that top officials in the Navy and DoD were aware of the problems but, for various reasons, either didn't react or didn't follow through.

They pointed out that Secretary Cheney himself was present at briefings in March and April 1990 in which briefers raised the issue of a potential $1 billion overrun on the A-12 program. Under Secretary Betti, Cheney's top procurement officer, gave short shrift to the estimate, and the discussion veered off in a new direction.

In another instance, a Pentagon staff member received a report about potential delays. He later said that he simply put it aside and forgot about it.

Secretary Cheney appeared before Congress . . . and gave the A-12 a clean bill of health.

Until his forced transfer in December, the Navy's principal overseer for the A-12 program was Capt. Lawrence G. Elberfeld, an aviation engineer with three advanced degrees. As program manager since June 30, 1986, Captain Elberfeld had full authority and responsibility for the program. He commanded a small staff with assistance from on-site personnel at the two defense plants.

As portrayed in Beach's investigation, Captain Elberfeld was protective of the A-12 and showed "good news" slide presentations to accentuate the positive, despite increasingly ominous signs. However, Beach also backed Captain Elberfeld's claim that he "repeatedly and forcefully" told superiors of "major challenges in the program" and that "he insisted at all times on candor."

One early indication of trouble came from a Navy cost analyst, who in March and July 1989 presented Captain Elberfeld with a range of cost estimates predicting that the contract could exceed the ceiling by as much as $200 million.

In reports to superiors in November 1989 and February 1990, Captain Elberfeld replaced the analyst's estimate with a lower calculation, "which he believed would result in an improvement in the contractor team's cumulative cost performance," according to the Beach investigation.

The Pentagon's own comptroller, in an October 1989 budget recommendation, warned that the A-12 program was two years behind and $500 million over ceiling. The budget recommendation and its accompanying forecast were shelved because "no one agreed with us," according to an analyst in the comptroller's office.

One Day, One Billion Dollars

The news got worse. On March 26, 1990, Deputy Director for Cost Management Gary Christle, an independent cost analyst assigned to Under Secretary Betti's office, was brought in to review the A-12 program. One day later, after gaining access to classified A-12 data, Christle concluded that the program was $1 billion over budget and a year behind schedule. Christle's own boss, Under Secretary Betti, refused to take the warning seriously.

In spite of the warning signs, Captain Elberfeld continued to present the A-12 as an unqualified success. In an April 14, 1990, briefing, he made no mention of the $1 billion cost overrun estimate and said the A-12 was "on track." He also warned that renegotiating the contract would strap the Navy with legal liabilities. On April 26, not long after the conclusion of the MAR, Secretary Cheney appeared on Capitol Hill to reassure key Senators and congressmen that the program was doing well.

Then the roof began to fall in. On May 4, 1990, eight days after Secretary Cheney's congressional appearance, Captain Elberfeld evidently had a frank talk about the A-12 with the two contractors and soon began to revise his optimistic assessment. "For the first time, they acknowledged a very strong likelihood they would exceed their ceiling costs," Captain Elberfeld told investigators.

The program manager, now worried, called a briefing three days later to alert his superiors. One of the officials, Rear Adm. John F. Calvert, the A-12 Program Executive

Officer, resisted taking the problem further up the chain of command to the Navy's Assistant Secretary for Research, Development, and Acquisition, Gerald Cann.

"I'm not going to take a problem to [Cann] without a solution, because if I do, he may give me a solution I may not like," Admiral Calvert reportedly told his subordinate. Captain Elberfeld then recommended a candid briefing for Cann to air the problems but was told by Admiral Calvert to reduce his points to a two-page working paper.

The working paper was further edited to one page. At a subsequent meeting between Captain Elberfeld and his Navy bosses, they decided not to tell Cann about the problems disclosed by the contractors on May 4. Admiral Calvert told Captain Elberfeld not to bring his talking paper to a meeting with Cann to discuss the Lot 1 purchase of A-12s. During the meeting, Captain Elberfeld kept quiet. To do otherwise, he said, would "have been contrary to [Admiral Calvert's] desires."

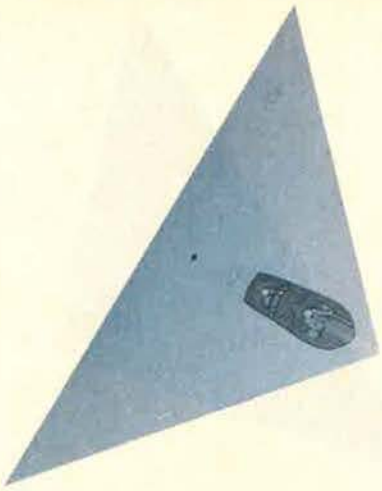
Others in the Pentagon were sluggish in responding to the bad news. Although Christle's $1 billion estimate was discussed in two briefings with Secretary Cheney, Betti said he made no effort to raise it as a "red flag" because he considered the analyst a "new kid on the block" unfamiliar with the A-12.

Problems weren't brought to Secretary Cheney's attention until June 1, when the contractors officially advised the Navy of severe delays and cost overruns and pushed the first flight to December 1991. The Pentagon then ordered inquiries to determine why the problems had not surfaced during the recent MAR.

Visions of a Bailout

In a December 17 letter, the Navy's Assistant Commander for Contracts, Rear Adm. W. R. Morris, informed the two contractors that they had "failed to fabricate parts sufficient to permit final assembly" and had failed to meet specification requirements. He ordered the two aerospace giants to show cause why the Navy should not cancel the contract for default.

Still, few expected Secretary Cheney to kill the A-12. Most predicted that the January 5 "show cause" meeting would result in a government bailout to keep the airplane going.



The choice was between a bailout and a termination. The issue focused on money.

Pentagon spokesman Pete Williams described the discussions: "[Secretary] Garrett did all the early talking, kind of laid out for [Secretary Cheney] what he thought the issues were and walked through his recommendations. Then Yockey [Donald Yockey, then the acting deputy secretary for Acquisition] made a follow-up presentation. They both kind of described the current problems with the contract and where we should go from there."

After that meeting, Secretary Cheney met for about an hour and a half with a smaller group that included Joint Chiefs of Staff Chairman Gen. Colin Powell, Deputy Defense Secretary Donald J. Atwood, and "only a few other people," Williams recalled.

The Pentagon spokesman said the choices boiled down to three options: carrying out the existing contract despite its problems, modifying the contract to bail out the manufacturers, or terminating the program.

"The general view," Williams said, was that the current arrangement was "not going to work" and that "the contractor cannot proceed under the current contract." The choice was between a bailout or a termination, and the issue focused on money. "Every time [Secretary Cheney] asked about additional costs, he was told that no one could be sure," Williams said. "That was part of the problem."

Was that a dominant factor in Secretary Cheney's decision? "Absolutely," said Williams.

The Pentagon chief made up his mind after the meetings and called Secretary Garrett late Saturday afternoon. "I don't want a bailout," Williams quoted Secretary Cheney as saying.

Now unable to continue the program, the Navy formally canceled the contract on Monday, January 7. The contractors were first informed by Admiral Morris. They were told that the contract was terminated for default.

General Dynamics and McDonnell Douglas stated that they did not agree that they were in default and that they would contest Secretary Cheney's decision and his characterization of the condition of the program.

How could such a fiasco occur?

Williams said that Secretary Cheney had always been led to believe the program was on track. Even though the Secretary attended the two Pentagon briefings during the spring in which an estimated $1 billion overrun was mentioned, according to a Navy inquiry, Williams said that Cheney didn't react strongly because he was still being led to believe the problems were manageable. "The constant message to him was: 'Don't worry, we've got this under control.'"

Was Secretary Cheney's credibility hurt as a result of the A-12 imbroglio? "I think he's concerned that he went out and told Congress one thing, and he found out later that another thing was the case," Williams reports, "but I don't think his long-term credibility suffers for it." ■

David Montgomery is Washington bureau chief of the Fort Worth, Tex., Star-Telegram. *He has extensively covered General Dynamics and the A-12 project. This is his first article for* AIR FORCE *Magazine.*

Actual flight test photo AGM-130, Eglin AFB, Fla.

AGM-130. THE STANDOFF WEAPON SYSTEM THAT WON'T MAKE A DENT IN THE BUDGET.

In deep strikes against fixed or mobile high-value targets, precision, payload and range are essential to mission success. And to aircraft survivability.

The U.S. Air Force/Rockwell AGM-130 standoff weapon system has proved itself capable of not just fulfilling these requirements, but doing so at an affordable price.

Recent development and operational tests demonstrated AGM-130's ability to deliver a 2,000-lb. warhead with pinpoint accuracy under a rigorous set of tactical profiles that included various range and altitude flights.

AGM-130 provides an unmatched combination of high lethality, aircraft survivability, flight profile flexibility and low cost. As a powered derivative of the modular GBU-15 system currently operational with the U.S. Air Force, it's built on proven technologies and tactics. And it benefits from GBU-15's established production, logistics, training and support resources.

No other weapon system can deliver as much punch with as much precision. And no standoff weapon system is as affordable. For more information, write: Tactical Systems Division, Rockwell International, 1800 Satellite Blvd., Duluth, Georgia 30136, or call (404) 476-6300.

Rockwell International

...where science gets down to business

Improvements are in store, both for the pilot and for the cockpit.

Changes Under the Canopy

By Jeffrey P. Rhodes, Aeronautics Editor

THE ULTIMATE ejection-safe cockpit of the future won't have a throttle or a stick that might snag the fighter pilot who tries to "punch out." In fact, it won't have any instruments at all, except a few backups for emergency use.

In this cockpit, the pilot likely won't be able to see the outside world. Instead, he will see a computer-generated display of a virtual world, containing every piece of information he needs to carry out his mission. Flight path, threat, altitude, speed, and armament data will be combined and presented in a way that gives the pilot total situational awareness, a complete picture of the environment in which he operates.

For controlling the aircraft, he will wear specially made gloves lined with fiber-optic cables. When the pilot makes the gesture of grabbing and moving the (imaginary) control stick, the aircraft computer will understand the motion and make the plane bank or pitch up and down. An image of a stick will appear in his cockpit display, but the pilot is only holding out his hand and flicking his wrist. The throttle works the same way.

Above, Nick Longinow, a researcher at Wright-Patterson AFB, Ohio, gives a new definition to "hand flying" in a simulator. Although he is not actually grabbing anything, he sees the stick and throttle in his helmet display, and fiber-optic cables in his gloves relay his motion to a computer, which then moves the simulated aircraft. At right, a pilot's face, helmet, and oxygen mask are measured by a laser scanner.

This is one potential cockpit of the future, and research on its basic enabling technologies is well under way. The reason, says Dr. Wayne Martin, an engineering research psychologist at Wright-Patterson AFB, Ohio, is simple. "We are working toward a virtual world," he explains, "because eighty percent of the controls and displays we use now have nothing to do with helping the pilot stay alive and do the mission."

Ensuring pilot survival and mission completion are primary cockpit concerns of Air Force Systems Command's Human Systems Division, which pursues them mainly at

its Armstrong Laboratory at Brooks AFB, Tex., and its detachment at Wright-Patterson. This newly created "superlaboratory" is the Air Force's center for human factors research.

Man and Cockpit

For the most part, human factors studies focus mainly on fighter aircraft, because fighters put a pilot in the most strenuous and demanding flying environment known. The increased emphasis on fully understanding how man and machine need to work in concert springs from three major factors.

First, highly maneuverable fighter aircraft that can withstand high G-loading present many new challenges. For instance, no one is exactly sure what happens to a human body when it is ejected at 350 knots.

The second factor is that, for the first time, detailed measurements can be performed. Computers and other devices necessary to measure the effects of high-speed, high-G flight are now available because they were developed, in part at least, for the very aircraft whose effects they will seek to measure.

The third factor is cost. "It happens a lot that the designer comes up with something in a cockpit design that is wrong from a human standpoint," says Dr. Joe McDaniel, an industrial engineer at Wright-Patterson who works with advanced computerized models and simulations. "If you build the design, it is tough to change it. If you can catch it in the design stage, it doesn't cost as much to make a correction."

Human factors work at Armstrong Lab falls into two distinct categories: experiments and studies of those forces that affect the pilot directly and of those that affect his work environment—primarily the cockpit. Cockpit issues generally are taken up by the engineers at Wright-Patterson, while research relating to pilots falls to workers at Brooks.

Some projects promise near-term payoffs, while others will take years of developmental work. Other efforts are in place and working. These will pay dividends over the long run.

Immediate Successes

Research into contact lenses is one such project. Contact lenses provide the pilot with many advantages over standard eyeglasses. The lenses don't impair peripheral vision, and they don't interfere with an oxygen mask or night vision goggles (NVGs). They do pose a problem, however, when they dry out; it's tough to adjust a lens while flying at 400 knots at low altitude.

Early studies indicated that contacts were unacceptable for cockpit use. Advances in lens composition led Tactical Air Command to request a second look. Soft contacts were tested in the centrifuge at Brooks, in the altitude chamber, under low-humidity conditions, and with chemical agents before they were tested in the field.

The tests showed that new contacts could be worn successfully. They now are approved, provided the pilot keeps a pair of glasses handy for emergency use. Researchers at Brooks are now studying whether rigid, gas-permeable lenses are acceptable.

The Combat Edge G-suit made by Boeing, now completing initial operational test and evaluation, addresses the potentially catastrophic problem of G-induced loss of consciousness.

When a pilot is "pulling" eight Gs, the plane is banking so steeply that the effect of gravity on a body is eight times the normal force. During such high-G maneuvering, the pilot's vision dims as the weight of his blood prevents it from reaching his brain. Loss of consciousness follows soon afterward. In many cases, the result is a crash.

Vision loss begins at 3.5 Gs. If the pilot has no protection, he will begin to lose consciousness at about 4.5 Gs. A pilot can increase his tolerance by wearing a G-suit or performing the L1 straining maneuver, a procedure in which one tenses the arms and legs and grunts. These measures increase pressure in the chest cavity, giving the heart a more stable platform against which to beat and helping blood reach the brain.

The G-suit adds approximately 1.5 Gs to a pilot's tolerance. The L1 maneuver, properly performed, adds up to four Gs, bringing the pilot's total tolerance to nine Gs for up to fifteen seconds at a time. Combat Edge uses a positive-pressure breathing system to add pressure mechanically to the heart. The pilot expends less energy performing the L1, and fatigue declines greatly.

Two other essential ingredients complete the Combat Edge ensemble. A counterpressure garment, which keeps the lungs from overexpanding from high-pressure oxygen, is worn over the flight suit. A bladder in the back of the helmet automatically tightens the oxygen mask, sealing it tightly to the pilot's face.

The Combat Edge G-suit ensemble reduces fatigue and almost doubles the time a pilot can withstand high-G forces. The ensemble uses two oxygen hoses, one to the pilot's mask (and the bladder that keeps the mask sealed tightly to his face) and one to the counterpressure garment (the vest under the harness straps).

"We tested the ensemble in the lab by having subjects performing simulated air combat maneuvering repeatedly up to nine Gs," notes Dr. Kent Gillingham, the laboratory technical director at Brooks. "The amount of time they can withstand nine-G forces has more than doubled. . . . It is conceivable the ensemble could withstand higher forces, but the aircraft can't go any higher than that."

Anthropometric Measurement

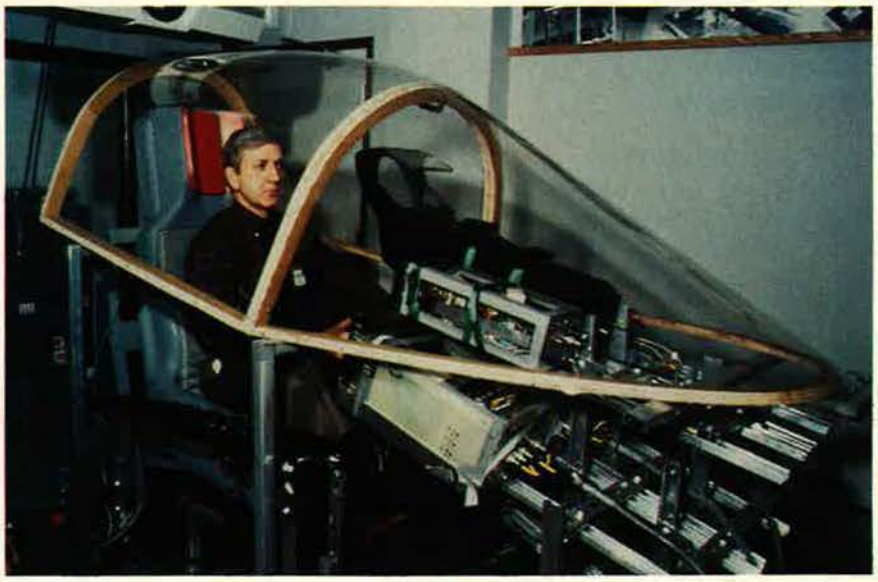
Air Force use of anthropometric measurement uncovered a potentially serious problem in the Air Force's new T-1A Jayhawk training aircraft. Studies based on accumulated physiological measurements of today's pilots showed that the throw of the present control yoke design would be reduced because the thighs of most pilots get in the way. Design changes are now being studied and implemented.

"There are two advantages to having a database of pilot sizes," says Jenny Whitestone, a biomedical engineer at Wright-Patterson. "First, if there are design changes in an aircraft, we will know if things will be out of reach. Second, specifications can be written, not amended later, with the right fit for a cross section of humans. There is no fiftieth-percentile [*i.e.*, exactly average] person."

Researchers at Wright-Patterson's work load and ergonomics branch are developing sizing charts for flight suits. They first determine what size bodies wear what size clothes. In all probability, the total number of sizes purchased can be reduced, a move that would lower costs substantially.

For pilots, one important piece of personal equipment is the oxygen mask. Getting a tight seal is vital. If a pilot does not fit in a standard-size mask, the Air Force must make one for him. Up to this time, technicians prepared a plaster cast of his face, and the mold was used to form the new mask. Sitting for a plaster cast is a long, uncomfortable process.

Now "special cases" are measured with a three-dimensional laser scanner in a procedure that takes about ten minutes. The mask mold can then be made by feeding the data into a computer-driven milling machine or using a new stereolithography apparatus (SLA).



The rapidly configurable cockpit simulator is a key element of the CAT (cockpit automation technology) program. If a new display or control works here, it may eventually move to flight test. The simulator, here "flown" by Joe Hendrix, a contractor employee, will be delivered to Wright-Patterson this year.

With an SLA, the 130,000 measurements taken from one individual by the laser go to a contractor who feeds the data into a computer-aided manufacturing machine. The machine fires a laser into a vat of liquid polymer at each measurement point. The polymer hardens wherever the laser strikes it, rapidly building up a mold.

There is no need to keep the mold, only contour data taken from the face. This eliminates the need to store the fragile plaster casts and produces a better fitting mask.

Building special-case oxygen masks is just one area in which the Cyberware 3-D helium-neon laser scanner helps the engineers. NVGs have to be ejection-safe, and current pads used to cushion the goggles on a pilot's face are stiff and poorly shaped. Using data collected with the scanner, technicians developed a new silicon gel pad that is better shaped and more comfortable. The pads are being tested and should be cleared for use soon.

Self-Inflicted Problems

Human-factors specialists are building up a computer database for the Aircraft Mishap Prevention (AMP) program at Brooks. Historically, human factors are at the root of more than two-thirds of the Air Force's Class A mishaps, but the exact correlation of causes of mishaps is hard to analyze.

The goal of AMP is to develop a kind of clearinghouse for human factors data as they relate to type-specific and service-wide aircraft mishaps. Products that could be generated include training materials for aircrew members, human performance analysis for mishap boards, data to facilitate engineering design improvements, and background studies for policymakers.

Spatial disorientation (SD) is the most common cause of the Air Force's fatal aircraft mishaps. "It is an obvious problem," notes Dr. Gillingham. "A pilot flies into the ground because he is confused."

The drive to combat SD focuses on three areas. First, the mechanics of human spatial disorientation—what causes illusions—must be fully understood. Second, cockpit displays and symbology that help the pilot maintain spatial orientation need to be developed and tested. Third, in the near term, the key is proper training.

One solution is a ground-based training device that has a motion base and wide field of view projection. Called the Advanced Spatial Disorientation Demonstrator (ASDD), this simulator will be used to generate illusions and responses to illusions. It will be delivered to Holloman AFB, N. M., early next year.

"We want a pilot to control the vehicle and put it into unusual atti-

tudes, based on his perceptions of what he sees," says Dr. Gillingham. "We want him to see how easy it is to get disoriented."

ADAM and COMBIMAN

ADAM, the Advanced Dynamic Anthropomorphic Manikin, is no ordinary crash dummy. ADAM is a lean, mean, highly instrumented machine used to measure the effects of high-speed ejection on human beings.

"We don't have a lot of volunteers to eject at 450 knots so we can collect data," says Ric Rasmussen, ADAM program manager, "so we developed ADAM."

Developed as part of the now-dormant Crew Escape Technology (CREST) program, ADAM is one of the first manikins to have a shoulder. His bones have the same masses, centers of gravity, and moments of inertia found in human body parts. He even has a fluid-filled spine, like his human counterpart.

ADAM's self-contained data unit collects 1,000 samples of data per second via his 128 data channels. He can store up to one-half megabyte of data, and when he has finished a test, he lets researchers know how he did through his own data-transfer unit.

ADAM is also one tough customer. His skeleton is made of stainless steel and aluminum alloy. He is built to withstand forty-five Gs horizontally and twenty-five Gs vertically.

As test subject SSgt. Arch Currid tightens a bolt while kneeling, all of the forces and moments he employs to move the wrench are measured to become a part of the database for CREW CHIEF, a computer modeling system for maintainers. With these parameters, a designer can change a design still on the drawing boards.

He comes in two sizes: five foot six and 145 pounds, simulating a person in the third percentile of all male Air Force pilot body size ranges, and six foot two and 217 pounds, to simulate a pilot in the ninety-seventh percentile. He also has his own repair kit. He costs $300,000.

Built by SRL Advanced Systems, ADAM is now undergoing integration tests with the Wyle Labs-built Multi-Axis Seat Ejection (MASE) sled on the rocket track at Holloman. MASE, a Fiberglas replica of the forebody of an F-16, is the first sled designed to permit ejection tests at attitudes other than straight and level.

"We are working on ways to keep the pilot's arms and legs from flailing during ejections," says John Plaga, the technical director of ADAM-MASE integration tests. "That way, we can limit arm and leg injuries. . . . With the sensors on ADAM, we know exactly where the limbs are during ejection."

ADAM has recently taken up skydiving. "Aircraft speeds are getting higher, and we are seeing more ejections at high speeds," notes Steve Mehaffie, CREST deputy program manager and ADAM's skydiving coach. "Parachute opening shocks, which have always been a problem, are greater with NVGs. We need to get quantifiable data on exactly what is happening when that parachute opens."

ADAM allows for testing in the physical world, but COMBIMAN allows for testing in the computer world. The COMputerized BIomechanical MAN-model is a 3-D graphic representation of a pilot. He is used to test how well a person will fit in a cockpit before it is even built.

In use since 1972, COMBIMAN creates a model of the body size and correct proportions of Air Force pilots (based on accumulated physiological data). He helps researchers determine how clothing and person-

Nilda Martinez, an engineer at Wright-Patterson, works with COMBIMAN on a computerized design terminal to see if the computerized pilot can reach a certain button in a proposed cockpit design. COMBIMAN is based on accumulated physiological data from actual Air Force pilots.

al protective gear will encumber a pilot, how well the arms and legs can reach controls, how much strength is needed to operate a device, and so forth.

An outgrowth of COMBIMAN is CREW CHIEF, a similar computer modeling system used to simulate maintainers. The computer figure works with hand tools and lifts and lowers objects. This system evaluates how well humans will work with an aircraft while it is still on the drawing boards. Even such problems as obscured or awkwardly accessible bolts can be accounted for in the models. CREW CHIEF can use and simulate the forces needed for every tool in the standard 222-piece flight-line toolbox.

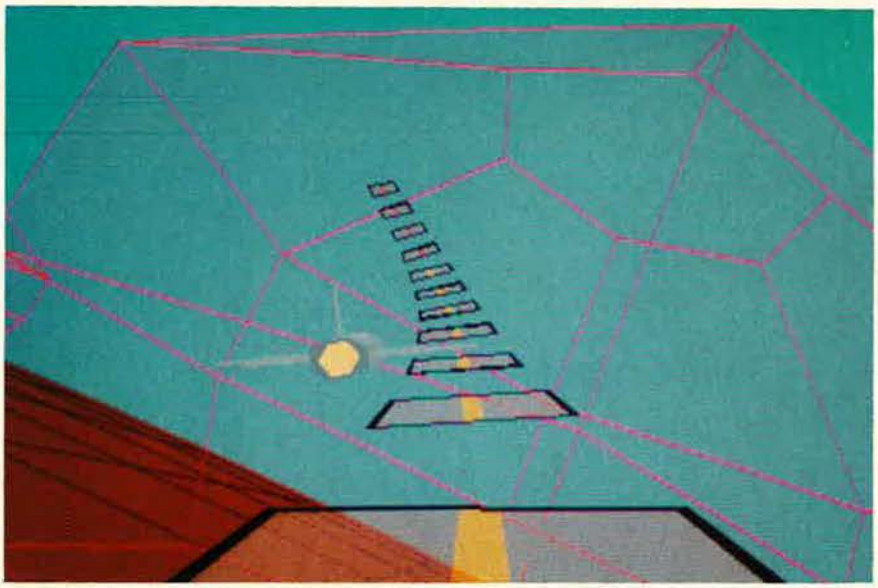
One big advantage of COMBIMAN and CREW CHIEF is that the computerized pilots and maintainers can be tailored, ranging from a physically weak person to a strong one, providing a complete description of the forces needed to evaluate a specific task. Every motion the models make is backed up by measurements taken with a real human doing the same tasks in a laboratory.

CAT, PAWES, and VCASS

"The process of designing and developing a cockpit is different from company to company, even aircraft to aircraft," says Lt. Col. Robert Collins, chief of Wright-Patterson's crew-centered cockpit design program. "Finding problems once an aircraft is fielded is not the way to do it." To avoid this problem, the Air Force is pursuing several programs.

CAT (cockpit automation technology) is an advanced development project addressing the methodology of cockpit design. The process is based on mission requirements and crew capabilities. CAT and its computerized design support system won't dictate how a cockpit will look, just how it should be designed.

CAT works in a circular way: Mission requirements provide impetus for a particular design of a cockpit display or control. The design is then tested in a rapidly configurable cockpit simulator (to be delivered to Wright-Patterson this year). If the display or control doesn't work, it can be reengineered at that point. If it works and presents usable information to the pilot, that piece of equipment then goes through further testing, including tests in a high-fidelity simulator and, eventually, flight test.



In this prototype virtual cockpit display, the "follow-me" airplane gives the pilot a visual "rabbit" to follow. The pavement sections show the pilot the best pathway to fly. The amber lines indicate danger, and the red framework shows the pilot he is in a threat area. The rust-colored area represents the ground.

Developers of the system want to make the CAT processes so easy that industry will voluntarily incorporate them into their own computerized design tools.

CAT's companion project, PAWES (Performance Assessment and Workload Evaluation System), will give designers flight test feedback on how a particular cockpit design is working. PAWES will provide continuity of crew system analysis, simulation, and flight test. It will also be used to demonstrate flight-qualified hardware. PAWES is not so far along in development as CAT.

The virtual cockpit is years away, but research into the pieces that will form the virtual world cockpit is well along. The Visually Coupled Airborne Systems Simulator (VCASS) at Wright-Patterson presents information to the pilot via helmet-mounted displays. It is being used to evaluate candidate designs for the Army's in-development Light Helicopter. AH-64 crewmen use helmet-mounted displays for weapons delivery, but the LH helmet will be the first to present such a large part of the outside world.

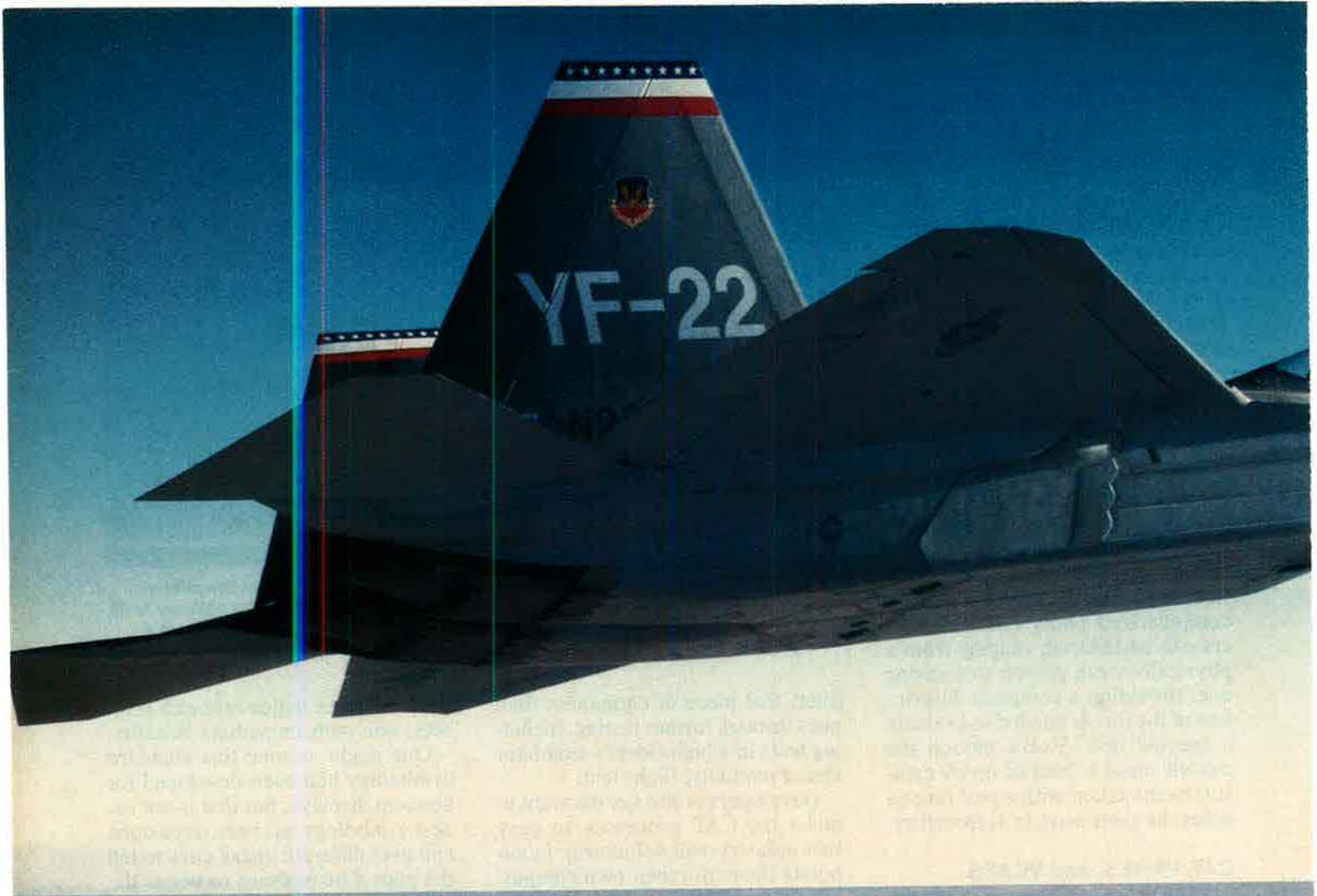
The MAGIC (Microcomputer Application of Graphics and Interactive Communications) simulator, also at Wright-Patterson, is now being used for three major research projects, one with immediate benefits.

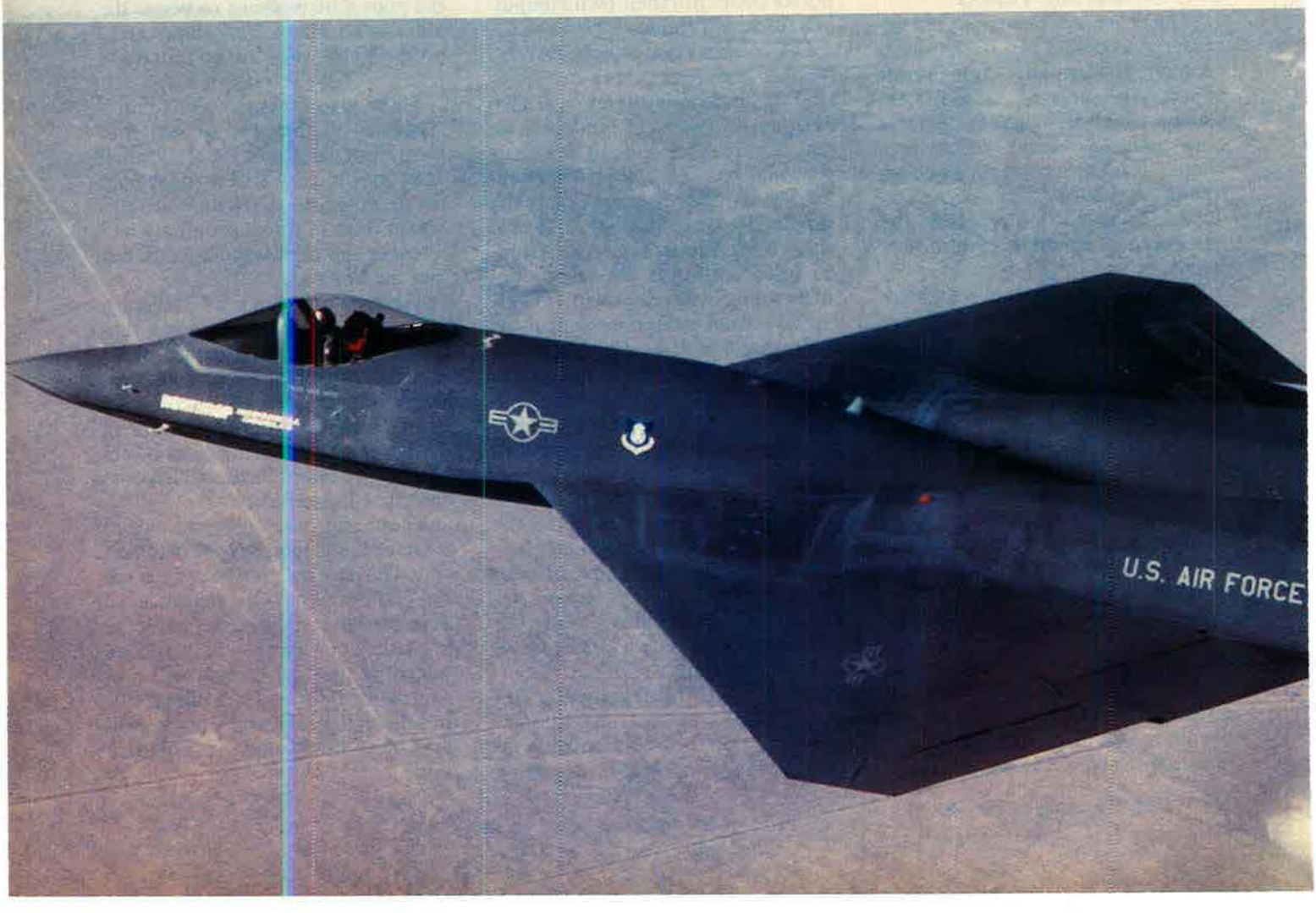
One might assume that standard symbology had been developed for head-up displays, but that is not so. Test symbology has been developed and uses different visual cues to tell the pilot if he is above or below the indicated horizon. This shows great promise and will soon go into flight test.

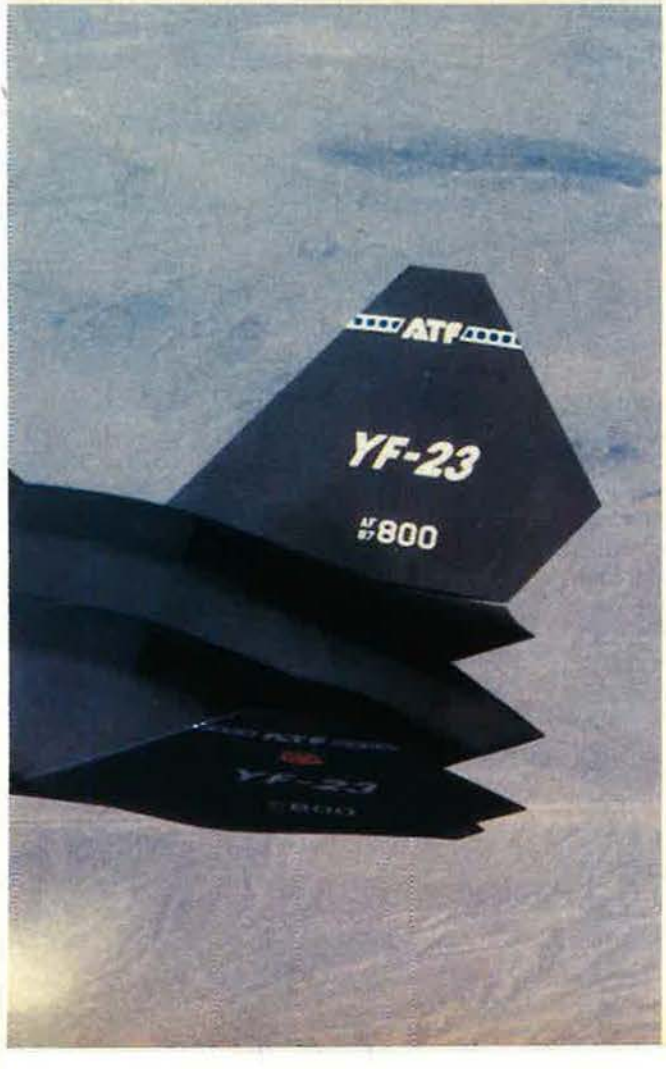
There also is work to develop a "pathway in the sky," a series of pavement sections on a display, showing the pilot's best flight path for a mission. Different colors would warn of threat proximity and whether the pilot was above or below the horizon.

The final program is a 3-D display showing the pilot his plane in a representation of "virtual" space. If his aircraft is "painted" by a threat radar, a wire-frame ball surrounding the aircraft would change color in the area from which the radar is emanating. The pilot turns and looks to this area immediately.

These and other projects aim to produce the "supercockpit" of tomorrow. The pilot may not be able to see out of the cockpit. One reason is the predicted severe laser threat on the battlefield of tomorrow. The second reason is that the display will present all the information a pilot needs in a clear, logical form. Looking out a window would only be a distraction. ■


YF-22


U.S. AIR FORCE



America's next great fighter engine is now flight-proven.

Extensive flight testing of both ATF prototypes demonstrated the YF119's capability. All performance predictions were achieved with 100% reliability: no in-flight shutdowns; no mission aborts; no stalls; unrestricted operability throughout the envelope; proven ease-of-maintenance and unmatched fuel efficiency. You asked for an engine capable of demonstrating critical ATF technologies and the YF119 delivered. We read you loud and clear.

UNITED TECHNOLOGIES
PRATT&WHITNEY

The Air Force will announce its choice between the YF-22A and the YF-23A on May 1.

Decision Time on the ATF

On May 1, the Air Force will announce what shapes up as its most far-reaching aircraft decision of the 1990s. It will name the contractors for the Advanced Tactical Fighter, the service's air-superiority fighter of the future.

The ATF will be the first new air-superiority fighter since the F-15 in 1974. Winning contractors will reap the rewards of a huge fighter aircraft deal—500 to 600 aircraft produced over a twenty-year span at a cost of $53.8 billion in 1985 dollars. The losers will get nothing.

The ATF will be based on either the YF-22A, developed by a team of Lockheed, Boeing, and General Dynamics, or the YF-23A, developed by Northrop and McDonnell Douglas. The winner will proceed to full-scale development (FSD). One engine-builder—either Pratt & Whitney or General Electric—will win an engine FSD contract.

On January 2, the Air Force ended a fifty-four-month demonstration-validation phase and five months of prototype flying. It received the contractor teams' final proposals and has been examining them ever since. Brig. Gen. James Fain, program manager, says the criteria for selection include technical merit, cost, and management skill.

The Air Force in 1986 established that the ATF should be hard to detect in flight, highly maneuverable, able to cruise supersonically without afterburner, highly reliable, and easy to fix with few maintenance personnel.

Speed vs. Agility?

The Air Force faces a choice between two substantially different airplanes. Observers speculate that the contest may boil down to the superior speed of the Northrop-led entry vs. the stronger maneuverability of the Lockheed team's contender.

The sleek, slate-gray Northrop YF-23A is sixty-seven feet, four inches long and has a wingspan of forty-three feet, six inches, making it significantly longer and wider than the F-15. It sits low to the ground. The two YF-23 prototypes have delta-shaped wings with squared tips, forming a diamond planform.

Lockheed's dark-gray-on-light-gray YF-22 has a diamond-shaped nose section. Its trapezoidal, cantilever wings sweep back at angles

of forty-five degrees. The YF-22 is sixty-four feet, two inches long, with a forty-three-foot wingspan, making the Lockheed plane about the same size as the F-15.

Northrop officials have claimed publicly that the YF-23 has met or exceeded all specifications for stealthiness. Lockheed officials say the same about the YF-22. Few details have been made public.

The YF-22 is built of composites and metals, mostly aluminum. It has about twelve percent thermoplastic composite components and ten percent thermoset structures, but composite content could grow to as much as fifty percent in the production plane. The YF-22 has a high-arched, single-piece canopy reminiscent of the F-16's. The YF-23 is believed to be somewhat lighter than its competition.

Outsiders know little about range, turning rate, turning radius, and other critical characteristics of the two planes.

During the flying phase, Lockheed's entry successfully launched an AIM-9 Sidewinder missile and an AIM-120A AMRAAM. Northrop's fighter did not perform such test firings, but the Air Force did not require it to do so. Test pilots flew the YF-22 to angles of attack of sixty degrees.

No matter which contractor team wins the prize, the Air Force's fighter of the future will use common-module avionics, moving beyond the current "black box" approach to sensor and processing tasks.

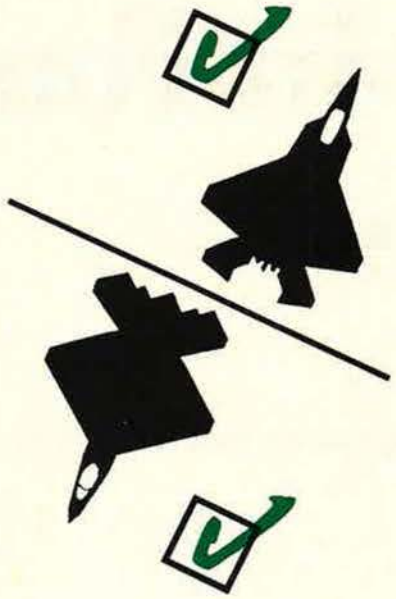
Within the framework of Pave Pillar architecture produced at the Wright Research and Development Center's Avionics Laboratory at Wright-Patterson AFB, Ohio, ATF contractors developed very-high-speed integrated circuit (VHSIC) signal processors to integrate such avionics elements as radar, infrared search and track, and major offensive and defensive functions.

The latter include Integrated Electronic Warfare Systems (INEWS) and integrated Communication, Navigation, and Identification (CNI) avionics, both under development for years at ASD and avionics houses.

Little detail is known about the two different approaches to the ATF avionics suite, which has long been viewed as the ATF's toughest developmental challenge.

In the YF-22, the various avionics systems, including the radar, electronic warfare equipment, and sensors, are tied in to one liquid-cooled, thirty-two-bit processor built by Hughes.

Westinghouse and Texas Instruments are building the radar for both ATF contractor teams.



The ATF contest may boil down to superior speed vs. stronger maneuverability.

The "Supercruise" Powerplants

The Air Force will choose one engine contractor—General Electric or Pratt & Whitney—to start FSD of the ATF powerplants. The ATF engine will be either the GE YF120-GE-100 or the P&W YF119-PW-100. Both produce about 35,000 pounds of thrust and permit the planes to cruise at approximately Mach 1.5 without afterburner, a capability known as "supercruise."

The P&W engine seems to have an edge in materials and digital controls. It is lightweight, with a high thrust-to-weight ratio. In tests of the YF-23, the plane in military power matched F-16s in afterburner. GE has produced a strikingly different variable-cycle, very-high-pressure engine that performs like a turbojet at supersonic speeds and like a turbofan at subsonic speeds. It, too, has successfully propelled a plane into supersonic flight while in military power.

The engines are expected to fly twenty percent more hours per year than those on the current-generation F-15 and F-16 (360 hours compared to 300 hours) and will require ten percent less maintenance due to their modular design.

On its YF-23A, the Northrop–McDonnell Douglas team chose not to install thrust-vectoring nozzles. Lockheed's YF-22 uses such nozzles, of a pitch-only type, assisting in its ability to fly at very high angles of attack. It is said that Northrop decided against thrust-vectoring nozzles in order to enhance the YF-23's stealthiness.

Nozzles on the YF-22 represent the second-generation type. A third generation, lighter and of improved design, could be used on production ATFs.

The Air Force plans, upon announcement of the decision, to let eight-year FSD contracts to the winning airframers and engine-builders. The FSD phase will begin officially in FY 1992, which starts on October 1, 1991. In the most recent Air Force budgets, programmers allot to the ATF development program $3.9 billion over Fiscal Years 1992 and 1993. The total estimated value of the FSD contract goes beyond $10 billion.

Industry officials say that the airframe accounts for only twenty-five percent of ATF cost. The other seventy-five percent stems from avionics, engines, and other features.

The Air Force will require the winning contractor team to produce eleven FSD aircraft plus training and support programs. Industry sources say that first flight of a pre-production FSD plane should come about forty-eight months after FSD begins—in the fall of 1995. Current plans call for the start of low-rate production in 1996. Low-rate production could go on for six years before the program ramps up to full-rate production of some forty-eight planes per year.

The Air Force expects to field its first operational ATF squadrons in the period 2000 to 2002. ■

The new budget groups forces into Atlantic, Pacific, strategic, and contingency categories. By 1997, defense will consume only 3.6 percent of GNP.

Defense in Four Packages

By Robert S. Dudney, Executive Editor

PRESIDENT Bush's plan to reshape US forces marks the last stage in a virtually unprecedented reversal of defense policy.

Numerous major defense themes advanced by two Republican administrations have been scrapped or altered beyond recognition—from confronting Soviet land power and airpower and reducing the vulnerability of US ICBMs to assembling a 600-ship fleet.

The US military, as a result, faces not only a new situation abroad but also a period of profound internal readjustment.

The change stems from a turnaround in the US response to Soviet power. Washington's traditionally tough approach, backed by large forces, has given way to a more relaxed stance.

Reversal of course on the size of US forces is the latest result. The US has long claimed the Soviet threat compelled it to maintain its two-million-strong force. The latest defense plan, unveiled February 4, calls for a force of 1,600,000.

Such a change is possible, says Secretary of Defense Dick Cheney, because the US has dropped its focus on Soviet power, "a focus that meant that we had to have sufficient forces deployed to be able to deal with a global conflict with the Soviet Union with very little notice."

The new force will focus elsewhere. Secretary Cheney explains that size and composition is "driven much more now . . . by a need to focus upon . . . regional contingencies," such as the Persian Gulf War. These conflicts presumably are to be handled with fewer forces than were needed in the cold war.

Such is the key underlying assumption of a new US defense blueprint, based on the conceptual work of Gen. Colin L. Powell, Chairman of the Joint Chiefs of Staff, and Paul Wolfowitz, the Under Secretary of Defense for Policy. Basics of the new policy are seen in budget documents for Fiscal Years 1992–97.

In these, President Bush proposes a new, six-year, $1.7 trillion plan (in constant 1992 dollars, $1.537 trillion) to maintain core elements of US military might even at a time of retrenchment and austerity. The budgets don't include the cost of Operation Desert Storm, which is being handled separately.

Four Forces

General Powell presents the new US military force in terms of four "packages," supported by four critical capabilities. The packages are strategic forces, Atlantic forces,

Pacific forces, and contingency forces. These, says the General, "aren't units," but rather "conceptual baskets that we're using in the Pentagon to organize ourselves and to design our force structure." The four underlying capabilities are transportation, space, reconstitution of forces, and intense research and development.

From the new thinking, say Pentagon officials, flow certain overriding priorities. These include the ability to mount a rapid response to global crises, which in turn requires superior troops and equipment, especially as the force shrinks. Also getting high priority will be defense R&D and the defense industrial base.

The plan concludes that the US will still need to maintain its alliances and forward deployments, though on a reduced scale. Washington will continue to need a large reserve force based in the US, a powerful sea-control Navy, and a robust strategic force based on a triad of bombers, ICBMs, and submarines.

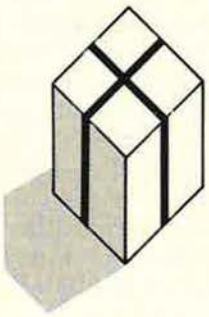
The Secretary of Defense concedes that the 1,600,000-strong US military, as proposed, is a best-case force, one that doesn't leave the nation much margin for error.

"What we've presented here," he told the House Armed Services Committee, "is a force that we think is the absolute minimum, irreducible capability that we have to have in order to defend the United States—under certain positive assumptions."

Among these assumptions are that Moscow will make good on its pledge to withdraw its forces from Hungary and Czechoslovakia by July, that it will keep commitments to withdraw forces from the former East Germany and from Poland, that the Warsaw Pact can never be resurrected, that the Kremlin's ability to project conventional power beyond its borders will continue to wane, that arms agreements are signed, and that the USSR doesn't collapse.

Under the Defense Secretary's plan, the US conventional military force in 1997 will field fewer Army divisions and smaller Marine Expeditionary Forces, fewer tactical fighter wings, fewer aircraft carriers and other warships, and a smaller strategic nuclear deterrent.

Plans call for a steady decline in funding. When the effects of inflation are factored out, defense budgets will drop by 0.9 percent in 1992, 3.9 percent in 1993, 3.6 percent in 1994, 2.7 percent in 1995, 2.9 percent in 1996, and 1.9 percent in 1997. In 1997, defense will consume 3.6 percent of US Gross National Product, the lowest level since 1939 and far lower than the 4.7 percent share during the 1970s, the "decade of neglect."



The first installment on the US military program came on February 4, when the Pentagon unveiled a new two-year budget of $278.3 billion for Fiscal 1992, which begins October 1, and $277.9 billion for Fiscal 1993. This budget represents a down payment on the six-year defense program. The combined 1992–93 budget provides $171.2 billion for operations and maintenance, $155.5 billion for personnel, $130.1 billion for procurement, $80.9 billion for research and development, and $18.4 billion for military construction, family housing, and other accounts.

Painful Cuts

In shaping the slimmed-down 1992 and 1993 defense budgets, Secretary Cheney and General Powell administered painful cuts in key areas.

Defense investment—procurement and R&D—is one such area. Already procurement funding has fallen from $81.4 billion in 1990 to $64.1 billion this year, a twenty-four percent drop in real terms. In 1992, it falls to $63.4 billion and then turns up to $66.7 billion in 1993.

In the latest program demolition derby, the Air Force took hard hits. It managed to protect the bulk of its big strategic and conventional programs but had to zero out some. USAF leaders canceled outright two major weapons production programs: the F-16 fighter and the Peacekeeper strategic missile.

The Air Force will budget $2.3 billion over two years for a final purchase of seventy-two F-16s. In 1993, Air Force orders cease. Early termination of the program will reduce previously planned defense expenditures by $15.4 billion through 1997.

Defense officials say that, given declining fighter force structure, the need for more F-16s has disappeared.

Peacekeeper production will end with the 1991 order, at a total of 114 multiwarhead missiles. Fifty are deployed in silos; the balance will be kept for tests. Cancellation will reduce planned defense spending by $2.9 billion over six years.

Secretary Cheney says the ICBM became expendable in light of the pending START Treaty, which will cap superpower ballistic missile warheads at 4,900. The number of test missiles supports three test shots a year, enough to maintain confidence in the system.

Also scrapped were numerous major Air Force development programs. In tactical forces, the service loses the AGM-136 Tacit Rainbow antiradiation missile, Mark XV Combat Identification System, Direct Airfield Attack Combined Munition, and Long-Range Conventional Standoff Weapons.

The budget scraps the Boost Surveillance and Tracking System satellite program, once a high-priority item. The Air Force will pursue enhancement of the current Defense Support Program satellite or other options. Savings: $2.9 billion over six years.

"One of the Biggest Headaches"

The Navy absorbed major blows, especially in aircraft programs. Secretary Cheney acknowledged this: "Naval aviation is probably one of the biggest headaches we've got right now."

Weeks earlier, the Pentagon announced that the Navy was canceling programs to develop the new A-12 carrier-based attack plane *[see "How the A-12 Went Down," p. 44]*. The P-7A antisubmarine warfare aircraft had been canceled in 1990. Collapse of these aircraft programs will, over six years, cut planned defense spending by $22.2 billion and $6 billion, respectively. Secretary

Cheney's cancellation of the A-12 effectively eliminated the Air Force's proposed Advanced Tactical Aircraft, based on the A-12.

More startling was the Secretary's decision to cancel the program to remanufacture F-14A fighters into F-14D models, for a $14.8 billion reduction. The Navy had counted on this program to keep Tomcats fit for the outer air battle. The Defense Secretary decided to develop and build an upgraded version of the F/A-18 fighter instead, a move that he conceded to be "a tough call."

Secretary Cheney sprang another surprise in canceling the Naval Advanced Tactical Fighter program, saving $2.1 billion through 1997. The move may be more a deferral than a cancellation, however. Says one official, "We'll take that up again . . . after the span of this particular funding period [through 1997]."

The Navy's shipbuilding program also took some hits. The major casualty: Electric Boat's Trident program, producer of the *Ohio*-class ballistic missile-firing strategic submarine (SSBN).

Secretary Cheney decided to cancel the program early and make the eighteenth Trident, purchased in the 1991 budget, the last of the line that some thought would number twenty-two boats. This move reduces Navy six-year spending plans by $4.2 billion. The Pentagon deferred beyond 1997 the planned reequipping of older Tridents with new D5 submarine-launched ballistic missiles.

Secretary Cheney also canceled a planned $2.1 billion purchase of an LHD amphibious assault ship for the Marine Corps.

This year, the Army absorbed relatively few major program cancellations, mainly because so few programs remained. The key parts of the Army's big modernization of the 1980s either were complete or had already been cut.

However, the Pentagon will terminate production of the service's Bradley Fighting Vehicle, eliminating $2.4 billion in previously planned spending. Bradley vehicles authorized in the 1991 defense budget will be the last built.

In all, across all services, Secretary Cheney terminated eighty-one major development and production programs. These actions, budget officials say, will produce savings of $11.9 billion in 1992. Over six years, the total runs to $101.9 billion.

Other programs, though they survived, suffered significant reductions in funding and stretchouts in schedule. For example, the Air Force has cut the planned number of AIM-120A Advanced Medium-Range Air-to-Air Missiles in 1992 and 1993.

Funding for the rail-garrison basing system for the LGM-118A Peacekeeper is cut back significantly. Development essentially ends after the Air Force conducts one test launch of a missile from a railcar, now set for August or September 1992. Funding drops off to about $100 million a year. Development of the single-warhead Small ICBM continues in a similarly desultory fashion, funded at about $700 million over the next two years.

Missiles "Kept Alive"

"Neither in the case of the Peacekeeper [nor in that of] the Small ICBM are we recommending deployment at this point," Secretary Cheney reports, "but both of those programs will be kept alive."

The Milstar satellite has been restructured from a nuclear-hardened strategic system to a more conventional system for jam-resistant communications. The size of the constellation has been pared from ten to six satellites. Even so, the program will consume $2.9 billion over two years.

In the Navy, the principal stretchout victim will be the new SSN-21 *Seawolf*-class submarine. SSN-21s will be procured at a rate of only one per year, not three every two years as planned.

Systems weren't the only casualties. Budgeteers also are taking a whack at force structure, which has been shrinking more or less since 1987.

The strategic deterrent force, left intact during earlier force reductions, has suffered serious cuts in accordance with US expectations regarding strategic arms agreements.

Strategic Air Command is called on to reduce today's bomber force of 268 B-1, B-52, and FB-111 aircraft to 181 bombers in 1995. It is expected to retire B-52Hs and transfer FB-111s to the Tactical Air Forces. Pentagon plans call for thirteen B-2 Stealth bombers to be on line in 1995, plus B-1s and B-52Gs.

In 1992, retirement of the full fleet of LGM-30F Minuteman II ICBMs begins, reducing by 450 the number of US landbased missiles.

In the sea-based leg of the nuclear deterrent, accelerated retirements of SSBNs and the end of new production of the Trident will reduce the SSBN fleet from thirty-four to only eighteen.

Conventional force reductions also will be large. "If you take all of the force that's deployed today in support of Operation Desert Storm," says Secretary Cheney, "all of the US military personnel in Saudi Arabia and the oceans around it, that's a little over 500,000 people. We're going to take a force of that size . . . out of the United States military over the next five years, if we follow this budget plan."

In the process, the Army suffers most. The revised plan calls for the Army to eliminate ten of its current twenty-eight divisions—six active-duty and four reserve. That will leave the Army with only a total of eighteen active-duty and reserve divisions, the smallest force in recent memory.

The Air Force is called on to give up, by 1995, the equivalent of ten of its current thirty-six active-duty and reserve forces tactical fighter wings. Expectations are that the final force would field twenty-six wings, fifteen of which would be in the active-duty force. Current plans are for TAF wings to decline to 33.5 by the end of 1991, twenty-nine by the end of 1992, and 27.5 by the end of 1993. Another 1.5 wings would go later.

No 600-Ship Fleet

In 1991, the Navy deploys 545 ships. In purely numerical terms, it is soon to lose nearly one-fifth of its fleet—ninety-four warships. The carrier fleet, with thirteen big decks today, drops to twelve by 1993. By the same date, active-duty and reserve air wings fall from fifteen to thirteen. The Navy will retire the last two *Iowa*-class battleships, *Wisconsin* and *Missouri*.

"You remember the old goal of a 600-ship Navy?" says the Defense Secretary. "Obviously, we're not going to make that. We're moving in

the other direction." Plans call for the Navy to deploy only 451 warships in 1995.

The Marine Corps, with three full Marine Expeditionary Forces (one reserve) today, will keep the same number but shrink to the equivalent of 2.5 of today's MEFs.

The drawdowns in force structure will automatically bring cuts in the end strengths of the services. They will fall most heavily on the Army and Air Force. Under current plans, the Army between October 1, 1991, and October 1, 1995, will shed 124,000 troops, settling at 536,000. The Air Force in the same period will lose 50,000 active-duty personnel and level off at 437,000. As for sea services, the active-duty Navy will lose 41,000 sailors, dropping to 510,000, and the Marines will lose 17,000, sustaining at 171,000.

In the latest budget decisions, some winners did emerge. Chief among these is the force of active-duty military personnel. To promote and sustain high morale, the budget seeks to give today's servicemen and -women a 4.2 percent pay raise in 1992 and a 4.7 percent pay raise in 1993. Also approved is a continuation of current benefits, bonuses, and special pay.

The Pentagon appears determined to preserve the battle-readiness of US soldiers, sailors, airmen, and Marines. The budget continues current training at approximately the same levels as in recent years. In fact, says Secretary Cheney, emphasis on maintaining ready forces will continue throughout the six-year build-down.

Air Force tactical fighter crews will fly an average of nineteen flying hours per month, slightly lower than the 19.5 hours of recent years.

Army ground operating tempo in 1992 and 1993 will continue to be 800 tank-miles per crew per year. Ship steaming days for the forward deployed fleets will be fifty days per quarter and twenty-nine days per quarter for the home-based Second and Third fleets.

Weapon Requirements

The winners also included major weapon programs and research projects. "The overall industrial base requirements that will still exist," says one Pentagon analyst, "are still rather formidable—$60 billion worth of investment in procurement-related items and another $39 billion worth of research and development [annually]. It's not small change."

Air Force aircraft procurement funds are sufficient to fund development and procurement of the B-2 Stealth bomber at a very healthy rate: a two-year total of $9.5 billion for eleven new planes. Originally, the B-2 had a funding profile of two in 1991,

six in 1992, and ten in 1993. Under the new plan, it's still two in 1991, but four in 1992 and seven in 1993.

In addition, Secretary Cheney reaffirmed Pentagon plans to proceed with production of all seventy-five aircraft.

Another Air Force plane project garnering strong Pentagon support, the Advanced Tactical Fighter, is set to receive $3.9 billion in 1992 and 1993 as it enters full-scale development and heads toward mid-1990s production.

The E-8A Joint Surveillance and Target Attack Radar System moves from development to production, receiving a combined $1.2 billion to fund continued further development and, in 1993, procurement of the first production aircraft.

Originally the Air Force planned to buy two C-17 transports in 1991, six in 1992, and twelve in 1993. Now plans call for skipping any purchases in 1991 but still buying six airplanes in 1992 and twelve in 1993. Total 1992–93 expenditure: more than $7 billion.

The Air Force also proposes to spend $787 million over two years to procure twenty additional C-130H tactical transports.

Navy procurement has fallen well off its blistering 1980s pace during the largest-ever peacetime fleet buildup. Major warship purchases in 1992–93 include $4.8 billion for development and production of two new SSN-21 *Seawolf*-class attack submarines and $8.2 billion for nine *Arleigh Burke*-class destroyers.

The Navy has won Pentagon approval to procure in the 1990s another 96,000-ton *Nimitz*-class nuclear-powered aircraft carrier, its fifth since 1982. Advance procurement funding of $898 million is provided in Fiscal 1993. Full funding of the remainder of the $4 billion warship would come in Fiscal 1995.

The biggest Army procurement programs will be the UH-60 Black Hawk helicopter. The Light Helicopter Program continues development at a two-year cost of $1.2 billion.

Finally, the Strategic Defense Initiative has been restructured to focus less on Soviet ballistic missile attack and more on the ballistic missile threat posed by smaller powers. The Pentagon proposes R&D money of $4.6 billion next year and $4.9 billion in 1993. Congress provided only $2.9 billion this year.

Though the Pentagon program is based on the assumption of Soviet military quiescence, the bloody turn in the Baltic states has raised anew the specter of resurgent militarism. Secretary Cheney warns that "there's enormous uncertainty today about what's going to transpire inside the Soviet Union in the future." He adds that "the jury's still out on where the Soviet military is headed."

As a result, he is hedging his bets. In the Secretary's words, "It's entirely possible" that, if things unravel, he and General Powell will come back to Congress to call a halt to the drawdown of forces.

Even the prime architect of the new force expresses wonder about the timing of the current force reductions.

"Frankly," maintains General Powell, "I don't know what historical precedent there is for the Secretary of Defense and the Chairman of the Joint Chiefs of Staff to present a budget that calls for a major, phased build-down of the armed forces of the United States at the same time that those armed forces are engaged in a major conflict in one theater and are continuing to perform their vital missions in all other theaters."

He adds, "I strongly suspect there is no such precedent." ■

The Chart Page

Edited by Colleen A. Nash, Associate Editor

Snapshots of the New Budgets

In February, President Bush presented to Congress a Fiscal Year 1992–93 DoD biennial budget request that continues the cutback in military spending. The proposal for the **entire national defense program** (DoD activities and defense activities in the Department of Energy and other federal agencies) is $290.8 billion in budget authority and $295.2 billion in outlays for FY 1992 and $290.9 billion in budget authority and $292.0 billion in outlays for FY 1993. The **direct program** (DoD activities only) is $278.3 billion in budget authority and $283.0 billion in outlays for FY 1992 and $277.9 billion in budget authority and $279.1 billion in outlays for FY 1993.

Adjusted for inflation, defense spending will decline by about one percent in FY 1992 and four percent in FY 1993. In FY 1996, the cumulative inflation-adjusted decline since 1985 will reach thirty-four percent.

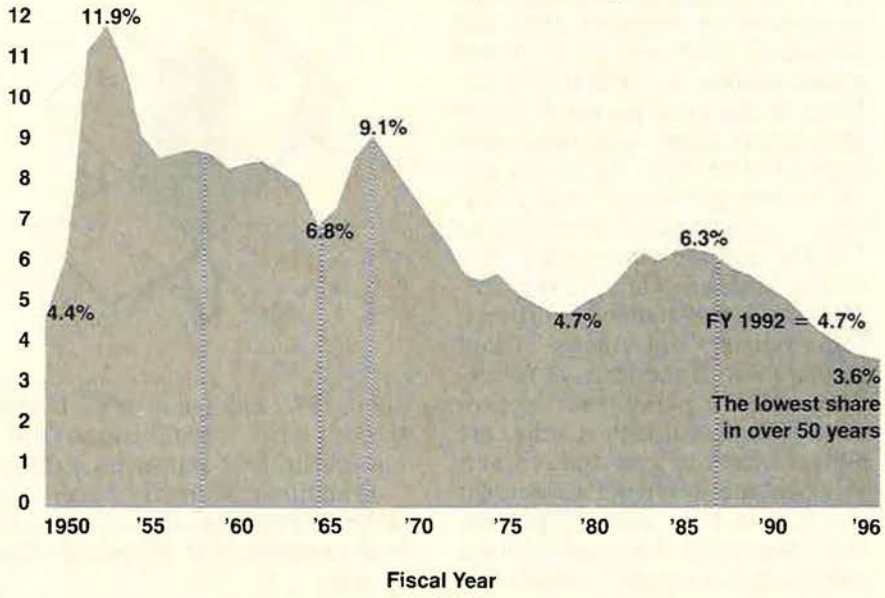
Funding for Operation Desert Storm will be handled as a separate emergency funding request, although the Pentagon cautioned that "some of the program decisions in the FY 1992–93 request will have to be adjusted in the aftermath of the Gulf crisis."

Funding levels can be expressed in several ways. Totals are most frequently stated as **budget authority** (the value of new obligations, including some to be met in later years, which the government is authorized to incur) or **outlays** (actual expenditures, some of which are funded by budget authority in previous years).

Another difference concerns the value of money. When funding is in **constant** or **real dollars,** the effect of inflation has been factored out to make direct comparisons between budget years possible. A specific year, often the present one, is chosen as a baseline for constant dollars. When funding is in **current** or **then-year dollars,** no adjustment for inflation has taken place. This is the actual amount that has been spent, budgeted, or forecast.

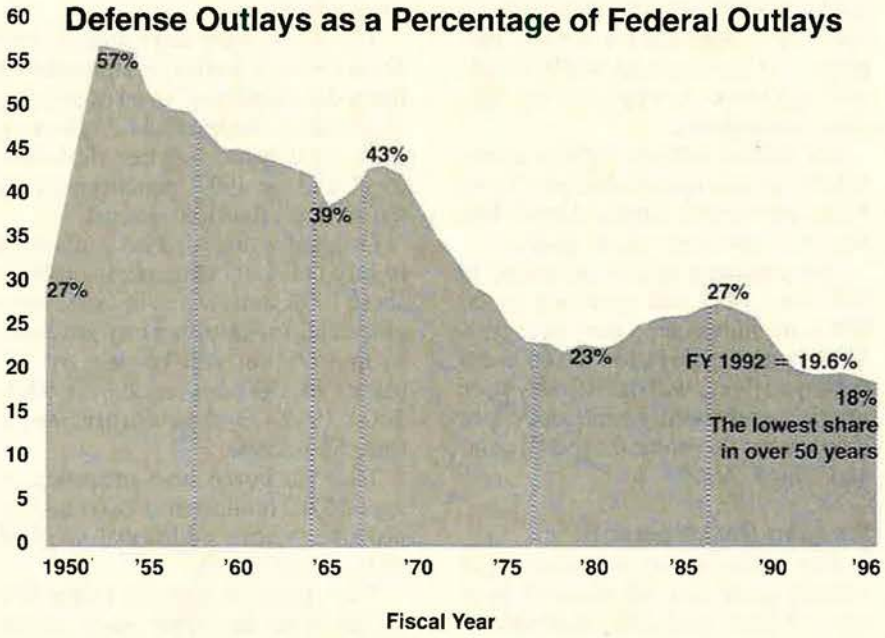
The following charts address only the direct program. In some instances, numbers on the charts in this section may not sum to totals shown because of rounding.

Defense Outlays as a Percentage of GNP



One way to measure the total burden on the economy of defense spending is to look at defense outlays as a percentage of the Gross National Product. By FY 1996, planned defense outlays as a share of GNP would be at their lowest level since 1939. During the "hollow force" period of the late 1970s, defense outlays consumed 4.7 percent of GNP.

Defense Outlays as a Percentage of Federal Outlays



The facts do not support the claim that defense consumes a disproportionate share of the federal budget. Planned defense outlays represent a declining share of total federal outlays and by FY 1996 will be at their lowest level in fifty years.

Budget Topline

(Current $ billions)

	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996
Budget authority	273.0	278.3	277.9	278.2	280.7	282.6
Outlays	287.5	283.0	279.1	273.3	274.6	278.5

How the Budget Dropped

(Budget authority in $ billions)

	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995
Summit baseline, July 1990	303.5	315.6	327.4	338.7	349.3
President's budget, February 1991	273.0	278.3	277.9	278.2	280.7
Reduction	−30.5	−37.3	−49.5	−60.5	−68.6
Inflation-adjusted decline	−11.3%	−0.9%	−3.9%	−3.6%	−2.7%

The summit baseline is based on defense spending at FY 1990 levels plus inflation. The President's budget request is consistent with the fall budget summit agreement totals, which reduce defense spending in FY 1991 by 11.3 percent and then by an average of three percent annually through FY 1995.

Where the Money Goes

(Budget authority in current $ billions)

	FY 1990	FY 1991	FY 1992	FY 1993
Military personnel	78.9	79.0	78.0	77.5
Operations and maintenance	88.3	86.0	86.5	84.7
Procurement	81.4	64.1	63.4	66.7
Research, development, test, and evaluation (RDT&E)	36.5	34.6	39.9	41.0
Military construction	5.1	5.0	4.5	3.7
Family housing	3.1	3.3	3.6	3.6
Other	−0.3	1.0	2.3	0.7
Total	**293.0**	**273.0**	**278.3**	**277.9**

FY 1993 RDT&E budget authority, adjusted for inflation, will be ten percent above FY 1991 levels. A handful of major programs accounts for most of the climb.

Service Shares

(Budget authority in $ billions)

	FY 1990	FY 1991	FY 1992	FY 1993
Current Dollars				
Army	78.5	72.4	71.1	67.7
Navy/Marine Corps	100.0	92.2	91.6	92.5
Air Force	92.9	82.7	86.5	91.4
Defense agencies, Defense-wide	21.7	25.7	29.1	26.3
Total	**293.0**	**273.0**	**278.3**	**277.9**
Service Percentages				
Army	26.8	26.5	25.6	24.3
Navy	34.1	33.8	32.9	33.3
Air Force	31.7	30.3	31.1	32.9
Defense agencies, Defense-wide	7.4	9.4	10.4	9.5

The Air Force was the only service in FY 1992 to get *more* funds, due in part to increased R&D spending for the B-2 bomber, C-17 airlifter, Advanced Tactical Fighter, and other programs. Army funding is low because 1980s modernization is ending. Growth in the Defense agencies' budget reflects major funding for the Strategic Defense Initiative.

Manpower Losses

(End strength in thousands)

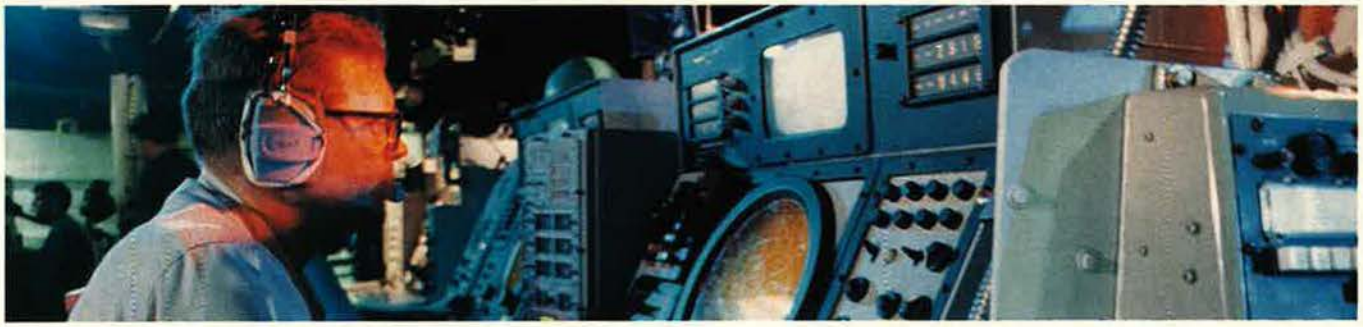
	FY 1987 (Actual)	Programmed				FY 1987–95 Reduction
		FY 1992	FY 1993	FY 1994	FY 1995	
Active Military						
Army	781	660	618	577	536	−245
Navy	587	551	536	516	510	−77
Marine Corps	199	188	182	176	171	−28
Air Force	607	487	458	445	437	−170
Total	**2,174**	**1,886**	**1,795**	**1,714**	**1,653**	**−521**
Selected Reserves	**1,151**	**1,068**	**989**	**924**	**906**	**−245**
Civilians	**1,133**	**1,003**	**976**	**958**	**940**	**−193**

In FY 1995, total active-duty military personnel will number 1,653,000, down 521,000 from the FY 1987 post-Vietnam peak. Some 30,000 civilian reductions stem from DoD management initiatives. The request funds a training tempo comparable to that in FY 1991.

Force Structure Changes

	FY 1990	FY 1995
Army divisions	28 (18 active)	18 (12 active)
Aircraft carriers	13	12
Carrier air wings	15 (13 active)	13 (11 active)
Battle force ships	545	451
Air Force tactical fighter wings	36 (24 active)	26 (15 active)
Strategic bombers	268	181

Recommended force structure cuts reflect a revised strategy, based on an expectation of reduced global conflict. The drop in strategic bombers reflects retirement of the B-52H aircraft and conversion of the FB-111 to the conventional role.



WE'RE HELPING SECURE AMERICA'S FRONT LINES.

Secure military communications, a key element of America's defense, are provided by the Defense Satellite Communications System (DSCS) to land, sea and airborne units operating worldwide.

The U.S. Air Force has the responsibility for providing this sophisticated system and has selected the Atlas II launch vehicle to deliver 10 DSCS III satellites into orbit over the next decade.

General Dynamics Space Systems Division is proud to be working with the Air Force to help secure the front lines of freedom.

GENERAL DYNAMICS

Space Systems Division

Funding for Forces

(Budget authority in current $ millions)

	FY 1992		FY 1993	
	Quantity	Dollars	Quantity	Dollars
Land Forces				
UH-60 Black Hawk helicopter	60	508	60	428
Single-Channel Ground and Airborne Radio System	–	288	–	292
LH (Light Helicopter)	–	550	–	617
Apache Longbow	–	233	–	264
Family of Medium Tactical Vehicles	1,815	170	3,288	293
Tactical Air Forces				
F/A-18 aircraft	36	2,423	20	2,534
Advanced Tactical Fighter	–	1,637	–	2,325
F-16D aircraft	48	1,419	24	923
C-17 airlifter	6	2,831	12	4,212
EA-6B remanufacture	–	110	3	556
AMRAAM	1,191	1,031	1,469	1,049
Naval Forces				
Aircraft carrier replacement	–	–	–	852
SSN-21 fast attack submarine	1	2,382	1	2,464
DDG-51 destroyer	5	4,335	4	3,480
LSD cargo variant	1	245	1	251
MHC-1 coastal minehunter	2	231	2	222
TAGOS Surtass surveillance ship	–	–	1	150
AOE replenishment ship	1	540	–	–

Major Program Terminations

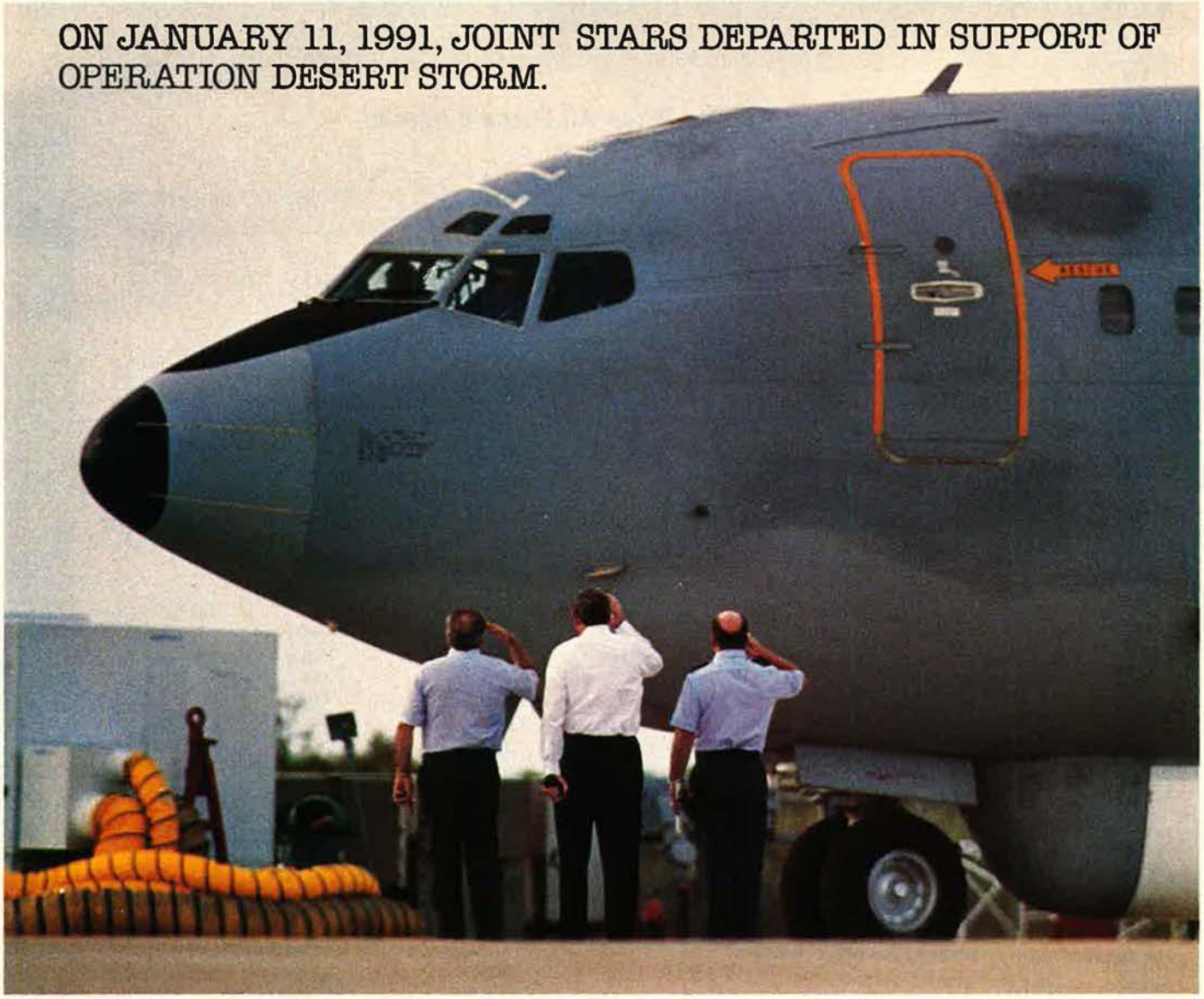
(Savings in $ billions)

	FY 1992	FY 1993–97
Bradley Fighting Vehicle	0.7	1.7
Trident submarine	1.4	2.8
LHD amphibious assault ship	–	2.1
P-7A antisubmarine warfare aircraft[1]	0.6	5.4
F-14D remanufacture	1.4	13.4
Naval Advanced Tactical Fighter	0.1	2.0
A-12 aircraft[1]	2.7	19.5
Air Force Advanced Tactical Aircraft[1]	–	0.8
F-16 aircraft (end of FY 1993)	1.6	13.8
Peacekeeper missiles	0.7	2.2
Mk. XV Combat Identification System[1]	0.1	0.2
Boost Surveillance and Tracking System (BSTS) satellite program	0.4	5.5
Tacit Rainbow program	0.2	2.3
Total	**9.9**	**71.7**

[1]Previously announced cancellations taking effect in FY 1992.

The budget calls for the termination of eighty-one programs, for a savings of $11.9 billion in FY 1992 and an additional $90 billion through FY 1997. There is no money in the budget for several major programs terminated last year, including the V-22 Osprey (production), F-14D aircraft, Army Helicopter Improvement Program (AHIP), Phoenix missile, M88A2 Improved Recovery Vehicle, F-15E aircraft, Apache helicopter, M1 tank, and Maverick missile.

ON JANUARY 11, 1991, JOINT STARS DEPARTED IN SUPPORT OF OPERATION DESERT STORM.



Joint Stars— a Global Mission.

Somewhere in the world there's a crisis. As long as aggressor actions affect national interests, regional security and stability, the world will need Joint STARS.

Warfighting: Joint STARS provides fixed and moving ground targeting, as well as low speed aircraft targeting information in real-time, directly to decision makers and tactical units.

Crisis Management: Wherever the crisis, Joint STARS is the rapid deployment solution to deter aggression with its stand-off, non-provocative and comprehensive surveillance capability.

Treaty Compliance Verification: Joint STARS is the missing link between National Technical Means (surveillance satellites) and intrusive on-site inspection. Nothing can match Joint STARS' capability to provide non-instrusive, deep-looking, wide area surveillance data on moving and stationary ground targets and share it with other treaty signatories. And it can detect, identify, classify and track TLE.

Indication and Warning: Tensions can be diffused by presenting this information to national command authorities, as well as the aggressor. Or it can be used to determine the military strength necessary to deter further aggression. For more information, contact Grumman Melbourne Systems, Melbourne, Florida 32902-9650.

GRUMMAN®

Funding for Major Air Force Systems

($ millions)

	FY 1991	FY 1992	FY 1993
Aircraft			
B-1B bomber	20.8	107.9	142.9
B-2 Stealth bomber	4,184.5	4,821.5	4,639.1
C-17 airlifter	1,025.8	2,830.7	4,211.7
C-20 jet transport	30.0	–	–
C-27A SOUTHCOM mission support aircraft	90.6	–	–
C-130H Hercules	–	391.2	406.6
Civil Air Patrol aircraft	1.9	2.0	2.1
E-8A Joint STARS aircraft	190.5	396.7	778.8
Enhanced flight screener aircraft	–	8.8	13.6
F-15E fighter	1,648.2	308.5	64.5
F-16 fighter	2,154.0	1,419.0	923.0
KC-135 reengining	582.7	466.3	483.8
MH-60G Pave Hawk helicopter[1]	43.5	27.9	34.7
T-1A Tanker/Transport Training System	175.4	173.0	183.5
VC-137 modifications to be determined	–	7.0	34.8
Missiles			
Advanced Cruise Missile (ACM)	506.0	626.4	551.5
AGM-130 air-to-ground weapon	52.3	93.2	110.7
AMRAAM air-to-air missile[2]	561.2	813.0	904.2
HARM air-to-ground missile[2]	33.6	116.6	232.0
Have Nap air-to-ground missile	27.9	37.3	–
Peacekeeper strategic missile	918.0	458.2	105.6
SRAM II air-to-ground missile	159.4	176.9	258.7
Other Procurement			
9-mm personnel defense weapon[2]	–	0.3	–
Cheyenne Mountain Upgrade (CMU)	126.4	170.4	220.5
Defense Meteorological Satellite Program (DMSP)	216.0	161.5	54.6
Defense Satellite Communications System (DSCS)	80.0	70.1	30.2
Defense Support Program (DSP)	674.1	272.8	653.2
Family of Medium Tactical Vehicles (FMTV)	4.5	7.4	8.7
Medium Launch Vehicle (MLV)	454.5	267.6	283.4
Milstar	955.6	1,404.4	1,536.3
Navstar global positioning system	282.3	396.8	419.7
Space boosters	345.3	463.5	519.9
Programs in R&D Only			
Advanced Tactical Fighter	955.3	1,637.2	2,324.6
Advanced Launch System	25.0	147.7	251.1
Small ICBM	100.0	202.2	548.8
SRAM-T	27.8	34.3	106.5
DoD Joint Programs			
Unmanned aerial vehicles (UAVs)	115.9	207.0	290.3
National Aerospace Plane (NASP)	161.5	231.8	183.3
Strategic Defense Initiative	2,873.9	4,580.6	4,933.2
Tactical missile defense initiative	218.2	603.0	723.8

[1]Army, Navy, and Air Force funding involved.
[2]Navy and Air Force funding involved.

Sanders·GE INEWS technology is right in step with tomorrow's electronic combat needs today.

Modular, integrated Electronic Combat for the 21st Century is ready for full-scale development today. Thanks to the unique Lockheed Sanders • GE INEWS Joint Venture Team.

In fact, our Advanced Development Model hardware and software, integrated with high performance core processing, has successfully flown in the F-22 Avionics Flying Laboratory.

Developed for the next generation of fighter and attack aircraft, technology from the INEWS program has wide potential for application in Air Force, Navy, and Army platforms.

So if there is still any question about who is ready today for the challenges facing advanced aircraft into the 21st Century, just ask us.

We'll step forward with the proven technology.

INEWS

SANDERS • GE

95 Canal Street, Nashua, NH 03061

Hard times are here. The Air Force will sacrifice force structure to preserve readiness and key weapon programs.

The No-Frills Air Force

IN THE last round of defense budget reductions, the Air Force lost $37 billion that it expected to receive for this year and for Fiscal 1992 and 1993. Air Force leaders decided they had to sacrifice force size to protect readiness and key weapons.

"We can't afford the size of today's management and support functions and still maintain a viable fighting force," explained Secretary of the Air Force Donald B. Rice. "So we are going to protect the viability of the fighting force."

The future Air Force will be a lean outfit, fielding far fewer tactical fighter wings and strategic combat aircraft. Some big systems have been canceled, deferred, or slowed down, chief among these being the F-16 fighter and Peacekeeper ICBM.

There will be fewer military and civilian personnel. Over the next five years, the Air Force will eliminate 130,000 personnel slots. As part of this reduction, Secretary Rice announced a set of actions that will chop Air Force corporate headquarters and take out layers of management across all commands.

The Secretary's move eliminates two major commands, the numbered air forces of the Reserve, and fifteen of nineteen Air Divisions. The Air Force's Pentagon and Field Management organizations will lose a net of 8,600 positions.

In addition, one of every six Air Force general officer positions will be eliminated by 1995. In three years, there will be 14,000 fewer officers overall. The civilian work force declines by 28,000 in the same period.

In last year's budget deliberations, Congress gave the Air Force's FY 1991 budget a huge whack. It finally settled at a level fifteen percent lower, in real terms, than it was in 1990.

From that low base, however, the budget of the Air Force, alone among the services, will show real growth in each of the next two fiscal years.

Air Force total obligational authority will hit $86.5 billion in 1992 (one percent real growth) and $91.7 billion in 1993 (1.7 percent real growth). By comparison, the Army's budget declines in both years; the Navy's declines in 1992 and then turns up slightly in 1993.

The service's combined 1992–93 budget, made public on February 4, provides two-year totals of $48.4 billion for operations and maintenance, $41.4 billion for personnel, $53.9 billion for procurement, $30.3 billion for research and development, and $4.4 billion for military construction and other accounts.

Thus fifty-three percent of the total funds current operations. The other forty-seven percent will be available to finance long-term investment.

This F-16 refueling from a KC-135 aerial tanker, opposite, is en route to attack targets in Iraq during the six-week Gulf War. Plans call for the future Air Force to be a lean outfit, with some large weapon programs canceled, deferred, or slowed. Purchases of F-16s end in 1993.

The "No-Frills" Budgets

According to Air Force program documents and senior officials, the no-frills budgets will bring major

—USAF photo by TSgt. Perry Heimer

changes in the size and composition of the service's fleet of aircraft.

Over the next two years alone, according to service projections, the total USAF aircraft inventory will fall by some ten percent, from 8,932 to 8,067, with unspecified cuts to come in years beyond. The active force in 1993 will end up with 5,597 planes of all types, with the Air National Guard dropping to 1,875 and the Air Force Reserve to 595.

The reductions will be imposed on virtually all types of aircraft in the inventory. Fighter-interceptor aircraft, numbering some 2,305 today, will drop by about seventeen percent, to a new level of 1,904. In addition, the number of ground-attack planes will fall from 400 to 161, transports from 800 to 769, bombers from 291 to 238, tankers from 538 to 469, trainers from 1,449 to 1,407, and reconnaissance aircraft from 295 to 235.

Rising numbers will be seen only in the service's fleet of helicopters, rescue aircraft, and other unspecified types.

Changes in numbers of aircraft will be reflected in a dramatic reduction between 1991 and the end of 1993 in the number of active and reserve Air Force flying units and in the number of Primary Aircraft Authorized (PAA) of these units.

In active tactical forces, there are today eighty-eight squadrons containing 1,707 PAA of the fighter and attack types. In 1993, the tactical forces will have dropped to a level of only seventy-six squadrons with 1,264 aircraft. Lost in the process will be 192 A-10s, sixty F-4s, 105 F-15s, fifty-four F-16s, seventy-eight F-111s, eighteen RF-4Cs, and eight EF-111s.

In only one specific type of fighter aircraft will the active force see an increase in numbers. The Air Force will add four new squadrons of F-15E dual-mission fighters, raising the force from seventy-two today to 144 PAA in 1993.

Tactical units of the Air National Guard and Air Force Reserve will drop from their inventories 204 A-7 attack planes, seventy-two A-10s, seventy-two F-4s, and thirty-six RF-4Cs. In a big gain, however, the reserve forces will pick up an additional 300 F-16 multirole fighters shed by the active forces.

In active-duty strategic aircraft units, the story is much the same. Strategic Air Command's twelve squadrons of B-52s, containing 171 PAA, will drop to eight squadrons and only 117 B-52s by October 1, 1993. Today SAC has nineteen squadrons of 950 Minuteman ICBMs; in two years, under current plans, it will field only sixteen squadrons of 792 Minutemen.

The strategic components of ANG and AFRES will maintain about the same number of F-15 and F-16 air defense fighters—some twelve squadrons containing 216 aircraft. The number of KC-135 refueling aircraft in the reserve forces, however, will grow greatly, from sixteen to twenty-three squadrons, raising the number of PAA in these units from 158 to 222.

Elsewhere, little major change is anticipated. SAC is scheduled to give up three KC-135 tanker squadrons, but Military Airlift Command will retain all of its C-5 and C-130 transports and almost all of its C-141 airlifters. The active inventory of Air Force special operations aircraft is scheduled to grow from eighty-six today to 111 in two years, with eleven SOF squadrons.

The Shrinking Force

The next two years will see a significant shrinkage in personnel. Air Force officials say they have budgeted sufficient amounts to provide adequate pay, allowances, and benefits for active, ANG, and AFRES officers and enlisted personnel, Air Force Academy cadets, and others.

Total active-duty strength, however, will drop in two years from 508,558 to 458,100—a ten percent reduction. At the end of the two-year period, there will be 119,400 ANG members, 82,400 AFRES members, and 220,617 Air Force civilians.

The personnel reductions will be felt most sharply within the 95,026-member Air Force officer corps, where the cuts will be proportionately larger than in the enlisted ranks. Secretary Rice says that, between 1990 and 1993, the number of officers will have declined by almost 14,000 positions, and the ratio of enlisted personnel to officers will have grown.

The enlisted-to-officer ratio had been scheduled to decline to 4.06 to one in 1995. With the new officer cuts, however, the ratio will be 4.29 to one at the end of 1993. The service is even considering conversion of some officer career areas to enlisted ranks.

Today's Air Force headquarters strength of 3,168 positions will shrink by 700 positions—twenty-two percent—over the next five years. This includes a net reduction of twelve generals, two of whom have three stars, in the Pentagon. At that point, USAF headquarters staff will be seven percent below authorized levels.

As for force readiness, Air Force officials say they will try to hold it at today's high level. Reductions in the number of primary aircraft will bring about a fifteen percent reduction in the Air Force's flying-hour program. Force structure reductions will also reduce depot maintenance requirements.

Officials say that depot maintenance is not funded at 100 percent of true requirements but that there is enough money to maintain adequate readiness of critical weapon systems and support equipment. There will be some backlogs, which will have an impact on sustainability.

Meanwhile, tactical fighter pilots will get about twenty hours of flying time per month, about the same as in years past. Strategic pilots also will have about the same number of flying hours. The Air Force's direct flying-hour program for the airlift crews will be down a bit, but will be supplemented by DoD-funded flying time.

The Air Force, after a hiatus of several years, again is buying War Reserve Materiel. It plans to spend about $600 million on these items over the next two years. Spending on munitions and associated equipment will rise to $314 million in 1992 and $543 million in 1993.

The O&M Squeeze

Some eighty-five percent of the service's operations and maintenance (O&M) budget is allocated to fixed, "must-pay" bills that cannot be reduced in the short term: flying hours, training, weapon system support and maintenance, and contract operations. Though the 1992–93 budget figures look about the same as those for 1991, the figures are somewhat deceiving, inasmuch as there are now more programs to fund and the prices of individual programs have grown.

"When price growth and transfers-in are discounted," warns one budget document, "the Air Force O&M budget reflects a programmatic decline of 10.2 percent in Fiscal 1992 and 0.2 percent in Fiscal 1993. This significant reduction affects programs across the spectrum of the O&M account."

Similarly squeezed in years just ahead will be funds for the procurement of new combat aircraft.

The Air Force's overall procurement budget fared better than that of either the Army or Navy, with funding increasing nine percent in nominal terms in FY 1992 and seventeen percent in FY 1993. The specific aircraft procurement budget, however, has lots of ground to make up; it fell 41.1 percent from 1990 to this year. It declines further in 1992.

The 1991 budget funds only 146 new combat aircraft—108 F-16s, thirty-six F-15Es, and two B-2 Stealth bombers. However, plans call for the Air Force to buy only fifty-two combat planes in 1992 (forty-eight F-16s and four B-2s), and in 1993 an anemic thirty-one planes (twenty-four F-16s and seven B-2s). For the first time in recent memory, in 1994 and 1995 the Air Force will buy no new fighter aircraft.

Michael Donley, the Air Force's Assistant Secretary for Financial Management, notes that the new budgets place a greater emphasis on aircraft modifications. Air Force leaders have decided to get away from single-purpose aircraft, he says, noting that the modifications will help the Air Force achieve "greater efficiency" in its structure.

—USAF photo by TSgt. Perry Heimer

Above, 1st Lt. Orlando Nunez of the 1705th Aerial Refueling Squadron participates in F-16 refueling on the second day of Operation Desert Storm. High-quality personnel remains the Air Force's top priority, but deep personnel cuts in the next five years will be felt sharply in the officer and enlisted ranks.

© Dennis Brack/Black Star

F-15s and personnel of the 1st Tactical Fighter Wing (above), Langley AFB, Va., arrived in Saudi Arabia shortly after the start of Operation Desert Shield last August. With the war over, the Air Force will soon be returning tactical fighter units to the US. The tactical fighter force will undergo a major reduction by 1995.

The budgets show that funding for aircraft modifications will climb from $1.3 billion this year to $1.8 billion in 1992 and $2.2 billion in 1993—with more increases expected in the outyears.

Major Modifications

One major modification effort focuses on the F-16 force. Budget documents show that the Air Force will spend a total of $645 million over two years to help fund the F-16 Radar Warning Receiver program and the engine replacement program.

Also in 1992, R&D for the F-16 increases $149 million to accelerate the close air support (CAS) modification. Funding starts in 1993 for the program to convert existing F-16s to the CAS version.

Originally, the Air Force planned to buy new-production F-16s for the F/A-16 CAS and RF-16 reconnaissance roles. Now USAF officials say that 300 to 450 F-16s will be converted.

The Air Force plans to allot another $641 million in 1992 and 1993 to ramp up the Multistage Improvement Program for the existing fleet of F-15 air-superiority fighters.

In another major modification program, the Air Force will continue the reengining and modernization of its KC-135 fleet. The effort incorporates new engines, nacelles, pylons, and thirty-four subsystem modifications. The cost, in R&D and procurement, will be nearly $1 billion over two years.

The modification will enable the KC-135 to take off with maximum fuel loads, in shorter distances, and with a greatly reduced noise impact on surrounding neighborhoods. The operational payoff, says the Air Force, will be to increase fuel offload capability by at least thirty percent. This modernization effort helps to alleviate the growing tanker shortfall and will enable the KC-135 to operate well into the next century.

Funds for missile procurement will remain more or less constant over the next several years. The Air Force will continue a low-rate purchase of 223 stealthy, nuclear-tipped Advanced Cruise Missiles. The air-combat AMRAAM goes to full-rate production, with the Air Force spending $1.7 billion for 2,310 missiles over two years. Procurement continues in the HARM low-cost seeker and missile programs.

The Air Force is supporting two standoff air-to-ground weapons. It plans to buy thirty-two new models of the Have Nap, an Israeli-designed, rocket-powered 2,000-pound weapon, and 120 new AGM-130s, rocket-powered variants of the GBU-15 glide bomb.

The joint USAF-Navy long-range conventional standoff weapon (LRCSW), however, has been canceled.

The Air Force is providing robust funding for satellites and other types of space systems. For example, the 1992 budget contains $193 million for advance procurement of two Defense Support Program satellites, the first of which will be procured in 1993. That year's budget contains $464 million in DSP procurement money.

The service also provides $478 million over two years to continue multiyear procurement of the Navstar Global Positioning System—a twenty-satellite buy. The money funds ten new satellites over two years.

The major space casualty is the Boost Surveillance and Tracking System satellite program, once a high-priority item. The Air Force will pursue enhancement of the current Defense Support Program satellite or other options.

A Brighter Day for the B-2?

Once again, the Air Force's highest priority—and most controversial program—is the B-2 bomber. Not counting research and development funds, the B-2 program is expected to consume $2.9 billion in 1992 and $3.6 billion in 1993. When R&D funding is counted, the tab over the two years comes to $9.5 billion for eleven new aircraft.

Senior Air Force officials maintain that the B-2 may enjoy stronger support on Capitol Hill this year than in years past, for several reasons. They note that the Air Force is now able to fund the program within the budget ceilings provided by the President, the preliminary tests of the bomber's stealth characteristics look "positive," and Operation Desert Storm has dramatized the value of stealth aircraft in modern war.

With respect to the latter claim, the Air Force points to the strikingly successful performance of the stealthy F-117A tactical attack plane in action against Iraqi targets. Though F-117s make up only 2.5 percent of combat assets, they covered thirty-one percent of all targets in the war's first twenty-four hours.

"One of the lessons learned in the Gulf," remarks Secretary of Defense Dick Cheney, "has been the enormous value of stealth. If anyone had any doubts about stealth, they ought to look at the performance of the F-117 fighter-bomber." ■

Infrared sensors loom large in the Air Force's future. They emit no telltale radiation, and some of their drawbacks can be resolved.

Seeking Heat

By John Rhea

INFRARED sensors, which first began supplementing radars in US Air Force fighter aircraft thirty years ago, are being groomed for a larger role in low-observable aircraft and other systems of the future, even as they prove to be highly effective additions to today's fighters.

The rising popularity of today's infrared, or IR, systems rests on two factors: the increasing vulnerability of aircraft to electronic detection and the emergence of technological advances that promise to erase what for years have been inherent deficiencies in IR systems.

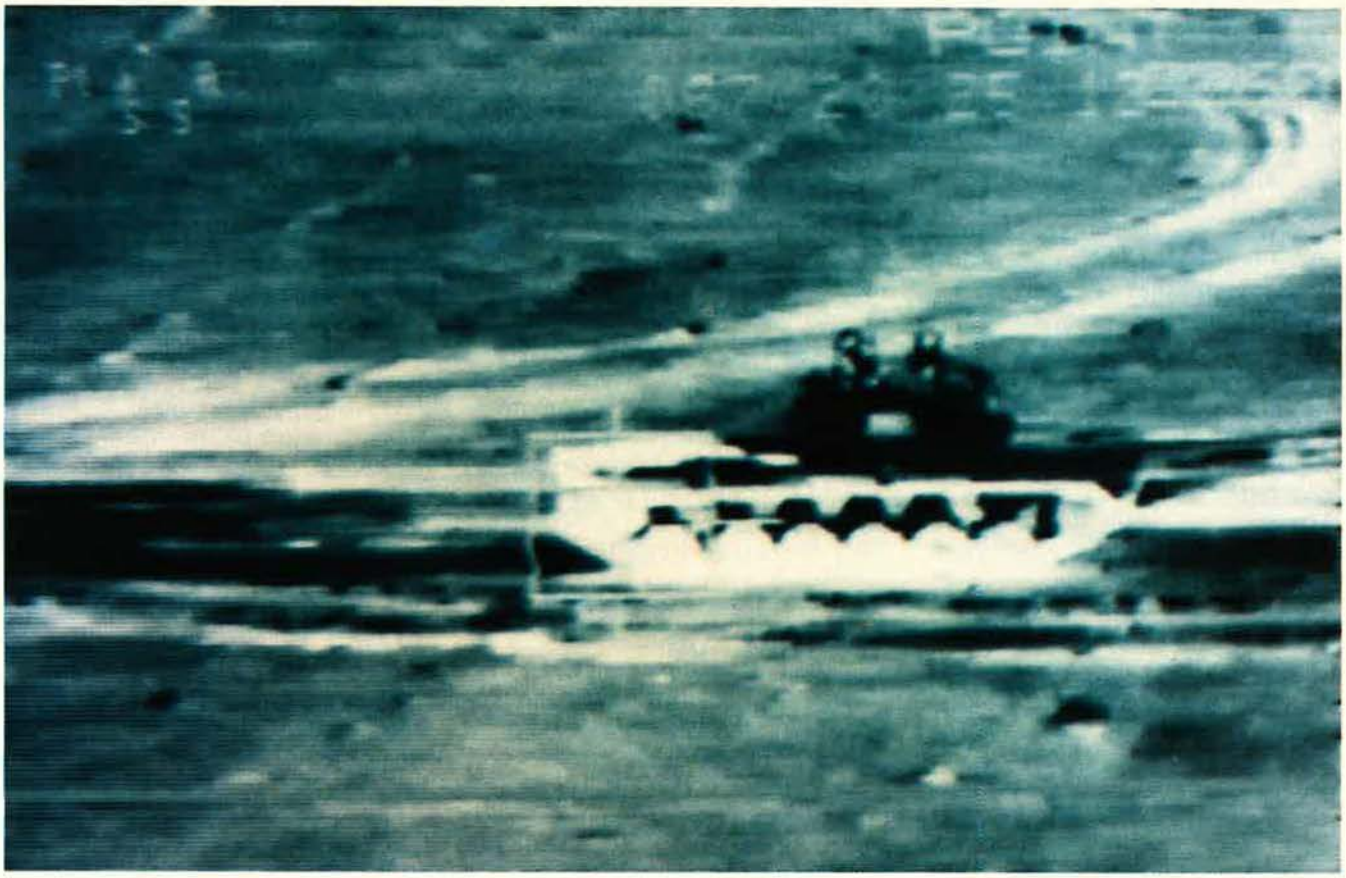
In air combat operations, infrared sensors provide the fighter pilot with one big advantage: They are passive. Unlike radar, they do not radiate telltale electromagnetic signals that give away the position of an aircraft and permit an enemy to use his jammers and accurately fire his antiradiation missiles. This property is expected to be of large and growing importance to stealthy aircraft. After spending billions to make planes resistant to radar detection, the Air Force will want to make sure they don't give themselves away with the beacon of active radar.

A host of technological disadvantages has tended to offset this advantage, at least until recent years. IR sensors operate in a portion of the electromagnetic spectrum next to the one used by the human eye and have many of the same limitations. For example, the human eye can't see through clouds; neither can IR sensors. As one researcher dryly observes, "They work great against a blue sky."

IR sensors *do* work well in the clear air of the upper atmosphere. They work even better in the airless void of space. That's one of the things they did in the Persian Gulf conflict, and it illustrates what can happen when radar and IR sensors work in tandem.

US forces used both technologies to detect the Iraqi launches of Scud missiles toward Israel and Saudi Arabia. They combined the early warning radar in the E-3 Sentry Airborne Warning and Control System (AWACS) aircraft, radar in satellites, infrared sensors in Defense Support Program satellites in geosynchronous orbit, and IR sensors

This imagery from a LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) system on an F-15E shows how clearly the targeting pod "sees" its objective even at night and in poor weather. Infrared systems have the added advantage of being passive. Unlike radar, they do nothing to increase the aircraft's vulnerability to detection.



in lower-orbit satellites. Once detection was achieved, information was passed on to the Patriot air defense system's own radar, which then pinpointed the incoming Scud and helped guide an interceptor missile to it.

Clear Skies, Night Flying

Desert Storm is expected to provide useful information about the value and contribution of IR sensors. The weather generally was clear, and there was a great deal of night flying. Although Iraq's relatively unsophisticated electronic warfare capability did not demand much stealthiness on the part of US fighters, use of forward-looking-infrared (FLIR) sensors aided low-altitude nighttime ground attacks in the clear desert air.

The most significant example is the Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system developed for the Air Force by Martin Marietta Aerospace of Orlando, Fla., and used operationally, evidently for the first time, on F-15Es in the Persian Gulf. All signs are that LANTIRN performed admirably.

Until recently, IR systems in aircraft were limited to air-to-air applications at the higher altitudes. In fact, though all the Air Force's "century series" of fighters (F-100, F-106, etc.) were equipped with the forerunners of today's IR devices, one of the first major applications was in the early 1970s with the Navy's F-14 Tomcat.

The Air Force's Rome Laboratory (formerly Rome Air Development Center) at Griffiss AFB, N. Y., is developing the IR sensors of the future, based on exotic platinum and iridium silicides, for use in the B-52 bomber and perhaps later in the stealthy B-2 bomber.

The Air Force isn't the only service interested in the future of IR systems. The Army also has been enthusiastic about IR sensors for tanks and has been working with the Defense Advanced Research Projects Agency (DARPA) to develop a common module that would combine the detector with devices to contain the liquid nitrogen in the cooling assembly.

Because it is passive, an IR sensor can only receive target information. It cannot transmit a pulse of its own. Among other things, this limitation prevents IR sensors from providing their own range data, as radar can by bouncing a pulse off a target and measuring the time delay between the transmitted pulse and the return.

Balanced against this, however, is the ability of IR sensors to provide more accurate azimuth and elevation information. This is possible, say experts, because IR sensors use shorter wavelengths than those in radar systems. Researchers hope to exploit this capability in future IR systems.

Oddly, one of the driving factors in the comeback of IR systems has been the Soviet Union's strong and continuing effort to develop such devices for its own combat aircraft. Western experts say that the Soviet MiG-29 and other modern Soviet fighters have been fitted with infrared sensors.

In the US, however, IR sensor systems were slow to catch on during the 1960s and 1970s because both the sensors and the necessary supporting airborne computers were inadequate to handle accurately the large volume of data received.

Expanded Computing Power

This situation is changing, however. The early generation of airborne analog computers, slow and primitive by today's standards, is being replaced by powerful, microprocessor-based, sixteen-bit digital computers. These, moreover, are soon to be replaced by an extravagantly powerful thirty-two-bit supercomputer that can be carried aloft.

In addition, the original silicon-based sensors are being phased out in favor of more sensitive focal plane arrays made of mercury-cadmium-telluride (HgCdTe, pronounced "mercadtell").

For now, "mercadtell is king of the roost," according to Robert Hale, engineering manager for electro-optical systems at Westinghouse Electric Corp. in Baltimore. He explains that these focal plane arrays can be used to scan the natural temperature of the Earth as it is radiated into space. The systems typically scan at around twenty degrees Celsius and then search for heat sources whose temperatures exceed the scan temperature. The difference in the two temperatures is called a "Delta T."

With such a system, detecting a missile or an aircraft is relatively easy. Their exhaust plumes typically reach some 600 degrees Celsius, so it's not hard to detect their Delta T. To a high-quality IR sensor, says Mr. Hale, "an aircraft looks like a star."

Tanks are a different matter; they create a Delta T that rarely exceeds twenty-five degrees Celsius.

This points up an inherent problem of IR sensors, although it also has a technological solution: They have to be kept very cold. Because the whole purpose of IR sensors is to detect heat, whether from an aircraft engine, a missile's exhaust, a tank, or even an individual enemy soldier, the sensors have to operate at the temperature of liquid nitrogen, or minus 196 degrees Celsius.

This isn't as big a problem as it might appear, explains Robert Sendall, director of IR technology development at Hughes Aircraft Co.'s Electro-Optical and Data Systems Group in El Segundo, Calif. "IR is much less expensive than radar because there's no transmitter and the liquid nitrogen coolers can be produced for a few thousand dollars per item," he says. "IR uses less power and is smaller [than radar], and I hope that implies more reliability."

At last year's Association of the US Army Exhibition, Hughes demonstrated what Mr. Sendall calls a "second-generation imaging system," in which a focal plane array of some 480 individual elements was linked to a high-speed signal processor to process incoming data at ten million to twenty million bits per second and to provide a real-time image of thirty to sixty frames per second.

This combination of better sensors and more powerful computers, however, still doesn't solve a basic problem inherent in each IR sensor: its inability to penetrate rain and fog.

Filtering Out the Clutter

It does promise a solution to one of the major stumbling blocks in the past to the wider use of IR: excessive clutter and frequent false signals. Because the new sensors and computers are more accurate, they are better able to distinguish real targets from spurious signals.

The other major drawback, lack of range detection capability, is being addressed by military contractors in a new demonstration project for the Naval Weapons Center at China Lake, Calif. The purpose is to operate an IR sensor and carbon dioxide (CO_2) laser rangefinder through a single aperture.

The Navy hopes that, if the demonstration is successful, it will be able to integrate an entire IR search and track (IRST) system with a laser rangefinder for use in future air-to-air missions. Hughes expects the rangefinder to reduce the IR sensor's false-alarm rate by verifying the location of targets.

The key challenge of this program, which is due to be completed early in 1992 following airborne tests later this year, is to find a way to use a common aperture successfully. This will reduce the required surface space outside the aircraft and minimize wind drag.

Another major challenge will be to shield the IR sensor from nearby lasers. Because IR sensors are sensitive to light of any kind, the light from the rangefinder cannot be permitted to come in contact with the sensor.

During the mid-1980s, technicians at Air Force Systems Command's Aeronautical Systems Division at Wright-Patterson AFB, Ohio, conducted major IR experiments under the Advanced Fighter Technology Integration (AFTI) program. They combined a FLIR sensor with an exotic laser and a 1750A computer. They then tested it in air-to-ground missions.

Already here, of course, is the LANTIRN system, which provides

Infrared systems will deliver a wealth of information to pilots and Weapon System Officers. This sensor, in tandem with the Hughes's Electro-Optical Signal Processing Computer, not only shows the raw images, it also automatically differentiates the various target types. It is not out of the question that systems of the future will be able to detect heat from even so small a target as an individual enemy soldier.

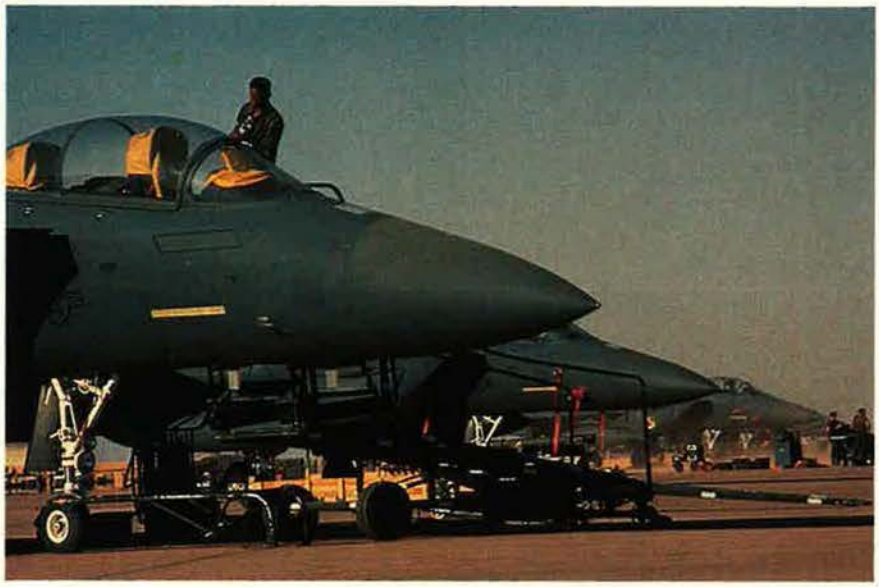
strike aircraft with all-weather, autonomous day/night navigation and precision weapon delivery against tactical ground targets. The LANTIRN system comprises two underwing pods, one for navigation and the other for targeting. Depending on the mission, the aircraft can carry either sensor singly or both at the same time.

The navigation pod contains the wide-field-of-view FLIR and a terrain-following radar from Texas Instruments. It enables the aircraft to operate at altitudes of a few hundred feet. The FLIR imagery from the pod is displayed on a new holographic head-up display (HUD) developed by Marconi Avionics to provide the pilot with night vision for safe flight. Terrain following can also be performed manually.

The targeting pod contains the stabilization system, wide- and narrow-field FLIR, laser designator and ranger, automatic target recognizer, automatic IR Maverick missile hand-off system, and other necessary electronics.

—USAF photo by MSgt. Kit Thompson

Some IR systems have been used operationally in the war with Iraq. In addition to LANTIRN, the Target Acquisition Designation System and Pilot Night Vision System for the Army's AH-64 Apache helicopter received good marks. This Apache took out two Iraqi radar sites early in Operation Desert Storm.



—USAF photo by SSgt. Robert Jackson

Though they have reason to be optimistic, analysts caution that LANTIRN's success aboard F-15Es in the Persian Gulf War does not guarantee its decisiveness in encounters with more sophisticated air defenses in other parts of the world. The relatively clear weather in the theater also eliminates a variable that could degrade the system's performance significantly.

The Persian Gulf War saw use of yet another system employing IR sensors: the Target Acquisition Designation System and Pilot Night Vision System (TADS/PNVS), which was installed on Army AH-64 Apache attack helicopters. It also was produced by Martin Marietta. TADS/PNVS provides target information and navigation capability for day or night and under limited adverse weather conditions. It consists of two independently functioning systems: the target acquisition designation sight and the pilot night vision sensor.

The TADS portion of this IR system provides the copilot/gunner with search, detection, and recognition capabilities with direct-view optics, TV, or FLIR, all of which may be used singly or in combination. PNVS also permits nighttime nap-of-the-earth flying operations.

Once acquired by the TADS, targets can be tracked manually or automatically for autonomous attack with guns, rockets, or Hellfire antitank missiles.

The successes of these and other weapons in the Persian Gulf War, against a technologically inferior foe, does not automatically mean that they can counter the more sophisticated electronic and military systems of the Soviet Union's armed forces, analysts warn.

Viewed in that context, it seems likely that the Air Force's new low-observable aircraft will require both radar and thermal imaging systems, such as IR sensors. Both technologies have made rapid strides in the past decade. The final judgment on their performance in the Persian Gulf War will have a major impact on their future applications. ■

John Rhea is a free-lance writer who specializes in military technology issues and is a frequent contributor to Air Force *Magazine. His most recent article, "Backyard Training," appeared in the February 1991 issue.*

Despite all the reforming and streamlining, some of the big problems remain. As one PEO says, "Nobody trusts anybody."

The New and Improved But Not Yet Perfect Procurement Process

By Peter Grier

OVER the past decade, the Air Force has wrought so many changes in plans for, and purchases of, major weapon systems that the acquisition system of 1991 bears only faint resemblance to the one the Reagan Pentagon inherited in 1981.

The transformation is not over. Air Force leaders say budget austerity and political uncertainty will generate more reform. "We have not seen the end of change," warns Assistant Secretary of the Air Force for Acquisition John J. Welch, Jr., USAF's top acquisition officer.

Mr. Welch addressed his remark to defense industry leaders who gathered in suburban Washington, D. C., in mid-January for the Air Force's first Acquisition Conference. In short order, Mr. Welch's cautionary tone was picked up by other service leaders at the AFA-sponsored event.

They maintained that recent reforms, such as establishment of the Program Executive Officer (PEO) structure, have not yet resolved all acquisition problems, though they have helped the Air Force identify and face up to inherent weaknesses.

"I believe the majority [of weaknesses] are identified," Mr. Welch observed, "but we still have a job to do in fixing all those things."

The timing of the acquisition conference, on the eve of Operation Desert Storm, served to emphasize the seriousness of the job ahead. Speaker after speaker argued that, in the Persian Gulf military action, the Air Force had proved itself to be the most advanced aerospace arm in the world and that the challenge now is to make sure this same edge is maintained in a Desert Storm of the early twenty-first century, if need be.

For all that, there is only scant hope of a long-term increase in the Air Force's budget. The opening months of the 1990s have continued

the downward trend of the late 1980s. From Fiscal 1990 to Fiscal 1991, the service absorbed reductions of fifteen percent in RDT&E (research, development, test, and evaluation) and twenty-seven percent in procurement.

Losses of this magnitude mean that a business-as-usual approach is out of the question.

Said Air Force Chief of Staff Gen. Merrill A. McPeak, "Modifying our operations on the scale we are talking about means we can't simply take cuts at the margins. There will be fundamental program and organizational change."

A "Comprehensive" Air Force

If a corporation had to make such a fundamental change, it might choose divestiture. Nonessential business or departments would be identified and sold off, leaving only a core business, an absolute minimum, on which the corporation depended.

The Air Force can't do that. It can't abandon an entire function, such as aeromedical evacuation, just to save money for tactical fighter modernization. "We must be a comprehensive air force, not just a good air force," said General McPeak.

In pursuit of this goal, the service's uniformed leader declared, the Air Force needs to restructure itself for greater efficiency of operation. The start of this process can be seen in two recent moves: the shuffling and shrinkage of the Air Staff and the merger of Systems Command and Logistics Command, USAF's principal acquisition organizations.

One important aspect of the Air Staff changes will be establishment of a Director of Operational Requirements, remarked General McPeak. He explained that this requirements chief, who is to be a senior general officer, will work with major Air Force commands to make certain that all new programs rest on a hard base of detailed mission analysis and sound operational concepts.

This effort is aimed at improving the acquisition of an advanced weapon before the program even gets going. General McPeak wants to put special emphasis on the development period that comes before the first formal acquisition "milestone," because "I'm not convinced that the system always works so well before milestone one."

The consolidation of the two big acquisition bureaucracies, AFSC and AFLC, shows that restructuring will not occur without pain. Neither side is happy about giving up its independence, but these are not normal times. Air Force officials insisted that the merger is not a case of one agency swallowing the other. It is, rather, a kind of "double liquidation," beginning this October and ending in July 1992, with the new entity being formed from the assets of the dissolved commands.

This will work to the benefit of all, said Gen. Ronald W. Yates, AFSC's commander, because "we share the same customers and focus on many of the same processes, products, and services." The result, he adds, will be "positive synergy."

The time is right, says General Yates. Both commands already were streamlining operations. Systems Command last year handed over contract management responsibility to the Defense Logistics Agency and cut two of six product divisions. Logistics Command in the past year has cut its work force and realigned major functions at Air Logistics Centers.

Both commands are trying to improve the quality of service. AFSC officials set up government-industry teams to study the RFP (request for proposals) process, producing forty-eight recommendations, of which twelve have been accepted. Similar changes are under way at AFLC.

"We are no longer just looking for the lowest qualified bidder," said Gen. Charles C. McDonald, AFLC's commander.

Many in industry would like to see this attitude become widespread within the Air Force. In the defense business, emphasis on price alone weakens industry's financial health, say industry leaders.

Lost: Forty Percent of Value

Conference attendees were told in blunt terms that the industry's financial viability has been eroding. In the last five years, defense stocks lost forty percent of market value, asserted Bernard Schwartz, chairman and chief executive officer of Loral Corp. Industry debt, he adds, has grown by eighty-one percent as earnings fell forty-five percent.

Meanwhile, contractor-bashing has continued to be a favorite blood sport of some journalists and politicians, progress payments have decreased, oversight has increased, procurement procedures have proliferated, and firms have been forced into massive write-offs.

"The situation has gotten so out of hand," said Mr. Schwartz, "that the best thing that can happen to a contractor is to lose a big development competition. Certainly, losing the [Navy] A-12 [aircraft] competition may have been a blessing in disguise."

(In January, Defense Secretary Richard Cheney declared that the two A-12 contractors—General Dynamics and McDonnell Douglas—were in default and canceled the program. The contractors vigorously dispute Cheney's characterization and have lodged claims.)

The Loral chief, however, was quick to say that industry should accept some of the blame for its dire predicament. It has cheerfully gone along with budget and schedule requirements that it knew to be unrealistic. Mr. Schwartz insisted that the government can't rely only on the free market to decide who will survive. Instead, the Pentagon should change its attitudes about its responsibilities toward industry and emphasize incentives for performance. Specifically, Mr. Schwartz suggests that the government take the following steps:

- Increase progress payments by at least five percent.
- Reject proposals to eliminate flexible payments.
- De-emphasize use of "best and final" offers.
- Clarify what "total quality management" really means.
- Introduce a second source only when a program is large enough for two suppliers and only after the initial supplier has had a chance to recover its investment.

Both sides must change their attitudes if such rule changes are to make any difference. "We have become so entrenched in our antagonistic attitudes toward each other that every item of discussion becomes a battle royal," said Mr. Schwartz. "Mistrust is rampant."

Industry's lack of faith in blue-suit contracting officials has driven trust way down, agreed one Air Force PEO, Maj. Gen. Stephen M. McElroy. Complicated and vague ethics laws haven't helped, the PEO for Tactical Strike Systems maintains, but industry and the military aren't the only antagonists. Congress is suspicious of the quality of Air Force procurement stewardship as well. "Nobody trusts anybody," said General McElroy.

Impervious to Reason?

For example, says the General, "Congress reached in with a 1991 appropriation [provision] to one of my programs and took away my authority to spend 1989 dollars. I explained in great detail what damage that was going to do to that program. They didn't buy any of that."

Another problem in the acquisition process, from General McElroy's perspective, is that the government's transfer of risk to industry has gone too far and needs to be rolled back. Overall, he said, "we have kind of lost [the] lock on the system's approach to doing business."

He pointed out to the conference that, even though Air Force procurement deals with the cutting edge of high technology, the system is shaped as if success were preordained once things get going. Defense acquisition, he concludes, has now become absolutely intolerant of failure in the full-scale development phase.

He said that other manifestations of the system's problems include the Air Force's dismal record of software management and poor subcontractor management and the long-standing difficulty the military has had in taking weapons through the transition from development to production. "These are three major things we've got to work very hard," said General McElroy.

Speakers consistently maintained that one way to help fix the system is to instill a true sense of program "ownership" throughout the length and breadth of the acquisition chain.

The direct link between the Service Acquisition Executive (SAE) and the PEO is relatively new, but its origins go back five years to the recommendations of the Packard Commission. The SAE-PEO chain of command was modeled on the formal—sometimes informal—set-ups that industry puts together to handle big tasks.

Orbital Sciences Corp. President David Thompson said the system attempted to create three beneficial conditions.

First, it was supposed to set up a single and well-defined acquisition chain of authority from the grass roots to the government equivalent of a CEO. Second, it was supposed to invest program managers with the authority needed to deal with everyone who had a say in a project. Third, it was supposed to be a means for keeping watch on program progress and for evaluating it at critical milestones.

"The general but not unanimous sense seems to be that so far things have been working pretty well," said Mr. Thompson.

The most common positive comment: The tangled chain of command that used to complicate government acquisition decision-making has been substantially reduced. No longer does a program manager have to provide two dozen preliminary briefings before the system can move to handle a problem.

Four Strikeouts

Mr. Thompson said that the most common negative comment was that, although the position has been filled by four different men since it was created in 1987, no one who has served as the Under Secretary of Defense for Acquisition has ever become a truly effective player in the defense procurement game.

Many speakers said they have also detected concern that the efficiency of the PEO process is heavily dependent on the quality and quantity of those individuals who run it. Given limited PEO manpower, the structure might break under the weight of too many programs.

Time after time, conference attendees heard charges that the government isn't the only player that needs to shape up.

Software programs, for example, are plagued with schedule delays and cost growth. Manufacture of defense hardware has made great strides in the last fifteen years, "but when you examine the performance of software over the same period, it becomes obvious that similar progress has not been made," said Al Verderosa, president of Grumman Melbourne Systems Division.

As overall system integrator for the E-8A Joint STARS (Surveillance and Target Attack Radar System) ground-surveillance and battle-management aircraft program, Grumman has taken on one of the Air Force's truly vast software challenges.

Mr. Verderosa contends that industry executives, when they wander into the software area, too often set aside the hard-nosed approach to performance and schedule and fall prey to a belief that designing software is a black art whose progress cannot be scheduled.

"That is pure, unadulterated hogwash," said the Grumman leader. "Software management can indeed be planned."

Management also must resist the temptation to cut corners early and proceed quickly to coding. Coding, said Mr. Verderosa, is not the most important part of the process. Far more important is the requirements-definition phase, which he says should receive thirty to forty percent of total program effort.

He adds that software developers should imitate their hardware brethren and use preproduction prototypes. "On [Joint STARS], we were extremely successful in using a prototype technique," said Mr. Verderosa, who added that the company prototyped approximately seventy percent of the system's software before it moved into "production."

In addition to these problems, industry may also be spending too much time worrying about what Harold McCard, Textron Defense Systems president, called "product factors" as opposed to crucial "process factors."

Product factors involve hard system attributes—how big it is, how fast it is, how much it weighs, and so forth. Process factors relate to how the system is to be produced—how to design it, how to test it, how to maintain it, and so on.

The sooner management devotes attention to process factors, the better. The company will have a stronger chance to catch and remedy such problems as bad design and lagging design maturation. Unless it does so, it will enmesh itself in what Mr. McCard describes as the dreaded project "crunch," when risks all seem to develop into real problems at once and some design deficiencies are rationalized as being acceptable.

Inattention Equals Failure

"Our inattention leads to failure to recognize that the risks have increased," said Mr. McCard.

With more competition and fewer contracts, big contractors might be well advised to rid themselves of duplicative or cost-ineffective departments and activities, relying instead on small defense subcontractors for support and supplies.

"This provides an opportunity for small business to step in," said Phillip Friedman, president of NASCO Aviation Corp.

Of course, in many cases small business can stand on its own. NASCO is a small, feisty, brake firm that long has fought for the right to compete for contracts, and its president believes that the 1980s' trend toward more use of competitive contracts should continue.

The problem, says NASCO's president, is that something like half of all Air Force procurement officers still dislike the use of competition. It imposes added bureaucratic burdens on them, and the money they save doesn't accrue to benefit them or their programs; instead, it reverts to the Pentagon pot.

"The Air Force needs to come up with a program to give its contract officers incentive to save money through competition," said Mr. Friedman.

USAF procurement officials agreed that some of their best contractors are small. Of AFLC's 135 blue-ribbon contractors last year, seventy-five were small firms. However, they say that small businesses typically try to make products for which many good suppliers already exist. "What we really need to do is channel [them] and focus [them] on where we're headed," said Anthony DeLuca, director of Air Force small and disadvantaged business utilization.

System requirements will receive more and more attention, claimed the Vice Chief of Staff of the Air Force, Gen. John M. Loh. The framework will run something like this: Systems equipment should perform tasks to achieve operational objectives. These operational objectives, in turn, must support a CINC's military strategy. All CINC strategies will underwrite the national security strategy.

Air Force acquisition personnel "should learn how to write systems operations requirements documents," said General Loh. "I haven't seen a truly well-written one yet." ■

Peter Grier is a Washington defense correspondent for the Christian Science Monitor *and a regular contributor to* Air Force *Magazine. His most recent article, "The On-Call Air Force," appeared in the February 1991 issue.*

Don't laugh. It has been tried hundreds of times, and many of the experiments were successful.

Missile Mail

By C. V. Glines

It was June 8, 1959, and the event was a special postal ceremony in Florida. Postmaster General Arthur Summerfield used the occasion to declare his belief that "guided missiles may ultimately provide a solution to problems of swifter mail delivery." Such unorthodox means, he added, could provide mail service "for international marts, for isolated areas where other transportation is infrequent, as well as a supplementary high-priority service to big population centers."

Send mail by missile?

Why not? Missiles fly faster than aircraft; no human pilots are needed; they can land safely; many pounds of mail, including packages, can be sent at one time; and security is assured—so long as the missiles land in friendly areas.

Don't think it hasn't been tried. It has been, hundreds of times, with varying degrees of success.

The first person known to have suggested propelling mail by explosive means was Heinrich von Kleist, renowned playwright and editor of the newspaper *Berliner Abendblätter,* in 1810. As von Kleist envisioned it, artillery batteries stationed between cities would fire hollow shells filled with letters and postcards. The mail would be shot from one city to another, retrieved, and fired to the next.

"As a quick computation will show," von Kleist wrote, "a letter dispatched by this means would cover the distance from Berlin to Stettin [seventy-five miles] or to Breslau [180 miles] in half a day, or in about one-tenth the time required by a mounted courier."

Von Kleist was ahead of his time. In the 1920s and 1930s, enthusiasm for rocket mail gathered momentum. In 1928, Dr. Franz von Hoefft called for rockets that would carry a mailbag and "be capable of reaching any point of the globe, along a Keplerian ellipse, in about an hour."

That same year, Professor Hermann Oberth proposed building rockets with automatic guidance systems, vehicles that could travel 600 to 12,000 miles while carrying up to forty-four pounds of mail. The rockets would parachute to earth, and "some other means would then carry the apparatus to its precise destination." Oberth did not build his mail rockets, however.

Over the Alps

Friedrich Schmiedl, operating independently from von Hoefft and Oberth, claimed a missile mail first. In July 1928, he attempted a series of six experimental firings of rockets (designated V-1 through V-6) over 4,600-foot peaks in the Austrian Alps, from Mount Schoeckl to the village of Saint Radegund, four miles away. Although the test rockets had instruments on board to gather scientific data, a few pieces of mail were included as mementos.

Despite early failures, Schmiedl refused to give up. He persuaded the Vienna government to let him print and sell stamps to finance his mail-carrying flights. The government changed, and the new regime withdrew support.

He persisted, however, and on February 2, 1931, he successfully launched his V-7 mail rocket. It carried 102 cards and letters over the mountains to Saint Radegund, where the burned-out rocket parachuted gently to earth with the mail unharmed. Other shots followed, including one at night from Grazerfeld to Saint Peter. In all,

Schmiedl fired twenty-five mail rockets between 1931 and 1935. Most succeeded.

Reinhold Tiling, a German, in 1931 fired a rocket containing 188 postcards to a site near Hannover.

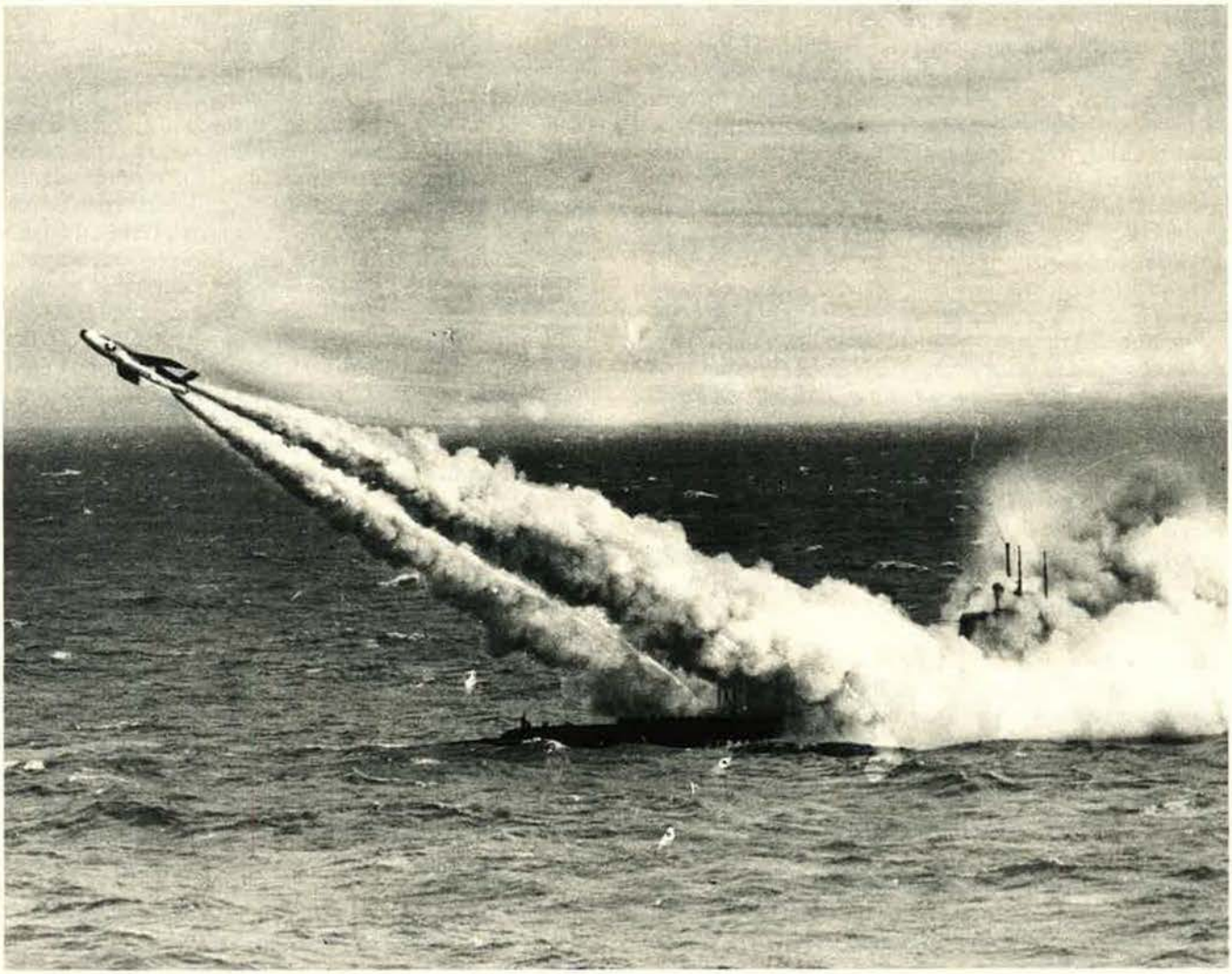
In 1933, Gerhard Zucker conducted unsuccessful missile tests near Hasselfelde. He went to England to try to further his ideas. His first experiment took place in 1934 on the South Downs overlooking the English Channel. There he launched a rocket from a catapult rack lubricated with butter. He predicted his cross-Channel service would take only fifty seconds. It carried no mail and crashed into the Channel. On the second attempt, the rocket, filled with 1,000 letters, flew about half a mile. The letters were recovered and sent through the postal system. Later attempts resulted in huge explosions. Zucker was nearly killed when a rocket landed twenty yards from the launchpoint.

In 1935, Stephen H. Smith fired a missile named *David Ezra* (after one of the sponsors) across India's Damoodar River. In addition to 189 specially printed postcards, it successfully carried a rooster and a hen, "Adam" and "Eve"—another missile first. Smith later became the first to rocket a snake ("Miss Creepy"), mice, food, whiskey, medicines, propaganda messages, newspapers, cigarettes, and photographs. He made several hundred successful firings, most of them carrying postal covers for collectors.

In the United States, the first rocket mail flight attempts were made in 1935 by William S. Sykora at Astoria, N. Y.; by Professor L. Russo on January 31, 1936, from Newark, N. J.; and on February 23, 1936, at Greenwood Lake, N. Y., by Willy Ley of the Rocket Airplane Corporation of America. The latter's missile, a curious device named *Gloria*, was eleven feet long with a fifteen-foot wingspan. It used a liquid propellant and carried 6,149 letters and postcards, upon which were affixed specially printed rocket stamps in addition to regular postage.

"From The Garden of Golden Grapefruit"

Elsewhere in the US, Keith E. Rumbel achieved a rocket mail first in June 1936 when he made several experimental rocket flights from a pasture near McAllen, Tex. On July 2, he set up his apparatus and loaded 1,500 envelopes aboard five rockets, all marked with a special inscription: "First International Rocket Flight From The Garden of Golden Grapefruit Over the Silvery Rio Grande To Scenic and Historic Mexico."



From the Napoleonic Wars to the Space Age, delivery of mail by explosive means attracted a variety of exponents—from German dramatists to US Postmasters General. A successful attempt occurred in 1959 using a Regulus I, such as this one, fired from a submarine seventy-seven miles off of Florida. It arrived safely twenty-one minutes later, its 3,000 envelopes intact.

The flights, sponsored by McAllen's American Legion post, were short but significant, since they were the first successful international rocket mail flights. Although one of the rockets exploded in flight, the other four landed on the outskirts of Reynosa, Mexico, with the covers intact. However, one of these landed on a house, and the mail was seized by Mexican authorities. The covers were finally released twenty years later, on the anniversary of the flight.

As soon as the rockets were launched across the river, Rumbel and an entourage of Legionnaires crossed the international bridge and readied the mail canisters for return flights. Rumbel fired the rockets from Reynosa to McAllen—the first return international mail flights. However, two rockets were damaged in flight, and their letters were scattered over the countryside.

Other experimenters tried to make history with missile mail flights in Mexico, Cuba, Australia, France, England, the Netherlands, and India, but none succeeded with lasting effect. Almost all shots, however, carried cacheted envelopes, many of which today are worth thousands of dollars to collectors.

Instances have been reported of foreign ships firing mail rockets to the shores of remote islands in the 1920s and 1930s. Just after World War I, the *Tofua*, a New Zealand ship, used signal rockets to fire mail to shore while making monthly voyages between Samoa and Fiji.

Just as balloons, artillery, and aircraft have been used to drop propaganda on enemy troops, so have rockets been used for such deliveries. The first wartime propaganda rockets were fired in 1936, during the Spanish Civil War, by forces of Francisco Franco. Written in Spanish and Arabic, the messages ascribed criminal intentions to enemy leaders and demanded that the troops surrender to Franco.

In April 1940, Germany used missiles to spread thousands of leaflets over Copenhagen and other Danish cities, announcing the occupation of Denmark and warning the Danes against disobeying the Nazi authorities.

The V-bombs launched against England during World War II were also used to spread leaflets. On Christmas Eve 1944, a V-1 dropped leaflets titled "V-1 P.O.W. Post" containing facsimiles of letters written by British prisoners languishing in German POW camps. In January 1945, a V-1 missile dropped four-page leaflets near Antwerp, Belgium. Printed in three languages was a headline that warned, "Get Out of The Way of the V-1 and V-2! The Bombardment Won't Stop!"

Cold War Mail

After World War II, rocket technicians developed air-breathing missiles with automatic guidance and landing systems. They were cheaper to construct than liquid-fuel or solid-fuel rockets. Mail by guided missile became a renewed possibility. On May 1, 1954, propaganda leaflets were shot from West Berlin to East Berlin, and vice versa.

On August 5, 1957, the Director of the Army's Missile Firing Laboratory sent an official message from Cape Canaveral, Fla., to the commanding general at Redstone Arsenal in Huntsville, Ala. The unusual part was its delivery aboard a Jupiter missile fired 1,500 miles downrange. It was picked up by a Navy ship and returned to the US for delivery.

One of the earliest US Navy guided missiles was the Regulus I, a surface-to-surface missile that could be fired by ships and submarines against shore targets. Anxious to prove the capability of its new weapon, the Navy made a secret test launch of a follow-up model, Regulus II, from a submarine, USS *Grayback*, 200 miles off the Pacific coast to Edwards AFB, Calif., on September 16, 1958. Just before takeoff, a packet of official Navy mail was placed aboard.

The Regulus was launched without difficulty, but on the missile's arrival over Muroc Dry Lake, the ground controller could not get it to respond to signals and had to bring it down to a fiery landing on its belly. The mail was recovered intact and sent on its way through regular postal channels.

Since this flight was classified and the mail bore no stamps and was not dispatched through Post Office Department mail channels from the point of origin, neither the Post Office Department nor philatelists recognized it as the first official US missile mail. The Navy decided to try again for proper recognition.

On May 1, 1959, a Regulus I was launched from the Pacific Missile Test Range at Point Mugu, Calif., and recovered after a controlled landing at the same base. It carried 150 envelopes. Although US Navy penalty envelopes were used, seven-cent airmail stamps were also affixed, and the mail was sent on its way through postal channels after a successful landing. However, although the postmaster of Los Angeles witnessed the flight, the Post Office Department again declined to recognize this flight as an official missile mail first because the envelopes were Navy penalty envelopes. The postage stamps placed on them and the use of a cancellation that was not an official strike caused the Postmaster General to declare it unofficial. The Navy decided to try once more.

On June 8, 1959, another Regulus I carrying "United States First Official Missile Mail" was launched from the submarine USS *Barbero,* seventy-seven miles off the Florida coast, and landed successfully twenty-one minutes later at the Naval Auxiliary Air Station at Mayport, Fla. Postmaster General Summerfield was on hand at the landing site to receive the 3,000 envelopes. He called the flight "of significance to the peoples of the entire world" because it had "given us extremely valuable information of far-reaching importance to the future of United States mail service." He predicted that missiles would be used some day to carry mail over great distances.

Mr. Summerfield could not have foreseen the electronic future. Will television, satellites, computers, and fax machines eventually eliminate our desire to send original, untouched handwritten symbols by whatever means?

Don't bet on it. Even those with computers and fax machines continue to find reason to send things through the mail. As Postmaster General William T. Barry remarked in 1834, "The celerity of the mail should always be equal to the most rapid transition of the traveler." ■

C. V. Glines, a retired Air Force colonel and a regular contributor tc this magazine, is the author of Airmail: How It All Began, *a complete history of the air transport of messages from pigeon post in 3000 BC to missile mail. His most recent article for* Air Force *Magazine, "Flying the Hump," appeared in the March 1991 issue.*

LTV/FMA team has 130-year headstart on JPATS.

In the search for our country's next trainer, LTV Aircraft Products Group evaluated more than two dozen candidates from around the world.

Jets. Turboprops. Different seating and wing configurations. Until we singled out an aircraft that we believe has all the features to provide the best training to generations of future Air Force and Navy pilots: the Pampa 2000.

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.

LTV Aircraft Products Group **FMA**

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

Seventy years ago, aviators knew little about the hazards that awaited them above 20,000 feet.

Pioneers at High Altitude

By Robert E. van Patten

AT 35,000 FEET, air pressure outside an airplane is so low that, should explosive decompression occur, the atmosphere inside the craft would instantaneously turn to blinding fog. Passengers would hear a tremendous explosion. In such a catastrophic loss of cabin pressure, expanding air would blast meals, luggage, crew, and unbelted passengers into the thin and frigid air outside.

The pilot would have to put the aircraft into a dive at once, since the passengers would be threatened not only by the loss of oxygen but also by the drop in pressure. At this altitude, pressure is so low that dissolved gases in the blood fizz like the contents of an abruptly opened shaken bottle of pop. This causes aeroembolism, or the bends, bringing excruciating joint pain and sometimes paralysis. Life-threatening bubbles in the blood enter the heart, lungs, and brain.

Seventy years ago, none of this was well understood. What *was* clear was that military airplanes, especially fighters, were going to have to fly higher than they usually did during World War I. German zeppelins, ghosting in from the fog and clouds of the English Channel, had presented the first challenges of flying and fighting at high altitudes, about 20,000 feet. Few fighters, and even fewer pilots, operated well at that altitude. Fortunately for England, German crews also suffered; frostbite and hypoxia, or oxygen hunger, were constant companions of the zeppelin crews, though some primitive oxygen devices were used.

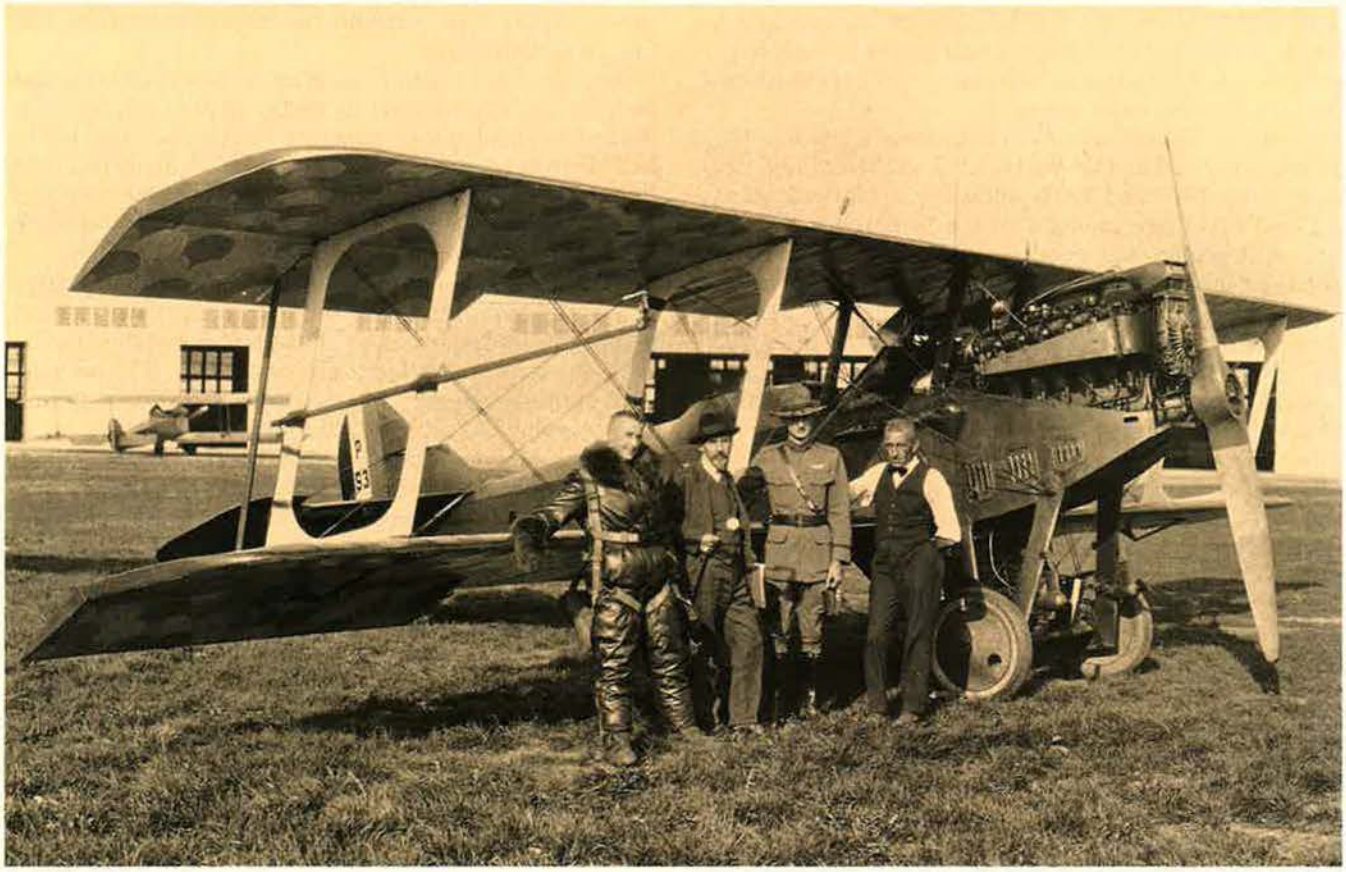
By 1918, the US War Department was well along in creation of the Air Service Engineering Division and its Flying Section, a flight-test organization, at McCook Field in Dayton, Ohio. At McCook Field, predecessor to one of the world's largest military research facilities (Wright-Patterson AFB, located about ten miles from the site of McCook), the earliest experiments in high-altitude flight took place.

The first of the high-altitude pilots at McCook Field was Capt. Rudolph W. Schroeder, known as "Shorty." At six-foot-two, his physical appearance belied his nickname. He was an intense, wiry man with the soul of an explorer. As early as 1914, Captain Schroeder had made a name for himself in air racing. In 1919, he was handpicked by his commanding officer to compete in a landmark New York–Toronto race. Schroeder and McCook's engineers and technicians resurrected a moribund Vought VE-7. In this plane, Shorty flew to victory.

The X-15 of Its Day

Captain Schroeder's high-altitude work commenced in earnest with a series of flights beginning in 1918. Late in World War I, a new biplane, the LePere type C-11, entered the inventory of the US Army Air Service. In production trim, this craft was powered by a normally aspirated Liberty engine with a twelve-cylinder Vee configuration. Soon after the war, this aircraft became America's first dedicated research aircraft and was, in a sense, the X-15 of its day.

Captain Schroeder's early high-flying attempts netted altitude marks of 24,000 and 27,000 feet, and with this background of experience, another record attempt was made on September 8, 1918. By the time he had reached 23,000 feet, Captain Schroeder was experiencing symptoms of hypoxia: He felt sleepy, tired, cross, and hungry. The symptoms were relieved by oxygen.



Just before his September 28, 1921, flight, a well-insulated 1st Lt. J. A. Macready poses with colleagues at McCook Field, Ohio. In this LePere C-11, boasting a newly modified two-bladed propeller to take full advantage of the turbosupercharger (in housing just aft of prop, on the front of the engine), Lieutenant Macready reached a record altitude of nearly 37,000 feet.

On earlier flights, Captain Schroeder had used a face mask and an oxygen bottle with a "very positive regulator." However, the mask fit so tightly that it numbed his face. On this flight, he used a rubber hose and pipestem connected to an oxygen flask, with a valve he controlled manually to regulate the flow. Having no flow regulator or indicator, he checked to make certain that oxygen was flowing by putting his tongue over the pipestem opening to feel the pressure. By the time the flight was well under way, the hose and oxygen flask were covered with a quarter-inch of frost.

Continuing to climb, he again experienced hypoxia symptoms at 25,000 feet and cranked up his oxygen supply, noting in his log that the temperature was minus sixty degrees Celsius. At 27,000 feet, he could not see through the frost on his goggles and raised them to read the aneroid altimeter. The air was so cold that his eyes watered excessively, but he saw that he had reached an altitude of almost 29,000 feet.

At this point, however, he ran out of fuel and the plane began to spiral down to 20,000 feet, where he recovered from most of the adverse symptoms. Captain Schroeder continued his descent through clouds and snow and finally broke into the clear over Canton, Ohio, about 200 miles from McCook Field.

He was forced to make a landing on rough ground, breaking off the tip of his propeller in the process. It was a good landing, considering that his hands and face were entirely numb and his lips and four of his fingers were frozen badly enough to require immediate medical attention.

On February 27th, 1920, Major Schroeder (who had been recently promoted in recognition of his high-altitude work) set a new world altitude record of 33,113 feet in the further-modified LePere, which by now was equipped with a Moss turbosupercharger built by General Electric. This historic flight took an hour and forty-seven minutes, logged an average speed of 119 miles per hour, and came close to costing Major Schroeder his life.

A Blind Landing

As he neared the top of his climb, Major Schroeder discovered that falling ambient pressure caused what is described in official records only as a "valve problem." The valve probably was the one on his oxygen regulator, since Major Schroeder later stated that he was losing consciousness.

Whatever the case, he raised his goggles in an attempt to see and deal with the problem, but the intensely cold blast of the slipstream instantly froze the moisture in his eyes. Now blind, and on the verge of passing out, Major Schroeder put the plane into what he thought was a steep spiral; it was actually a dive.

The fabric-covered LePere screamed earthward for six miles at speeds of up to 300 miles per hour. At an altitude of only about 2,000 feet, the crippled pilot managed to bring the plane back under control. Despite his impaired vision, Major Schroeder landed safely at Mc-

Cook Field with a new world's altitude record and a wealth of valuable new information on the winds, temperatures, and turbulence that one could expect to encounter near the stratosphere.

Following Major Schroeder's pioneering work, the torch was carried further by 1st Lt. J. A. Macready. Between early 1919 and 1921, intensive work went on at McCook Field developing a new propeller for the LePere. A propeller was needed that would not overload the engine in the "thick" air at low altitudes but would allow the engine to develop full turbocharged performance in the "thin" air at altitudes higher than 35,000 feet. (In those days, the variable-pitch propeller was just a gleam in an engineer's eye.) The final design was a large two-bladed propeller, which proved superior to earlier four-bladed designs.

By September 28, 1921, Lieutenant Macready and the modified aircraft were prepared. Lieutenant Macready described the day as being perfect for the flight. He suited up in his long woolen underwear, topped by an all-leather flying suit filled with down and feathers, coupled with similarly insulated boots. On his head he wore a helmet-like head "mask" made of leather and lined with fur. Attached to the head mask was a fitted oxygen mask, which, though not described in detail, does not appear to have contained any valving and was probably connected by a hose to a manually operated flow valve and regulator. The goggles were separate pieces of equipment; the insides of the lenses were coated with a "secret gelatin" which was supposed to prevent ice from forming on them.

The on-board oxygen system consisted of five flasks loaded at 2,300 pounds of pressure to supply the oxygen mask. There was an additional emergency flask, pressurized at 1,500 pounds. By ripping off a patch of tape on the side of the oxygen mask, Lieutenant Macready could, in the event of trouble with the main oxygen supply, push the hose from the emergency supply through the exposed hole and into his mouth.

Following takeoff, Lieutenant Macready flew in circles over McCook Field in order to be within gliding range of the airstrip. By the time he reached a record altitude of 36,750 feet, his circle was about seventy miles in diameter.

"Dim and Shaky"

Lieutenant Macready began using oxygen at an indicated altitude of 20,000 feet. He noted that he observed a significant "slowing up of the senses" starting at around 30,000 feet, and the effect steadily worsened as he flew higher. He also observed that any physical effort at these higher altitudes caused his vision to become "dim and shaky," and when this happened he increased the flow of oxygen.

Fortunately for the unknowing pilot, his slow ascent and use of 100 percent oxygen allowed his body time to rid itself of the normal nitrogen dissolved in his blood. As a result, he remained unaffected by the bends.

At an indicated altitude of 39,000 feet, Lieutenant Macready's breath froze in the oxygen mask tube. Fortunately, he was alert enough to notice the restriction in flow and immediately began an effort to clear the blockage, achieving only a slight taste of ice for all his trouble. He ripped the tape off his mask and inserted the emergency supply tube, opened the emergency valve, and felt immediate relief.

An hour after takeoff, Lieutenant Macready reached an indicated altitude slightly higher than 41,000 feet. On the basis of preflight engineering studies, he expected to be able to exceed this altitude by 7,000 to 8,000 feet, but he could not. Inasmuch as he was breathing pure oxygen at what was probably ambient pressure, it was fortunate for him that the aircraft could not struggle higher.

In modern systems, the regulators supply pure oxygen at positive pressure at these altitudes since, at that height, the partial pressure of water vapor in the lungs is the same as the partial pressure of oxygen. Without positive pressure oxygen, Lieutenant Macready would not have survived at a higher altitude.

As the biplane struggled along at maximum ceiling, Lieutenant Macready found it almost impossible to control the aircraft. Its aerodynamic surfaces had virtually lost control authority in the thin air. After about five minutes, he became convinced that the aircraft had topped out and reduced throttle to begin his descent. At that point, he later reported, "the bottom seemed to drop out of the plane and down it went quickly."

The aircraft was completely out of control. The speed of descent was so rapid that Lieutenant Macready was unable to adjust the engine and radiator to maintain cockpit heat. Because of this, his goggles iced over and, as his plane fell to earth, he became weak, groggy, and effectively blind in his struggle to regain control.

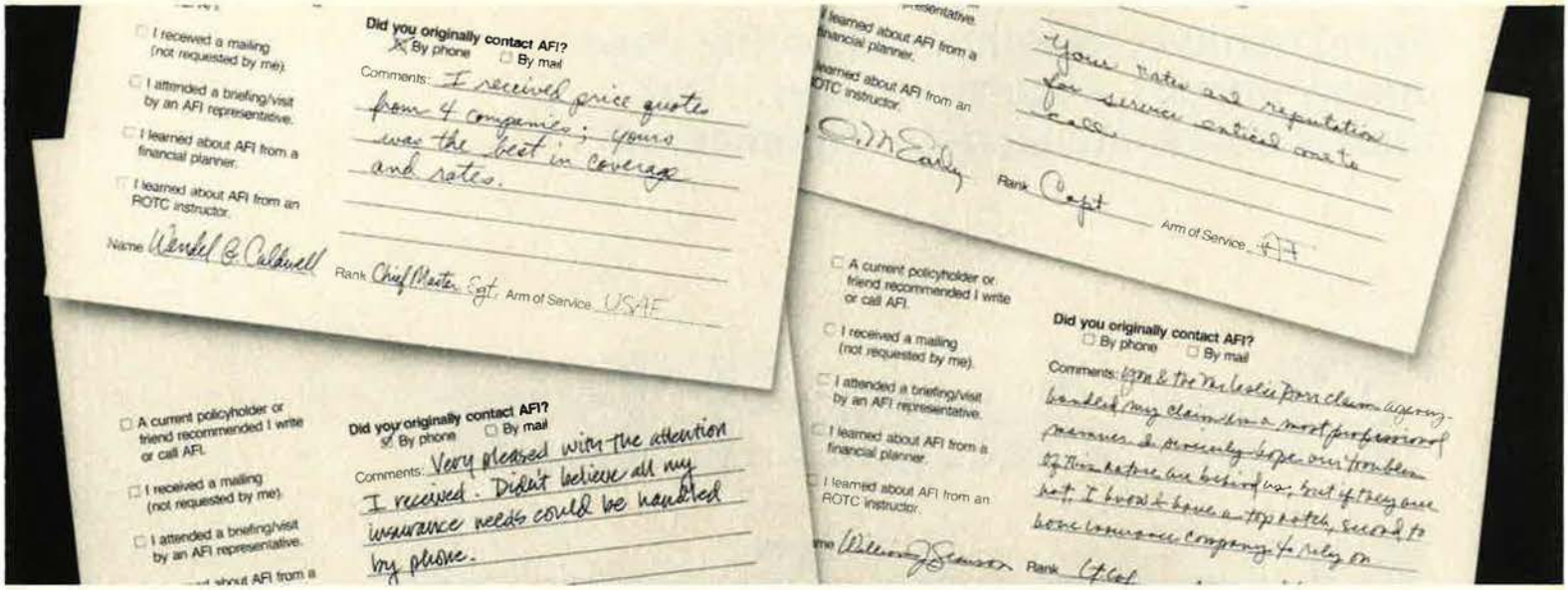
Lieutenant Macready knew that, if he could fall to thicker air, he could survive and regain control of the aircraft. He hung on grimly and finally got the LePere flying again at 30,000 feet. He then descended to 20,000 feet (where, he noted, he felt comfortable) and flew there for around twenty minutes to make certain everything was working properly. His return to McCook Field was routine.

Postflight analysis yielded various estimates regarding his record-setting altitude. Measured by the method used by the Fédération Aéronautique International (custodian of aviation records) in 1919, he had reached 39,730 feet. Calculated by the FAI method used in 1920, it was 34,563 feet. The probable (best estimate) altitude was 36,750 feet. In any case, Major Schroeder's record had been broken by a decisive margin.

In the course of his many research flights, Lieutenant Macready set three world altitude records, the highest officially logged at 38,704 feet. For this work he was awarded the McKay Trophy three times. He had set the stage for modern high-altitude flight in piston-engined, turbosupercharged aircraft.

Partial-pressure and full-pressure suits, cabin pressurization, and sophisticated oxygen regulators were more than ten years in the future at the time of Lieutenant Macready's flights. His heroic work, and that of Major Schroeder, laid the foundation for all that we now take for granted and paved the way for safe and reliable high-altitude flight. ■

Robert E. van Patten is an assistant clinical professor at Wright State University School of Medicine in Dayton, Ohio. He is a consultant in aerospace medicine, life sciences, information sciences, and accident reconstruction. This is his first article for AIR FORCE *Magazine.*



Call Us Toll-Free For A Quote On Homeowner

(insures dwelling, personal property and personal liability)

or Renter's Insurance.

(insures personal property and personal liability)

Then We Can Quote You, Too.

1-800-255-6792

There's a lot to be said for homeowner's or renter's insurance from AFI. Just ask our customers! You'll discover that our rates are very competitive, because we insure only military professionals whose loss experience on an individual basis is normally better than other companies' average insureds. When it comes to claims, AFI is responsive, with a fast settlement turnaround that has given us a 97% claims satisfaction rating.*

Coverage from AFI means custom coverage. We'll design coverage suited especially to your needs. For example, most policies contain dollar limits for firearms and silver, while ours provides unlimited coverage up to the unscheduled personal property amount of the policy (except in North Carolina).

Most of all, our customers will tell you we listen: Our staff of qualified professionals provides the kind of undivided, personal attention that means real service, not just lip service. And, it's all as easy as a phone call.

Just dial our toll-free number and ask us for a quote. Before long, you might be giving us one in return.

ELIGIBILITY—Officers senior NCO's (E-7, 8, 9) of all U.S. uniformed services; active duty, retired, regular, reserve or National Guard; also eligible are service academy and advanced ROTC cadets/midshipmen and former officers of all U.S. uniformed services.

*Based on a survey conducted by a leading independent rating organization.

Or fill out and mail

AFM-B

YES, I want to know more about:

- ☐ Homeowner package to insure dwelling, personal property, personal liability.
- ☐ Personal property /personal liability "Renter's" package.

Name Rank Pay Grade SSN

Address

City State Zip

ARMED FORCES® INSURANCE

FORT LEAVENWORTH, KS 66027-0346

Serving the Military Professional, Since 1887

Aerial gunners have been shooting down enemy aircraft since World War I, but their victories are seldom remembered.

The Aces That History Forgot

By Bruce D. Callander

AMONG the first American flyers to shoot down five planes was an enlisted aerial gunner, but don't look for his name on the list of Air Force aces.

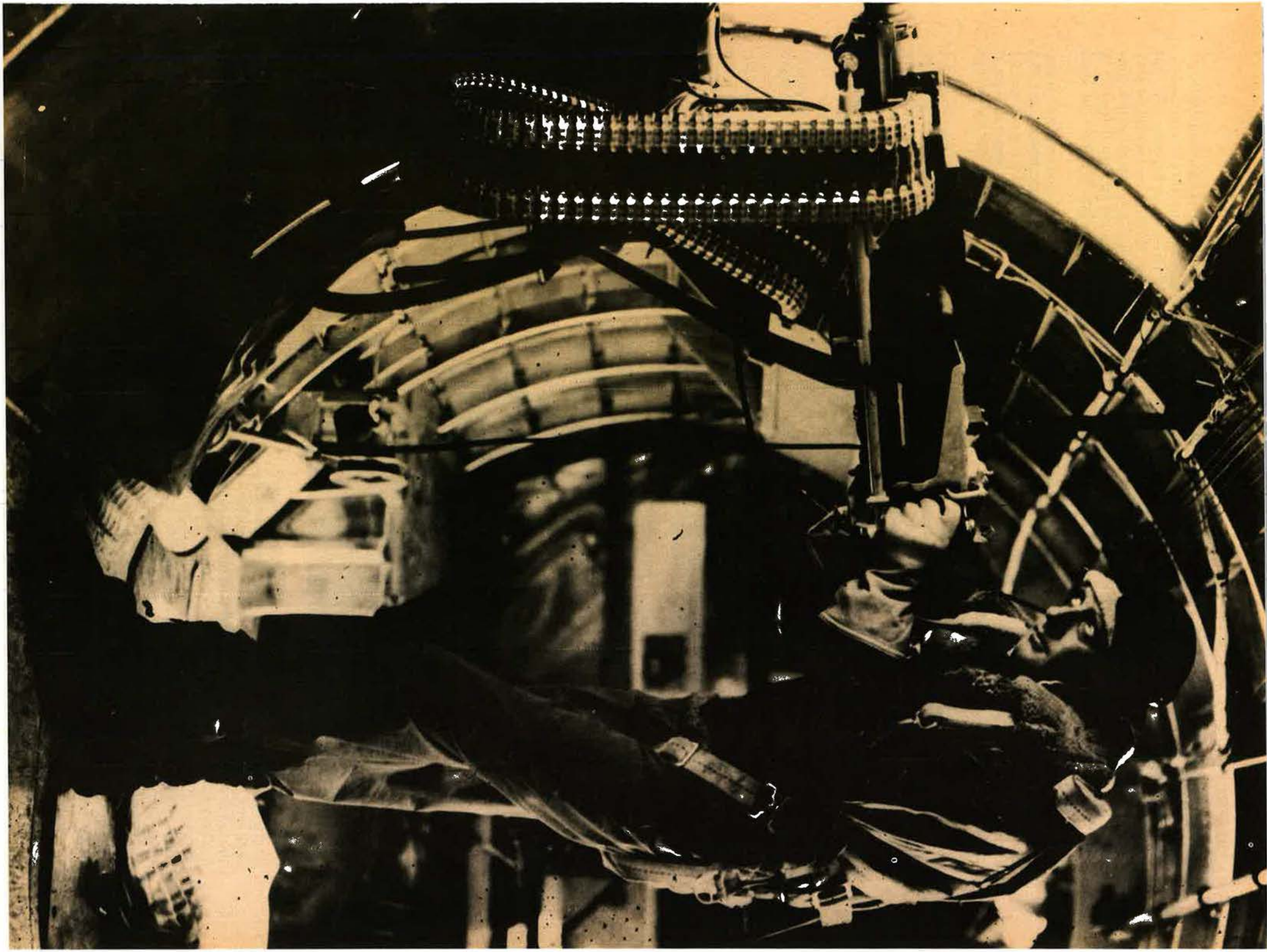
Early in World War I, while the US remained neutral, Frederick Libby of Colorado joined Canada's army and went to France. The Royal Flying Corps called for observer-gunners, and he volunteered. On his first combat patrol, Private Libby shot down one German warplane. Soon he shot down nine more. He became a pilot, earned a commission, and shot down fourteen more planes before the Armistice in November 1918. Among Americans, Libby's record of twenty-four victories trailed only Eddie Rickenbacker's, but they didn't count. Libby didn't fly with the US Air Service.

In general, gunners have been overlooked in assessments of aerial kills. In the last six months of World War I, more than seventy US flyers became aces. Many more were credited with scoring at least one victory. Gunners shared in some of these kills, but the public focused on pilots who did battle in single-seaters.

The public paid even less attention to observer-gunners, who were drawn from enlisted ranks when the US Air Service ran short of officer-observers. Several scored aerial victories. For example, Sgt. Albert Ocock and Sgt. Philip Smith of the 8th Observation Squadron each claimed a victory in the St.-Mihiel offensive.

Late in the war, several noncommissioned officers flew with bomber squadrons. S1C Fred Graveline logged fourteen missions with the 20th Bombardment Squadron and downed at least two planes. Cpl. Raymond Alexander of the 20th and S1C J. S. Trimble of the 96th Bombardment Squadron each claimed one.

Though enlisted aerial gunners in both world wars shot down enemy planes, most of the glory went to fighter pilots. Unlike fighters, bombers like the Boeing B-17 Flying Fortress (in which waist gunner SSgt. Don Blake, right, served in World War II) did not carry gun cameras to record the action.



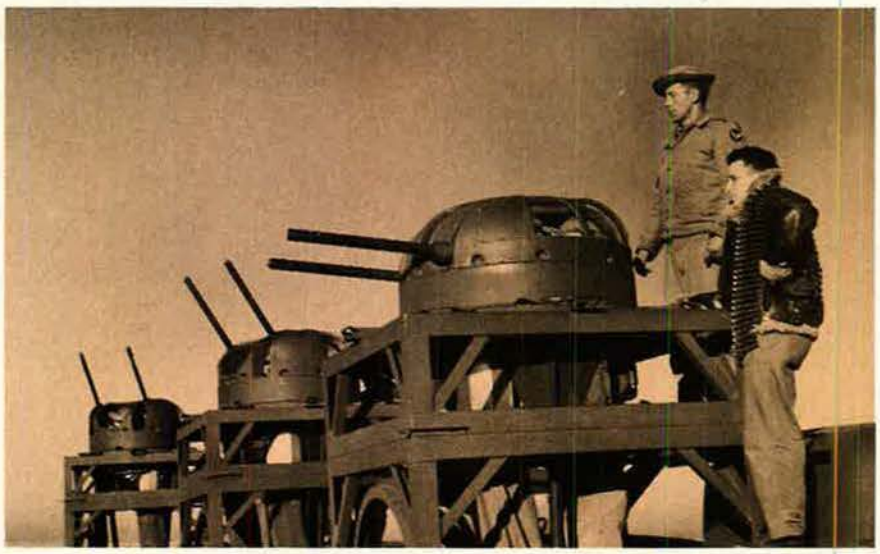
In the Argonne offensive, American flyers downed 357 German warplanes. Of this total, fifty-five were shot down by the gunners on US observation planes and thirty-nine by those on US bombers. Barely a month after Sergeant Graveline made his first flight, the war was over.

The Air Service's assessment of lessons learned in the Great War was sobering. One problem identified was the uncertain reliability of air weapons. Guns jammed, and fragile gunsights were knocked out of alignment. Explosive shells went off in gun barrels, and the tracers that were supposed to help gunners get their aim followed erratic trajectories. To hit anything, gunners had to be close enough to their targets to avoid wide dispersal of their rounds. About ninety percent of the planes shot down were hit at ranges of ten feet to 100 yards.

As early as 1912, Capt. Charles DeForest Chandler had experimented with a new low-recoil machine gun designed by Col. Isaac N. Lewis. Firing from a Wright B machine, he had scored some hits on a ground target. When excited reporters tried to pursue the story, however, an Army General Staff officer assured them that airplanes were designed for observation. There would be no aerial gun battles, he said.

Picking Up Tricks

For novice gunners, merely spotting another plane in the air was difficult, because most tended to focus on immediate surroundings. The gunner had to look at his wingtip until his eyes adjusted, and only then could he scan the skies for other objects. It was a trick familiar to sailors but new to flyers.



In the rush to get World War II crews into combat, enlisted crew members often received far better gunnery training than did officers. Turret gun training began with firing at outlines of enemy airplanes, as SSgt. John F. Buice prepares to do here, instructed by Sgt. Kenneth O'Brist.

The Americans picked up one trick from Maj. Raoul Lufbery, an American who had scored seventeen kills with the Lafayette Escadrille (but who also did not make the US ace list). When his formation was outnumbered, Lufbery would have his planes form a circle so the gunners could train their guns to the outside. Like circling the wagons in the Old West, this tactic directed maximum firepower against the attackers, something gunners would remember in the next war.

After the war, the Air Service had hundreds of obsolete Liberty-engined DH-4s and no funds for replacements. Officials modified the old crates as test-beds for new designs. By 1920, the Army was flying a twin-engine de Havilland with eight machine guns and a 37-mm cannon.

Even remodeled, the DH-4 was a hopeless relic, but by the early 1920s, Glenn Martin was working on a replacement, a twin-engine, five-gun bomber with a crew of four. The evolution continued through the series of Keystone bombers—open cockpit biplanes but good enough to last a decade.

In the early 1930s, Martin produced another winner, the all-metal B-10. The twin-engine monoplane carried a pilot, a radio operator, and two gunners. It had nose and tail turrets and a third gun in the floor. Faster than most fighters, it could fly at above 24,000 feet and had a range of more than 1,200 miles.

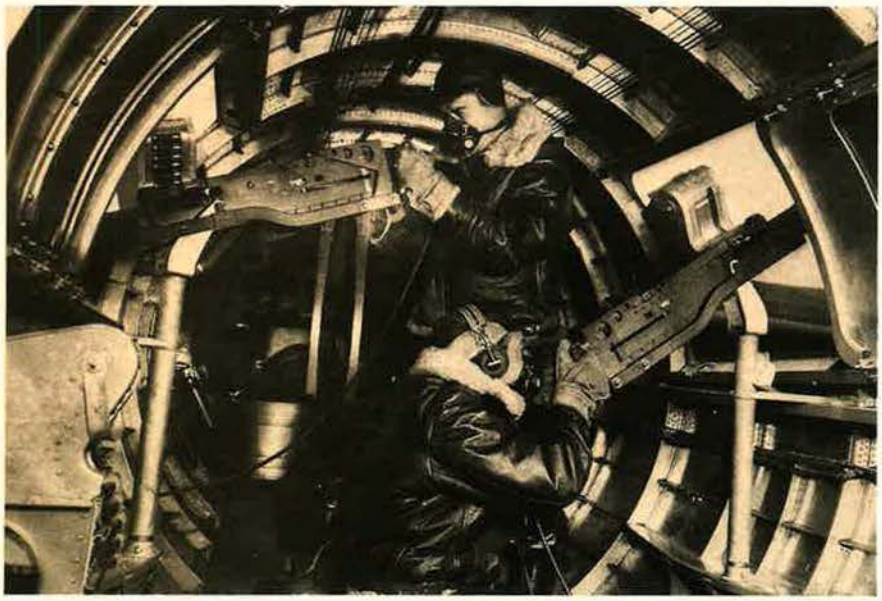
In 1934, while Lt. Col. H. H. Arnold was leading a flight of B-10s to Alaska, Boeing engineers began work on a four-engine plane to compete for a new bomber contract. Even before the Model 299 made its first flight, Boeing registered its trade name, "Flying Fortress." Early versions had only five guns, but succeeding models sprouted turrets in the nose, tail, belly, and upper fuselage and flexible guns in each waist window.

As the bombers grew, the makeup of crews changed. Well into the 1930s, the Air Corps had expected flyers to be generalists. In the 19th Bomb Group, for example, a copilot could not become a B-10 aircraft commander until he had qualified as a celestial navigator, bombardier, and expert gunner. After World War II erupted, however, US plants built bigger planes—calling for crews of up to eleven men—and built them by the thousands. There was no time to train every man to do every job.

No Time For Training

Some student bombardiers and navigators still were sent to gunnery school, but, in the rush to get crews into combat, many graduated without gunnery training. They were expected to learn to shoot during crew training, but there was little time for it there, either. Officers of the 464th Bomb Group, for example, spent one day on the gunnery range. Each shot one clip from his .45, a few rounds from a carbine, and a short burst from a truck-mounted turret.

Enlisted crew members received far better training. The typical gunnery course ran for six weeks and cov-



Between world wars, guns became easier to load and less likely to jam, but shooting remained a difficult task. Aircraft speed tripled, but machine guns' rate of fire remained about 800 rounds per minute. In one second, a gunner was able to get off only about a dozen rounds—often through open windows (below).

ered ballistics, turret operation, gun repair, and target recognition. Students fired flexible guns from North American AT-6s. Turret training was conducted in Lockheed AT-18s until actual bombers became available to the schools.

Gunnery technology had improved since World War I. Turrets had optical sighting devices that helped in calculating aiming data. The guns themselves became easier to load and less likely to jam. Rounds were less erratic.

Shooting remained a difficult task, more art than science. The speed of aircraft had tripled between wars, but the rate of fire for machine guns remained at about 800 rounds per minute. When a 450-mile-per-hour fighter attacked a 300-mile-per-hour bomber head on, the rate of closure was close to the speed of sound. In one second, the fighter's relative position changed by 1,100 feet while a gunner was able to get off only about a dozen rounds. A nose gunner barely had time to spot an attacking aircraft and fire before it was gone. Waist and tail gunners had more time to aim but still little time to track targets.

The solution was to put more guns on each plane and to use a defensive technique similar to the old Lufbery circle. Based on his plane's position in the formation, each gunner was assigned a specific, narrow area to cover. None had to move his guns more than a few degrees in any direction in order for the formation to confront an attacker with a daunting array of firepower.

Even against these odds, many enemy fighters took the risk, and many scored. More often, however, they looked for straggling bombers that had been crippled by flak or were suffering from mechanical problems. In this position, the lone airplane often could rely only on its own guns for protection. Many fell prey to the fighters, but a remarkable number survived their running gunfights to fly again.

Such gunfights became a staple for war movies of the day. In cinematic versions of the war, a lone plane battled swarms of fighters. The gunners, firing nonstop, swung wildly from one attacker to another. In the film "Air Force," the hero, played by John Garfield, even wrenched a gun from his downed bomber, cradled it in his arm, and from his position on the ground shot down a Zero.

Burning Up Gun Barrels

In real life, good shooting was a test of skill and self-discipline. The gunner had to concentrate on the target at hand, resist the temptation to shoot everything in sight, and, above all, use short bursts. Nonstop, Hollywood-style firing looked dramatic, but it produced enough heat to wilt a gun barrel.

When he was not shooting or being shot at, the gunner's prime concern was survival.

Missions lasted up to eight hours, with much of the flying taking place above 25,000 feet. Temperatures dropped as low as minus sixty degrees Fahrenheit in bombers that had no insulation and little heating outside the flight deck. Fleece-lined flight jackets were scant protection. The earliest electrically heated suits often shorted out and burned their occupants. Waist gunners worked through open windows, suffered frozen fingers, and slipped on the spent shells that piled up at their feet. Turret gunners had slightly more protection from the elements, but their cocoons allowed little room to move an aching arm or to stamp a cold foot.

In spite of all the hardships, US gunners gave a remarkable account of themselves. In Eighth Air Force, bombers claimed 6,259 enemy aircraft destroyed, 1,836 probables, and 3,210 damaged. On all counts, the record

topped that of the Eighth's fighter pilots. Other heavy, medium, and light bomber units showed similar records.

As in World War I, however, most of the glory went to the fighter pilots. The thousands of planes downed by bombers usually were counted as team, rather than individual, successes. The Air Force maintains that it is too hard to assign credit to individual gunners on missions where dozens of guns may have been blazing away at the same target. Spreading the credit among the gunners in formations of 100 to 1,000 bombers would have been a bookkeeping nightmare. Unlike fighters, bombers did not carry gun cameras to record the action.

Some units gave the gunners more recognition, and some of their stories have survived. In 1989, for example, the newsletter of the 99th Bomb Group Historical Society reprinted an old article from *Impact* Magazine titled "Our Only Enlisted Man to Become an Air Ace." The subject was SSgt. Benjamin Warmer, who joined the 99th as a B-17 waist gunner and flew during the invasion of Italy. The piece credits Sergeant Warmer with shooting down two planes on a mission to Naples and seven more during a strike against German airfields on Sicily.

Three More Candidates

Sergeant Warmer's story also is recounted in a 1986 book, *Aerial Gunners: The Unknown Aces of World War II*, by Charles Watry and Duane Hall. The book confirms Warmer's nine kills but challenges the claim that he was the only enlisted gunner ace in World War II. It names several others, including three noncommissioned officers who flew with the Army Air Forces.

Aerial Gunners reports that, in the China-Burma-India theater, TSgt. Arthur P. Benko may have downed nine planes and TSgt. George W. Gouldthrite five. Watry and Hall also credit SSgt. John P. Quinlan with five victories in Europe and three in the Pacific. Sergeant Quinlan was the tail gunner of *Memphis Belle*, the B-17 bomber that became the subject of a wartime documentary and a recent fictionalized movie. Neither Sergeant Quinlan's name nor those of the other three airmen appear on USAF's official list of aces.

Sergeant Quinlan's final missions were aboard a B-29, the World War II latecomer that was to set the stage for a new breed of bombers. The Superfortress dwarfed the earlier heavies. Its gunners controlled four turrets remotely from Plexiglas domes.

Some World War II hardware made an encore appearance in the Korean War, but the age of the traditional gunfighter was ending, and a new era of rockets and electronic aiming was beginning. When Northrop introduced the F-89 jet interceptor, it had a second seat, not for a gunner but for a radar operator. Early models had 20-mm nose guns, but these soon gave way to wing pods that held rockets. In later two-seaters, the man who aimed the weapons would become known as the GIB (guy in back) and the opportunity again was opened for a nonpilot to become an ace.

It didn't happen until 1972. In Vietnam, F-4 GIBs were called Weapon Systems Operators. As in World War I, both WSO and pilot received a full credit for each aerial kill. On August 28, 1972, Capt. Richard S. "Steve" Ritchie, a pilot, became the first Air Force ace of the Vietnam War and his WSO, Capt. Charles DeBellevue, earned his fourth victory. Captain DeBellevue later claimed two more kills to become Vietnam's top ace. That war's only other USAF ace was Capt. Jeffrey S. Feinstein, also a WSO. (Navy Lt. William Driscoll, a radar intercept officer, was also credited with five kills.)

Today's aircraft are packed with enough electronics to fill a video arcade. Weapons have minds of their own. Aerial gunners with strange titles track targets on TV screens and use computers to calculate firing data. One wonders if they trace their roots to the observer who nursed a Lewis gun on a limping DH-4 or to the gunner who froze his fingers at the waist of a B-24 Liberator. ■

Operation Desert Storm relied heavily on B-52 bombers (right) in attacking entrenched Iraqi Republican Guard units in Kuwait. The BUFFs' fire-control system operators, operational descendents of the world wars' aerial gunners, are among the last of an old breed.

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, *"Going: A Fifth of the Force," appeared in the February 1991 issue.*

AFA State Contacts

Following each state name are the names of the communities in which AFA chapters are located. Information regarding these chapters or any of AFA's activities within the state may be obtained from the appropriate contact.

ALABAMA (Birmingham, Gadsden, Huntsville, Mobile, Montgomery): **William M. Voigt,** 401 N. 20th St., Birmingham, AL 35203 (phone 205-254-2330).

ALASKA (Anchorage, Fairbanks): **Larry D. Willingham,** 20151 Lucas Ave., Eagle River, AK 99577 (phone 907-694-4034).

ARIZONA (Green Valley, Phoenix, Prescott, Sedona, Sierra Vista, Sun City, Tucson): **William A. Lafferty,** 1342 W. Placita Salubre, Green Valley, AZ 85614 (phone 602-625-9449).

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Hot Springs, Little Rock): **O. W. Lewis,** 717 E. Walnut St., Blytheville, AR 72315 (phone 501-763-8682).

CALIFORNIA (Apple Valley, Bakersfield, Camarillo, Edwards, Fairfield, Fresno, Los Angeles, Merced, Monterey, Novato, Orange County, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, Sunnyvale, Vandenberg AFB, Yuba City): **Arthur Trost,** 288 Lombardi Cir., Walnut Creek, CA 94598 (phone 415-934-2889).

COLORADO (Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Pueblo): **William D. Croom,** 31 N. Tejon, Colorado Springs, CO 80903 (phone 719-550-5059).

CONNECTICUT (Brookfield, East Hartford, Middletown, Storrs, Stratford, Torrington, Waterbury, Westport, Windsor Locks): **John T. McGrath,** 97 Morgan St., Middletown, CT 06457 (phone 203-344-4636).

DELAWARE (Dover, Milford, Newark, Rehoboth Beach, Wilmington): **Robert M. Berglund,** 128 W. Loockerman St., Dover, DE 19901 (phone 302-674-0200).

DISTRICT OF COLUMBIA (Washington, D. C.): **John J. Stirk,** 1501 Lee Highway, Arlington, VA 22209-1198 (phone 703-247-5820).

FLORIDA (Avon Park, Broward County, Cape Coral, Daytona Beach, Fort Walton Beach, Gainesville, Homestead, Jacksonville, Leesburg, Miami, New Port Richey, Ocala, Orlando, Palm Harbor, Panama City, Patrick AFB, Port Charlotte, Sarasota, Spring Hill, Sun City Center, Tallahassee, Tampa, Titusville, Vero Beach, West Palm Beach, Winter Haven): **Craig R. McKinley,** 735 Palmera Dr. E., Ponte Vedra Beach, FL 32082 (phone 904-741-7101).

GEORGIA (Athens, Atlanta, Columbus, Dobbins AFB, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Dan Callahan,** 100 Ridgecrest Pl., Warner Robins, GA 31088 (phone 912-929-1485).

GUAM (Agana): **Daniel A. Cox,** Box 7252, Tamuning, GU 96911 (phone 671-646-9255).

HAWAII (Honolulu, Maui): **Bob Noack,** P. O. Box 618E, Honolulu, HI 96818 (phone 808-422-2922).

IDAHO (Boise, Mountain Home, Twin Falls): **Ralph D. Townsend,** P. O. Box 45, Boise, ID 83707-0045 (phone 208-389-5226).

ILLINOIS (Belleville, Champaign, Chicago, Elmhurst, Moline, Peoria, Rockford, Springfield-Decatur): **Paul M. Cleary,** 911 Meadowlark, O'Fallon, IL 62269 (phone 618-632-6678).

INDIANA (Bloomington, Fort Wayne, Grissom AFB, Indianapolis, Lafayette, Marion, Mentone, South Bend, Terre Haute): **Harold F. Henneke,** 359 W. Edgewood Ave., Indianapolis, IN 46217 (phone 317-786-5865).

IOWA (Des Moines, Marion, Sioux City): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, IA 50701-5495 (phone 319-234-0339).

KANSAS (Garden City, Topeka, Wichita): **Samuel M. Gardner,** 1708 Prairie Park Ln., Garden City, KS 67846 (phone 316-275-4555).

KENTUCKY (Lexington, Louisville): **James R. Jenkins,** 3276 Carriage Ln., Lexington, KY 40517 (phone 606-278-6848).

LOUISIANA (Alexandria, Baton Rouge, New Orleans, Shreveport): **Doyle D. Blasingame,** 208 Wellington Dr., Bossier City, LA 71111 (phone 318-746-0252).

MAINE (Bangor, Loring AFB, North Berwick): **Richard F. Strelka,** 54 Country Rd., Caribou, ME 04736 (phone 207-492-4381).

MARYLAND (Andrews AFB area, Baltimore, College Park, Rockville): **Ronald E. Resh,** 416 Hungerford Dr., Suite 316, Rockville, MD 20850 (phone 301-294-8740).

MASSACHUSETTS (Bedford, Boston, East Longmeadow, Falmouth, Florence, Hanscom AFB, Taunton, Worcester): **David R. Cummock,** 174 South Blvd., West Springfield, MA 01089 (phone 413-737-5466).

MICHIGAN (Alpena, Battle Creek, Detroit, East Lansing, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **William L. Stone,** 7357 Lakewood Dr., Oscoda, MI 48750 (phone 517-739-3696).

MINNESOTA (Duluth, Minneapolis–St. Paul): **Doyle E. Larson,** 13509 York Ave. S., Burnsville, MN 55337 (phone 612-890-9140).

MISSISSIPPI (Biloxi, Columbus, Jackson): **Henry W. Boardman,** 10 Bayou Pl., Gulfport, MS 39503 (phone 601-896-8836).

MISSOURI (Richards-Gebaur AFB, Springfield, St. Louis, Whiteman AFB): **Charles E. McGee,** 5231 Lawn Ave., Kansas City, MO 64130-3152 (phone 816-861-5231).

MONTANA (Bozeman, Great Falls): **Jim Banks,** 7 Hill St., Bozeman, MT 59715-6029 (phone 406-587-7629).

NEBRASKA (Lincoln, Omaha): **Ralph Bradley,** 1221 N. 101st St., Omaha, NE 68114 (phone 402-392-1904).

NEVADA (Las Vegas, Reno): **Clarence E. Becker,** 5000 Lakeridge Dr., Reno, NV 89509 (phone 702-825-1458).

NEW HAMPSHIRE (Manchester, Pease AFB): **Frederic C. Armstrong,** 206 Woodland Rd., Hampton, NH 03842-1426 (phone 603-436-6909).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Old Bridge, Trenton, Wallington, West Orange, Whitehouse Station): **Dolores Vallone,** 143 Marne Rd., Hopatcong, NJ 07843 (phone 201-770-0829).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Robert H. Johnson,** P. O. Box 5081, Kirtland AFB, NM 87185 (phone 505-843-6230).

NEW YORK (Albany, Bethpage, Binghamton, Brooklyn, Buffalo, Chautauqua, Griffiss AFB, Hudson Valley, Nassau County, New York City, Niagara Falls, Plattsburgh, Rochester, Staten Island, Suffolk County, Syracuse, Westhampton Beach, White Plains): **Vincent J. Tampio,** 50 Main St., Silver Creek, NY 14136 (phone 716-631-6465).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Greenville, Havelock, Hickory, Kitty Hawk, Littleton, Raleigh, Wilmington): **Norman E. Davis,** P. O. Box 387, Wrightsville Beach, NC 28480 (phone 919-256-6036).

NORTH DAKOTA (Fargo, Grand Forks, Minot): **J. Michael Phillips,** 110 49th Ave. S., Grand Forks, ND 58201 (phone 701-795-3510).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Mansfield, Newark, Youngstown): **Fred F. Kubli, Jr.,** 823 Nancy St., Niles, OH 44446 (phone 216-544-7752).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **Kenneth W. Calhoun,** P. O. Box 300217, Midwest City, OK 73110 (phone 405-736-5642).

OREGON (Eugene, Klamath Falls, Portland): **John Lee,** P. O. Box 3759, Salem, OR 97302 (phone 503-581-3682).

PENNSYLVANIA (Allentown, Altoona, Beaver Falls, Bensalem, Coraopolis, Drexel Hill, Erie, Harrisburg, Homestead, Indiana, Johnstown, Lewistown, Philadelphia, Pittsburgh, Scranton, Shiremanstown, State College, Washington, Willow Grove, York): **Eugene Goldenberg,** 2345 Griffith St., Philadelphia, PA 19152-3311 (phone 215-332-4241).

PUERTO RICO (San Juan): **Vincent Aponte,** P. O. Box 8204, Santurce, PR 00910 (phone 809-764-8900).

RHODE ISLAND (Warwick): **John A. Powell,** 700 St. Paul's St., North Smithfield, RI 02895 (phone 401-766-3797).

SOUTH CAROLINA (Charleston, Clemson, Columbia, Myrtle Beach, Sumter): **Charles W. Myers,** 42 Palmer Dr., Sumter, SC 29150 (phone 803-775-7352).

SOUTH DAKOTA (Belle Fourche, Rapid City, Sioux Falls): **Robert Jamison,** 1506 S. Duluth Ave., Sioux Falls, SD 57105 (phone 605-339-7100).

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tullahoma): **Wayne L. Stephenson,** 12409 Valencia Point, Knoxville, TN 37922-2415 (phone 615-966-2569).

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 98044-4006 (phone 206-454-5548).

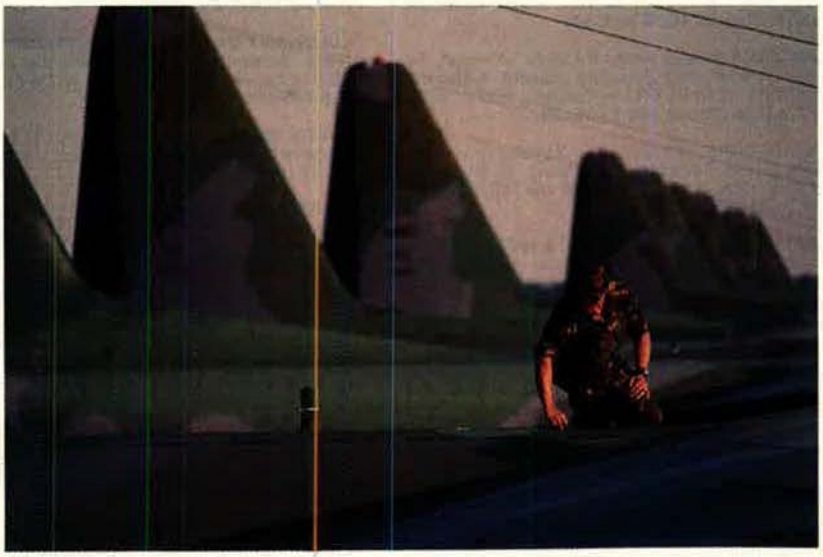
WISCONSIN (Madison, Milwaukee, Mitchell Field): **Gilbert M. Kwiatkowski,** 8260 W. Sheridan Ave., Milwaukee, WI 53218-3548 (phone 414-463-1849).

WYOMING (Cheyenne): **Irene G. Johnigan,** 503 Notre Dame Ct., Cheyenne, WY 82009 (phone 307-775-3641).

Despite high-tempo operations in Panama and the Gulf, the Air Force's mishap rate was one of the lowest on record.

The Safer Skies of 1990

By Amy D. Griswold, Editorial Assistant



—USAF photo by TSgt. Hans Deffner

SSgt. Roger L. Oberhelman, a crew chief with the 314th Organizational Maintenance Squadron, performs a preflight check on his C-130 Hercules. In the first days of Desert Shield, MAC crews flew more than 100,000 hours to support the operation.

THE Air Force had one of its safest years ever in Fiscal 1990, logging the fewest major flying accidents and the lowest rate of flying fatalities since it began keeping flight safety records in 1921.

Figures released late last year by Lt. Gen. Bradley C. Hosmer, the Air Force Inspector General, show that in the most recent twelve-month reporting period the service suffered fifty-one Class A flight mishaps while racking up a total of 3.46 million flying hours. That works out to a mishap rate of 1.49 for every 100,000 flying hours, equaling the lowest on record.

Forty-three persons died in the crashes. In relation to total Air Force flying hours, the figure sets a new record.

For the Air Force, Fiscal 1990—which ended last September 30—turned out to be a measurably safer year than either of the previous two twelve-month periods. In Fiscal 1988, for example, the service experienced a total of fifty-five Class A flight mishaps, resulting in forty-eight fatalities. The toll for Fiscal 1989 was fifty-seven mishaps and seventy-six deaths.

In Air Force parlance, a Class A mishap is an accident or incident that results in loss of life, permanent total disability, destruction of an aircraft, or more than $1 million in property damage.

The Air Force's 1990 safety record was all the more impressive because it was achieved as the service began participation in Operation Desert Shield, called by General Hosmer the "largest aerial deployment of military personnel and equipment in history." The operation began shortly after Iraq invaded Kuwait on August 2, 1990.

120,000 More Flying Hours

Largely as a consequence of Operation Desert Shield, total Air Force flying time in 1990 topped both the previous two years by a whopping 120,000 flying hours.

In the first twenty-eight days of that massive transport of men and equipment across the ocean, Military Airlift Command alone flew more than 2,000 missions, delivering to the Persian Gulf region more than 63,000 servicemen and -women and 81,000 tons of cargo. From August 7 through September 30, MAC crews flew more than 100,000 hours in support of Desert Shield.

In assessing the reasons for the improved safety performance, the Air Force Inspector General gave credit to the "professionalism and tireless dedication" of both ground crews and aircrews. Said General Hosmer, "As an aerospace leader, we fly the best aircraft in the world with the most dedicated aircrews."

He also cited the Air Force's creation of the proper environment by providing "technology, sufficient flying hours for aircrew training, and a solid logistics base," all of which "helped to make this year one of the safest in aviation history."

The safety statistics include the crash in Germany last August of a C-5A transport in which thirteen crew members died. It was bound for Saudi Arabia as part of Operation Desert Shield. Not included in these figures, however, were several other Desert Shield aircraft accidents and crashes that prompted a safety stand-down last October. Because they occurred after the close of Fiscal 1990, they will be included in the tally for Fiscal 1991. ■

We Believe...

—Photo ‹ Larry Chapman

We believe in Air Force people. As demonstrated again in the Gulf War, military power is not the result of modern weapons alone. It makes a big difference who's flying, fixing, and supporting them. We are proud of the men and women in all of the armed forces, but especially proud of those in the US Air Force, the service we know best.

They deserve our respect—and our support. They deserve our attention to their concerns, which range from health care to child care, and from government life insurance limits to the budget-driven uncertainties of a career in uniform. Pay and benefits, once comparable with those in the private sector, now lag far behind.

We believe that despite other preoccupations and problems, the nation can do better for military people and their families. We believe there should be special consideration and assistance for those forced out of service because of the projected military drawdown.

If you would like more information on these issues, write to us.

The Air Force Association
1501 Lee Highway
Arlington VA 22209-1198

Valor

By John L. Frisbee, Contributing Editor

"Milk Run"

Hard-pressed bomber crews of Eighth Air Force welcomed a rare milk run, but sometimes the milk turned sour.

FLYING out of England in World War II, Eighth Air Force was the largest air combat organization ever assembled. Between August 1942 and April 1945, the Eighth lost more than 4,000 heavy bombers to all causes. Air combat losses were about evenly divided between enemy fighters and flak. One measure of combat violence over Europe is the toll of human casualties. In thirty-three months, nearly 44,000 Eighth Air Force bomber and fighter crewmen were killed or missing in action, compared to some 33,000 battle deaths for *all* US forces in Korea and 47,000 in Vietnam.

Most of the Eighth's targets were guaranteed to be hot: Berlin, Schweinfurt, Merseburg, and Munich. Milk runs, on the other hand, were few and never guaranteed. The 44th Bomb Group's mission of January 21, 1944, looked like one of those few. Its target, military installations south of Calais, France, was only 120 miles from the group's base at Shipdham, a few miles west of Norwich. Enemy opposition was expected to be light. As a result of this benign forecast, Lt. Keith Cookus, who led twelve B-24 Liberators from the 67th and 506th Squadrons, had aboard his plane, *Liberty Belle,* three extra crewmen: the group bombardier and gunnery officers and command pilot Maj. William Anderson, who was on his twenty-fifth and final mission.

Lieutenant Cookus's formation, flying at the assigned bombing altitude of 12,000 feet, found heavy cloud cover over the target area. Regulations prohibited bombing any target in France under other than visual conditions. After five passes that failed to find a break in the clouds, the mission was aborted and the B-24s headed for home, still carrying their bombs.

A navigation error put the formation over Calais, where the Germans had covertly sited a concentration of mobile antiaircraft guns. Cookus's lead plane, an easy target at 12,000 feet, took seven direct hits when the guns opened up. One shell burst inside the bomb bay, ripping out the doors and the catwalk. Major Anderson, navigator Lt. Franklin Campbell, bombardier Lt. Woodrow Cole, and tail gunner SSgt. Herman Becker were wounded. The radio operator, who fortunately was wearing his chute, was blown out of the plane. Blazing hydraulic fluid badly burned the ball turret gunner and one of the waist gunners. Seeing a large section of the fuselage gone, the group bombardier and gunnery officers bailed out, to become POWs for the duration, along with the radio operator.

Surveying the damage, Lieutenant Cookus found that the numbers one and two engines had been destroyed, number three was on fire, and the right landing gear had been blown away. All communications and hydraulics were dead. Cookus put the bomber into a dive as soon as he regained control and headed west across the English Channel. The burning number three engine had to be kept running as long as possible, since Cookus would ditch with wounded aboard only as a last resort.

Over the Channel, bombardier Cole staggered onto the flight deck, covered with blood. Since the emergency bomb release mechanism was inoperative, he had crawled into the open bomb bay, where there now was no catwalk, and thrown out all the bombs he could release. He reported that some bombs were still hanging, then collapsed.

As *Liberty Belle* neared the English coast, barely able to hold altitude, the number three engine exploded, leaving only one prop turning—not enough to keep the torn-up bomber airborne. Over land near Canterbury in southern England, Lieutenant Cookus cut his one good engine, turned everything off, and prepared to crash-land. At fifty feet, in a final gallant maneuver that could have spelled the end for all of them, Cookus lifted one wing enough to clear a farmhouse. The bomber plowed into the ground, coming to rest in a ditch.

Fighting his way out of the wreckage, Cookus and other able members of the crew tried in vain to put out the fire in the number three engine. Copilot Lt. Howard Holladay stayed in the plane, which he knew could explode at any moment, struggling to free four crewmen trapped on the flight deck. Of the four, Major Anderson and Lieutenant Cole did not survive. Lieutenant Campbell and Sergeant Becker were extricated three hours after the crash.

The 44th Bomb Group mission of January 21, 1944, which began with the promise of a short, easy breather, ended, like so many others that penetrated the skies of Europe during World War II, in tragedy and heroism. There were indeed no guaranteed milk runs for the bomber crews of Eighth Air Force. ■

Does Your Life Insurance Pass Muster?

Thousands of AFA members like you have inspected AFA's Decreasing Term Life Insurance plan and found that it meets the need for comprehensive, low-cost insurance protection.

CHECK OUT THESE FEATURES:

- ✓ No war clause.
- ✓ Flexible coverage limits. Up to $200,000 — $300,000 — or $400,000 is available.
- ✓ Liberal age limits. Application may be made to age 65; coverage can be retained to age 80.
- ✓ Premium paying options. Monthly payments by allotment or by AFA Visa or MasterCard are offered, along with quarterly, semi-annual or annual direct billing.
- ✓ Waiver of premium. For a disability which begins while insured, prior to the 60th birthday, premiums are waived for the duration of the disability (up to age 80).
- ✓ Guaranteed conversion. At age 80, coverage may be converted to any permanent plan of insurance then being offered by the underwriter, regardless of health.
- ✓ Optional family coverage. Spouse coverage of up to $50,000 and children's coverage of $5,000 can be requested.

POST-INSPECTION GUARANTEE:

AFA's Decreasing Term Life Insurance Plan is considered by many to be the finest coverage available — and it's backed by this guarantee: within 60 days of the effective date of your coverage, you may return your certificate of insurance for a full refund of premium.

For further details on this outstanding program, just complete and return this coupon to Air Force Association.

PLEASE SEND ME COMPLETE INFORMATION ON AFA'S DECREASING TERM LIFE INSURANCE

Name _____

Address _____

City _____

State/Zip Code _____

Daytime Phone No. _____

__ I am __ am not an AFA member.

Mail to:
AFA, Insurance Division,
1501 Lee Highway
Arlington, VA 22209-1198

DTL 4/91

Reviews

By Jeffrey P. Rhodes, Aeronautics Editor

Benjamin O. Davis, Jr., American: An Autobiography, by Benjamin O. Davis, Jr. The author confronted two foes during his thirty-four-year military career—Axis fighter pilots and racial prejudice—and he overcame both. He believed then, as he does now, that he was an American first and that his success should be judged by character and deeds instead of race. His dedication led to his becoming the first African American to graduate from West Point this century, the first of his race to lead an AAF combat unit (the 99th Fighter Squadron and the 332d Fighter Group), and the first black general officer in the Air Force. This is the story of the uphill struggle he and his wife faced and the success they found in later life. Smithsonian Institution Press, Washington, D. C., 1991. 442 pages with photos and index. $19.95.

Fighters Over Israel: The Story of the Israeli Air Force from the War of Independence to the Bekaa Valley, by Lon Nordeen. Based on ten years of research, this account traces the evolution of the IAF from a collection of war-surplus airplanes (including Spitfires and Czech-built Bf-109s) to the premier fighting force it is today. Since 1947, the IAF has participated in five major wars, several smaller-scale conflicts, and hundreds of border skirmishes and confrontations with terrorists. The author interviewed the participants of such missions as the Entebbe rescue and the preemptive strike on the Iraqi nuclear plant. An in-depth treatment of the IAF such as this has been needed for some time. Orion Books, New York, N. Y., 1990. 226 pages with photos, maps, appendix, notes, and index. $21.95.

Flying Forts, by Martin Caidin; *Island in the Sky,* by Ernest K. Gann; *Pilot,* by Tony LeVier and John Guenther; *Barnstorming,* by Martin Caidin; and *The Electra Story: Aviation's Greatest Mystery,* by Robert J. Serling. These are the latest in the "Air and Space" series of classic aviation reprints. *Flying Forts* is the story of the B-17 and its crews. *Island in the Sky* tells of a downed crew's struggle for survival. *Pilot* is the autobiography of Tony LeVier, the famed Lockheed pilot. *Barnstorming* is the tale of daredevils who took flying to new limits. *The Electra Story* details the investigation of a series of perplexing crashes. Bantam Books, New York, N. Y., 1990 and 1991 Paperback, of varied lengths, with drawings and artwork. $4.95 each.

General Dynamics Aircraft and Their Predecessors, by John Wegg and *McDonnell Douglas Aircraft Since 1920: Volume II,* by René J. Francillon. The General Dynamics book is organized differently from the other volumes in the Putnam Aviation series. GD can trace its lineage to ten companies in four "families" (Consolidated, Vultee, Convair, and GD), and this book details more than 100 basic types and a large number of subtypes. The second book details the aircraft produced since McDonnell and Douglas merged. It also gives a complete history of Hughes Aircraft (acquired in 1984) and the company's space efforts. Naval Institute Press, Annapolis, Md., 1990. *General Dynamics:* 255 pages with photos, line drawings, and index. $42.95. *McDonnell Douglas:* 482 pages with photos, line drawings, and appendices. $44.95.

Images of War: The Artist's Vision of World War II, edited by Ken McCormick and Hamilton Darby Perry. With hourly updates from the war in the Persian Gulf, one might think the timing of this collection of words and images couldn't be worse, but the images of this book have more meaning than any television update ever could. This amazing collection of images encompasses work from artists of many nationalities and political persuasions. The editors have drawn from a huge pool of artwork to put together a handsome and haunting book representing all sides of the war and almost as many styles and schools of art—from an anonymous Japanese printmaker to American regionalist painter Thomas Hart Benton. This book is an important collection of work from World War II and an important statement about every war. Orion Books, New York, N. Y., 1990. 457 pages with indices. $65.00.

Those Wonderful Women In Their Flying Machines: The Unknown Heroines of World War II, by Sally Van Wagenen Keil. From 1942 to 1944, almost 2,000 women left their civilian lives and converged on Avenger Field in Sweetwater, Tex., to become pilots. After six months of training, these Women's Airforce Service Pilots (WASPs) went on to serve as test pilots, tow-target pilots, and ferry pilots and in other roles in every type of American military airplane. Initially regarded with skepticism or outright hostility, the WASPs eventually earned the respect of male pilots but received neither commissions nor military benefits. This reissue has been greatly revised and now includes the text of Jackie Cochran's 1944 AAF report on the WASP program. Four Directions Press, New York, N. Y., 1990. 418 pages with photos and index. $24.95.

Other Titles of Note

Aerospace Facts and Figures '90–91, compiled by the Economic Data Service of the Aerospace Industries Association. The thirty-eighth annual statistical abstract of the aerospace industry includes data through 1989 and estimates for 1990 and 1991. Historical data covering a number of areas are also included. Aerospace Industries Association of America, Washington, D. C., 1990. 176 pages with charts, graphs, glossary, and index. $20.00.

Forts and Fortresses, by Martin Brice. This interesting book traces the history of fortification from ancient Babylonian brick structures in 3500 B.C. to the Atlantic Wall erected by the Germans during World War II. Profusely illustrated, each chapter covers a specific historical period. Other key developments, such as the invention of gunpowder, are also included. Facts On File, Inc., New York, N. Y., 1990. 192 pages with photos, maps, diagrams, glossary, and index. $24.95.

Knights of the Air, by Peter King. This well-researched volume looks at the British aircraft industry through the careers of such engineers, designers, and pioneers as Geoffrey de Havilland, Henry Royce, and Sir Frank Whittle. Topics range from wooden biplanes to the Comet jet airliner. University of Iowa Press, Iowa City, Iowa, 1990. 544 pages with photos, notes, bibliography, and index. $29.95.

The Norton Book of Modern War, edited by Paul Fussell. This anthology draws a vivid picture of war as seen by the famous (Ernest Hemingway, e. e. cummings) and the not-so-famous (Cpl. William Preston). Through the four sections (World Wars I and II, Spanish Civil War, and Wars in Asia), the tone of the writings changes from idealism to determination to bitterness. W. W. Norton & Co., New York, N. Y., 1991. 830 pages with index. $24.95.

OTHER MEDIA—Continuing a tradition dating back to World War I, the baseball card company Topps, Inc., has released Operation Desert Storm trading cards. The cards feature such participants as Gens. Colin Powell and Norman Schwarzkopf (but not Saddam Hussein), as well as such equipment as the M1 tank and the F-117. There are a number of egregious factual errors in the descriptions on the card backs but the information on the eighty-eight cards and twenty-two stickers is basically accurate. These are sure to be collector's items. Topps, Inc., New York, N. Y., 1991. $.50 per package of eight cards and a sticker (but no gum). Mint sets are not available from the company. ■

Thirty-Second Annual Outstanding Squadron Dinner

May 25, 1991 • The Broadmoor • Colorado Springs, Colorado

Thursday May 23
Golf Tournament and Reception

Friday May 24
Air Force Acquisition Update

Saturday May 25
Outstanding Squadron Dinner

AFA's 32d Annual Outstanding Squadron Dinner will be held at The Broadmoor on Saturday, May 25. The dinner is in honor of cadets of the United States Air Force Academy for the 1990-1991 school year. The featured speaker is a returning academy graduate from the Class of 1960, Gen. Ronald W. Yates, commander of Air Force Systems Command. For more information, call Dottie Flanagan at (703) 247-5805.

Golf Tournament

The golf tournament will be held Thursday, May 23, 1991, at 12:00 noon on The Broadmoor West Course. The price is $100 per person. This includes golf, green fees, golf cart, and reception. For more information, call Dottie Flanagan at (703) 247-5805. The fee is $30 for the reception only.

Air Force Acquisition Update

This year, for the first time, in conjunction with AFA's Outstanding Squadron Dinner, the Lance P. Sijan Chapter is proud to offer an Air Force Acquisition Update for industry executives and government employees.

Featured will be The Hon. John J. Welch, Jr., Assistant Secretary of the Air Force for Acquisition. Confirmed speakers include Gen. Donald J. Kutyna, Commander in Chief of NORAD and Commander in Chief of US Space Command; Gen. Ronald W. Yates, Commander of Air Force Systems Command; Lt. Gen. Thomas S. Moorman, Jr., Commander of Air Force Space Command; Lt. Gen. Donald L. Cromer, Commander of Space Systems Division, AFSC; Maj. Gen. Joseph W. Ralston, Director, Tactical Programs, SAF/AQ; Maj. Gen. Garry A. Schnelzer, PEO, Space Systems; Brig. Gen. Kenneth R. Israel, PEO, C³ Programs; and Brig. Gen. James A. Fain, Program Director, ATF, Aeronautical Systems Division, AFSC.

The 1991 Air Force Acquisition Update will be held on Friday May 24, at Peterson Air Force Base, Colo., and will require a Department of Defense SECRET (NOFORN) clearance. The local AFA chapter has made arrangements to certify the Need-To-Know requirements in accordance with DoD 5220.22-M. The cost for the symposium is $195 for AFA individual or Industrial Associate members ($220 for nonmembers) and $75 for US military/government employees. The registration fee includes coffee and donuts, lunch, and a reception in honor of the speakers following the symposium. Additional individual reception tickets are $30 (spouses and individuals not registered for the Acquisition Update). For more information, contact Andrea Schmever at (719) 570-6200, fax: (719) 570-6202.

Registration Form

Please mail this form to:

ATTN: D. Flanagan
Air Force Association
1501 Lee Highway
Arlington, VA
22209-1198
or call (703) 247-5805

(please type or print)

AFA's 32d Annual
Outstanding Squadron Dinner
Saturday, May 25, 1991

Advance registration closes Friday, May 17

Refunds must be requested in writing and postmarked no later than Wednesday, May 15.

_____ My check for $80, payable to the Air Force Association, covering the Outstanding Squadron Dinner, is enclosed.

_____ Enclosed is $30 for a guest Golf Reception ticket.

_____ Send information on the Acquisition Update and Reception.

Name _____ Title _____ Affiliation _____

Address _____ City _____

State _____ Zip _____ Telephone ( ) _____

AFA/AEF Report

By Daniel M. Sheehan, Assistant Managing Editor

Florida Functions

There was no shortage of AFA activity in all parts of the Sunshine State this winter. The **Central Florida Chapter** held its seventh annual Tactical Air Forces Gala in conjunction with the Tactical Air Warfare Symposium in Orlando. This year's event raised $25,000 for AFA's Aerospace Education Foundation. Thirty-five aerospace corporations were on hand to demonstrate the capabilities of their products. The AT&T exhibit received lots of attention because it featured an open fax line to Saudi Arabia for guests to send messages to the troops of Operation Desert Storm.

Organizers of the gala praised Desert Shield and the effort provided to undertake that mammoth deployment, predecessor to Desert Storm. The following participants received Jimmy Doolittle and Ira Eaker Fellowships for their part in the operation: Tactical Airlift and Fighter Operations; Strategic Airlift, Tanker, and Bomber Operations; Operational Planning; Reserve Component Operations; Medical and Combat Support; Family Support; and Communications. The Central Florida Chapter also honored Gen. Robert D. Russ, commander of Tactical Air Command, with a Barry Goldwater Fellowship and paid tribute to the late Herbert M. "Bud" West, longtime AFA national director, presenting a Jimmy Doolittle Fellowship in his memory.

AEF President Gerald V. Hasler (right) accepts a $25,000 donation from Central Florida Chapter President Thomas Churan (center) and the Tactical Air Forces Gala chairman, former AFA National President and Board Chairman Martin H. Harris. The gala paid tribute to Operation Desert Shield, predecessor to Desert Storm.

Gus Grissom (Ind.) Chapter President B. C. "Buck" Hudgens (left) and Indiana Vice President for Aerospace Education James J. Wagner pose with Maj. Gen. Jay W. Kelley, vice commander of Air Force Space Command, after the General's speech on the role of AFSPACECOM in Desert Shield. A record number of people attended the meeting, including members of the Young Astronauts program and representatives from Purdue University's AFROTC detachment.

Florida's panhandle did not lack for AFA activity, either. The **Eglin (Fla.) Chapter** gathered to hear a speech from Col. Glenn H. Vogel, vice commander of the Air Force Development Test Center at nearby Eglin AFB. Colonel Vogel's speech provided a good look at how the center, which shepherds the Air Force systems of the future through their initial stages, does business. Chapter President Robert Patterson thanked the Colonel on behalf of the chapter. At a later meeting, the chapter presented an Exceptional Service Award to Maj. Gen. Walter B. "Bennie" Putnam, USAF (Ret.), for being the leading force in establishing the Eglin Chapter Scholarship

AFA's Nation's Capital Chapter held a dinner meeting at Bolling AFB, D. C., to introduce USAF Chief of Staff Gen. Merrill McPeak (left). Secretary of the Air Force Donald Rice (center) was on hand, and Lt. Col. William McKelvey (right) of the Civil Air Patrol spoke on CAP's counternarcotics programs. Colonel McKelvey accepted an AFA donation for construction of a new hangar at Andrews AFB, Md., for CAP's Congressional Squadron. Andrews is donating ramp space and building space for the hangar.

Foundation. The foundation annually awards scholarships to one outstanding AFJROTC cadet from each of four area high schools. It raises money through its annual Golf Extravaganza (held since 1974) and recently topped the $100,000 mark.

Lee Terrell, state vice president for Northwest Florida, attended both meetings. He also hosted former National President and Chairman of the Board and current National Director Judge John Brosky and his wife, Rose, on a recent visit to the panhandle. They visited the Bob Hope Village, which is chartered to provide "a secure, serene, and happy home for the widows of enlisted persons," to see the progress made since their visit there for the ground-breaking in 1982. The village is a favorite charity of the Eglin Chapter.

Further south on Florida's Gulf coast, the **Jerry Waterman (Fla.) Chapter** in Tampa hosted Lt. Gen. Robert L. Rutherford, USAF's deputy chief of staff for Productivity and Programs. The audience enjoyed the General's speech on the Advanced Tactical Fighter. He emphasized the importance of making the right decisions, pointing out that prospective pilots of an operational ATF are grade school children today. Among the many dignitaries who heard the General's speech were Lt. Gen. Craven C. Rogers, deputy chief of staff for US Central Command (who has since retired); Maj. Gen. Donald Snyder, deputy commander in chief of US Special Operations Command; Brig. Gen. Ed Byra, also of Special Operations Command; Maj. Gen. Ernest Bedke, USAF (Ret.); Maj. Gen. John Paulk, USAF (Ret.); and Maj. Gen. John Eubank, USAF (Ret.).

In other news, the Waterman Chapter, evincing its commitment to AFROTC, lent strong support to the Arnold Air Society's Area VIII Conclave held in nearby Clearwater Beach. The chapter also recently added Cellular One to its list of Community Partners, which Chapter President Ronald Hoelzer hopes will aid the membership in communications matters.

Yankee Ingenuity, Southern Hospitality

In an innovative move, Connecticut State AFA cemented its relationship with the Ramada Inn of Meriden by sponsoring it for a Community Partnership. Past State President Al Hudson called the sponsorship "a meaningful way to express our thanks for business support of the AFA program" by the hotel, which has been the site of state executive board meetings and, last year, the state convention.

In Virginia, the **Danville (Va.) Chapter** reached out to the spouses and dependents of area residents deployed to Saudi Arabia. Chapter members set up a videotaping session at the local mall, and twelve families took the opportunity to make tapes for loved ones serving in Operation Desert Storm. Numerous sponsors donated tapes, and the chapter gave each family a letter expressing the chapter's support and appreciation for the men and women serving their country so far from home.

Correction

In the obituary for former editor Jack Loosbrock, which appeared in the March issue, his wife's earlier name, Renée Amrine, and the names of his surviving stepsons, Neil, Douglas, and Eric Amrine, were misspelled. 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. ■

Coming Events

April 20, **Massachusetts State Convention,** Hanscom AFB, Mass.; May 10–11, **Maryland State Convention,** Andrews AFB, Md.; May 10–12, **North Dakota State Convention,** Minot, N. D.; May 17–18, **Alaska State Convention,** Anchorage, Alaska; May 17–18, **South Carolina State Convention,** Myrtle Beach, S. C.; May 31–June 2, **Alabama State Convention,** Mobile, Ala.; May 31–June 2, **New York State Convention,** Niagara Falls, N. Y.; May 31–June 2, **South Dakota State Convention,** Rapid City, S. D.; 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.; August 2–3, **Minnesota State Convention,** Hinckley, Minn.; August 3, **Indiana State Convention,** Bloomington, Ind.; 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 16–19, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.

Bulletin Board

For research on service personnel who volunteered to build **orphanages during the Korean War,** I would like to hear from anyone with knowledge of these efforts. I am especially interested in hearing from members of the 6147th Tactical Control Group in Chunchon, South Korea. **Contact:** R. B. Hutchison, 3900 N. Lake Shore Dr., Apt. 7G, Chicago, IL 60613.

Seeking information on and photos of **2d Lt. Ivan D. Canfield,** who was killed in action August 1, 1943, when his aircraft, the B-24D *Jose Carioca* of the 409th Bomb Squadron, 93d Bomb Group, crashed in the middle of Ploesti, Romania, during a bombing mission. **Contact:** Jose Gonzales, 214 N. Josephine Tobin Dr., San Antonio, TX 78201.

Seeking original color slides or photos of an **F-4D Phantom II,** serial number 65-0629. Also seeking contact with anyone who has worked on or flown this Phantom, especially in southeast Asia. **Contact:** Christopher J. Carney, 4484 S. Kinnickinnic Ave., Cudahy, WI 53110.

Seeking the whereabouts of **Col. Gordon "All American" Mulvey, Col. A. J. Mills, Col. Banta M. York,** and anyone else from Class 42-25 of the Las Vegas Gunnery School who remembers having Ronald Reagan and Burgess Meredith as graduation speakers. **Contact:** SMSgt. Ernest P. Morgan, USAF (Ret.), 1678 Fieldgreen Overlook, Stone Mountain, GA 30088.

Seeking information on the current whereabouts of **Wendy Edwards,** from Bawburgh, Norfolk, England, whose husband and son were killed in a car accident shortly after her husband returned from Vietnam. In the 1970s she married a USAF serviceman and returned to the US. **Contact:** Lesley (Eke) Read, 31 Larch Close, Sprowston, Norwich, Norfolk NR7 8LE, England.

For a book about military flight inspection, or **"flight check,"** seeking personal experiences, photographs, and other artifacts from present and former flight checkers. **Contact:** Mark Cato, 2810 Thousand Oaks, Suite 185, San Antonio, TX 78232.

Seeking information on a **42d Bomb Group Association. Contact:** Herbert Dykstra, 2150 N. Tenaya Way, #2117, Las Vegas, NV 89128.

Seeking photos and history of B-52 #054, ***Miss Magnolia,*** of the 454th Bomb Wing at Columbus AFB, Miss., in the 1960s. Also seeking photos and history of the Boeing B-17 Flying Fortress ***Spirit of Columbus, Mississippi.*** **Contact:** Sherry Medders, Public Affairs Office, Columbus AFB, MS 39701-5000.

Seeking World War II USAAF **A-2 flight jackets** and other aviation-related items for displays at reunions and air shows. **Contact:** John S. Reid III, 4797 Rebel Trail NW, Atlanta, GA 30327.

Seeking information on the whereabouts of **Leo M. Deschand,** a flight instructor at Webb AFB, Tex., in 1952. He flew P-47s in the south Pacific during World War II and was called back to active duty at the start of the Korean War. **Contact:** Jack Gilliland, 1232 Redwood Ln., Gulf Breeze, FL 32561.

Seeking **autographs** of aviation notables for my collection, especially Glenn Curtiss, Billy Mitchell, and Katherine Stinson. **Contact:** Tom Shane, 6109 Bridlington, Austin, TX 78745.

Seeking information, photos, and contact with people who were involved with **psychological warfare operations** from FEAF B-29s and B-26s during the Korean War. **Contact:** Steve Pease, P. O. Box 16854, Colorado Springs, CO 80935.

Seeking contact with people who knew **Harry W. Getting, Jr.,** a B-17 pilot in the 15th Air Force in Europe during World War II. **Contact:** Rose E. Getting, 2750 East Bay Dr., Apt. #4D, Largo, FL 34641.

Seeking contact with members of the **400th Bomb Squadron,** 90th Bomb Wing, stationed at Townsville, Australia, in World War II. I would especially like to contact relatives of **2d Lt. Dewey G. Hooper. Contact:** Ron Deering, 10851 Scarsdale Blvd., Suite 150, Houston, TX 77089.

Seeking contact with personnel of all grades who were at **Kelly Field,** Tex., or **Duncan Field** between 1935 and the beginning of World War II. **Contact:** CMSgt. R. W. Dyer, USAF (Ret.), 718 Windrock Dr., San Antonio, TX 78239.

Seeking contact with other **patch collectors** in order to trade Canadian Forces and USAF patches. Especially interested in William Tell and Gunsmoke patches. **Contact:** Ken A. McLaren, #304, 1171 Ambleside Dr., Ottawa, Ontario K2B 8E1, Canada.

Seeking contact with pilots of the **3d and 7th Ferry Groups** and any ground personnel who worked on the Alaska-Siberia route. **Contact:** James Barnett, 8544 Krull Parkway, Niagara Falls, NY 14304.

Collector seeks the following **Air Force patches:** 47th Bomb Wing; 84th, 85th, and 86th Bomb Squadrons; and 47th A&E Squadron. **Contact:** MSgt. Guy K. Moore, USAF (Ret.), 104 N. Crescent Dr., Blytheville, AR 72315.

Seeking the whereabouts of **2d Lt. Mark L. McDermott** and **SSgt. Sebastian L. Vogel** of the 303d Bomb Group, who were shot down January 23, 1943. **Contact:** Ernest T. "Mo" Moriarty, W. 105 Warwick Rc., Orange, MA 01364.

Seeking contac: with officers and NCOs of the **317th Fighter Interceptor Squadron** at McChord AFB, Wash., from 1953 through 1957. **Contact:** Dud Mahler, 6001 Fenwood Ave., Woodland Hills, CA 91367.

Seeking the whereabouts of the following members of the **35th Fighter Control Group,** who served in Fiji and Guadalcanal during World War II: Walter B. Smith, Henry Dow Goggins, Donald R. Messler, Emil Bernardes, Clayton Anderson, and Robert R. Adkins. **Contact:** Joseph Perlman, 1600 Garrett Rd., Apt. E-21, Upper Darby, PA 19082.

Seeking contact with members of the **389th Bomb Squadron,** 312th Bomb Group, who served in the Pacific theater during World War II. **Contact:** Stanley Zaborowski, 293 Woods Edge Pl., Langhorne, PA 19047.

Seeking information on **Irving "Pop" (or "Pappy") Fenster,** who was a B-26 crew chief in 1940–44 with the 19th Bomb Squadron, 22d Bomb Group, at Langley AFB, Va., and in California, Hawaii, Australia, and New Guinea. **Contact:** John Hamilton, 10548 Rivulet Row, Columbia, MD 21044.

Seeking information on **abandoned missile silos** near Walker AFB, N. M. **Contact:** Cadet Gersten, T. F., NMMI #900, Roswell, NM 88201.

Seeking photos, information, and contact with crew members involved with the **Lockheed RB-69 program.** I am especially interested in the seven aircraft involved, units they served with, and the dates they served with USAF before being returned to the Navy. **Contact:** Steve Tobey, 2604 Echo Point Dr., Fort Worth, TX 76123.

Seeking information on **2d Lt. Stanley E. Fish,** of the 359th Fighter Group, 8th Air Force, who was killed in action on April 8, 1944, while returning to his base at East Wretham, Norfolk, England. His picture in the group's history bears the name Stanley F. Stegnerski. **Contact:** Don Goodenow, 3128 Sunnybrook Dr., Charlotte, NC 28210.

Seeking information on and photos showing the use of the **small straight aircraft marking** of the early 1950s, which is similar to the airman's straight rank stripes. **Contact:** Ben K. Weed, P. O. Box 4643, Stockton, CA 95204.

Seeking contact with people who were involved with P-38s either through Lockheed or with the armed forces and who are interested in joining the **P-38 National Association. Contact:** Seymour V. Prell, P. O. Box 1816, Burbank, CA 91507.

Seeking information on the whereabouts of **Robbins King,** a B-17 pilot with the 774th Bomb Squadron, 463d Bomb Group, in Italy in 1944–45, and other members of his crew. **Contact:** Lt. Col. Berkeley S. Boyd, USAF (Ret.), Box 37 LOW, Locust Grove, VA 22508.

Seeking information on the whereabouts of **Lennon (or Winston) Harris,** a 3d Sergeant who was a close friend of Paula Hamilton-Marshall while based at RAF South Ruislip, Middlesex, England, in 1961. He was a member of a jazz band that used to play at Ronnie Scotts in London. **Contact:** Elizabeth Milton, 91 Glanville Rd., Brixton Hill, London SW2 5DE, England.

Seeking contact with **military widows** who are interested in joining the Society of Military Widows. **Contact:** Edmee J. Hills, 3657 E. South Laredo St., Aurora, CO 80013.

Seeking photos of the following aircraft: ***Wedding Belle, Red Ass,*** and ***Classy Chassis.*** **Contact:** Art Collier, 27 Mill River Rd., Upper Brookville, NY 11771.

Seeking contact with anyone involved in the B-26 bombing of the town of **Pont-Saint-Martin,** Italy, on August 23, 1944. **Contact:** Paolo Momigliano, Via Xavier de Maistre, 22, 11100 Aoste I, Italy.

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 included. Photographs cannot be used or returned.—THE EDITORS

Seeking the whereabouts of **Lieutenant Clevarious** who was the commander of Squadron A at Bradley Field, Conn., in 1944–45. **Contact:** Helen Snyder, 1463 Blvd., West Hartford, CT 06119.

Seeking information on the whereabouts of **Col. Clyde W. Armstrong,** who served with the 6152d Air Base Squadron at K-47 in Korea in the early 1950s and whose last known address was at the Air Force Academy in 1968. **Contact:** Donald W. Cook, Rte. 6, Box 99Y, Murphy, NC 28906.

Seeking contact with **Norman Feaney** or anyone who knew him while he was stationed in Shrewsbury, England, with the USAAF during World War II. **Contact:** R. B. Hinton, P. O. Box 10, Ammanford, Dyfed SA18 3WA, United Kingdom.

Seeking contact with or information on the crew of a B-17 of the **397th Bomb Squadron,** 96th Bomb Group, that went down over Belgium on May 1, 1944. **Contact:** Charles L. Gerard, Belgian Air Force Attaché, 3330 Garfield St., NW, Washington, DC 20008.

Seeking information on the whereabouts of crew members of a B-24 of the **826th Bomb Squadron,** 484th Bomb Group, 15th Air Force, piloted by Capt. Rodney T. Stewart. **Contact:** Lt. Col. Rodney T. Stewart, USAF (Ret.), 1972 Los Feliz Dr., Thousand Oaks, CA 91362-3010.

Seeking air and ground crew veterans associated with a **B-25 nicknamed *Werewolf,*** which was based in New Guinea in 1942–45. **Contact:** J. B. Walker, 888 Woodhill Rd., Dayton, OH 45431.

Seeking contact with veterans of the **406th and 788th Bomb Squadrons,** 801st and 492d Bomb Groups, 8th Air Force, who were stationed at RAF Harrington, RAF Alconbury, or RAF Watton in 1943–45. **Contact:** Igor P. "Pete" Petrenko, P. O. Box 1613, Springfield, VA 22151.

Unit Reunions

Aeromedical Evacuation
USAF Aeromedical Evacuation personnel will hold a reunion June 19–23, 1991, at the Embassy Suites Hotel in Colorado Springs, Colo. **Contact:** Charles W. Ritter, Rte. 7, Box 968, Lufkin, TX 75901. Phone: (409) 639-5917.

Air Force Postal Couriers
Personnel who served in Air Force Postal Courier organizations will hold a reunion September 20–21, 1991, in Colorado Springs, Colo. **Contact:** Maj. Jim Foshee, USAF (Ret.), 3509 Deer Trail, Temple, TX 76504. Phone: (817) 774-7303.

BAD 2
BAD (Base Air Depot) 2 veterans who served in Warton, England, during World War II will hold a reunion September 19–21, 1991, in Dayton, Ohio. **Contact:** Ralph G. Scott, 228 W. Roosevelt Ave., New Castle, DE 19720.

Bradley Field
Veterans who served at Bradley Field, Conn., during World War II will hold a fiftieth-anniversary reunion August 18, 1991, at the 103d Fighter Squadron in East Granby, Conn. **Contact:** Helen Snyder, 1463 Boulevard, West Hartford, CT 06119. Phone: (203) 561-3096.

CBI Hump Pilots
The China-Burma-India Hump Pilots will hold a reunion August 21–25, 1991, at the Holiday Inn Central in Omaha, Neb. **Contacts:** Lester K. Glaze, P. O. Box 309, Broken Bow, NE 68822. Phone: (308) 872-2896. China-Burma-India Hump Pilots Association, P. O. Box 458, Poplar Bluff, MO 63901. Phone: (314) 785-2420.

CBI Veterans
China-Burma-India veterans will hold a reunion at the Holiday Inn Hotel in Orlando, Fla., September 3–8, 1991. **Contact:** Lowell G. Simpson, 1469 Magellan Cir., Orlando, FL 32808. Phone: (407) 298-4580.

Glasgow AFB Ass'n
Officers and enlisted who served with the 91st Bomb Wing and Air Base Group, 322d Bomb Squadron, 907th Air Rescue Squadron, and 13th Fighter-Interceptor Squadron stationed at Glasgow AFB, Mont., will hold a reunion August 8–10, 1991, in Post Falls, Idaho. **Contact:** Lt. Col. James E. Bradley, USAF (Ret.), 1406 Evergreen Ln., Derby, KS 67037-2145. Phone: (316) 788-3627.

GEEIA/MDA
The former Air Materiel Command Units, Ground Electronics Engineering Installation Agency (GEEIA) and Mobile Depot Activity (MDA), will hold a joint reunion July 5–6, 1991, in Oklahoma City, Okla. **Contact:** Sophia Bronson, 13501 S. E. 29th St., Box 83, Choctaw, OK 73020. Phone: (405) 736-5201 or (405) 732-8982. AUTOVON: 336-5201.

Jolly Green Ass'n
The Jolly Green Association will hold a reunion May 3–4, 1991, at the Ramada Beach Resort Hotel in Fort Walton Beach, Fla. All former rescue personnel are invited. **Contact:** Col. Jack Allison, USAF (Ret.), 2007 Bayshore Dr., Niceville, FL 32578. Phone: (904) 678-8135.

Kingman Field
The Kingman Chamber of Commerce will hold a fiftieth-anniversary reunion October 15–17, 1991, for military and civilian personnel and families of personnel stationed at Kingman AAF, Ariz., during World War II. **Contact:** KAAF Reunion Committee, P. O. Box 1150, Kingman, AZ 86402. Phone: (800) 325-5223 or (602) 753-6106.

Tachikawa AB
Veterans who served at Tachikawa AB, Japan, will hold a reunion October 2–5, 1991, at the Marriott Riverwalk Hotel in San Antonio, Tex. **Contact:** Col. Raymond W. Henderson, USAF (Ret.), 5402 Timber Meadow, San Antonio, TX 78250. Phone: (512) 681-1745.

USAF Academy Parachute Team
The USAF Academy Parachute Team is hosting a twenty-fifth-year reunion April 25–28, 1991, at the Academy. Former members of the team are encouraged to attend. **Contact:** Coach Bill Wenger, USAF Academy, CO 80840. Phone: (719) 472-2064.

Unit Reunions

2d Combat Cargo Squadron
The 2d Combat Cargo Squadron will hold a reunion October 15–17, 1991, in Orlando, Fla. **Contact:** Lt. Col. Joseph R. W. Couture, USAF (Ret.), 159 E. Amber Pl., San Antonio, TX 78221.

4th Ferrying Group
Members of the 4th Ferrying Group, Air Transport Command, who served during World War II will hold a reunion May 16–18, 1991, in Dayton, Ohio. **Contact:** Wendell Jordan, Wildwood Rd., Box 161-H, Zebulon, GA 30295. Phone: (404) 567-8112.

5th Station Hospital
Former 5th Station Hospital personnel (Johnson Field, Japan) will hold a reunion June 19–23, 1991, in Nashville, Tenn. **Contacts:** W. H. Seabock or Don Burton, P. O. Box 35372, Louisville, KY 40232.

12th Bomb Group
Members of the 12th Bomb Group "Earthquakers" will hold a reunion September 12–15, 1991, at the Tacoma Sheraton Hotel in Tacoma, Wash. **Contact:** Alex Adair, 22925 14th Pl. W., Bothell, WA 98021. Phone: (206) 486-1221.

23d Composite Group
Officers of the 23d Composite Group and Air Proving Ground Command who served between 1940 and 1970 will hold a reunion September 11–12, 1991, at the Sheraton Coronado Beach Resort Hotel in Fort Walton Beach, Fla. **Contact:** George A. Walker, 605 Lake Ave., Altamonte Springs, FL 32701. Phone: (407) 831-7797.

B-26 Marauder Historical Society
The B-26 Marauder Historical Society is sponsoring a fiftieth-anniversary reunion April 18–21, 1991, in Baltimore, Md. **Contact:** John B. Walters, 291 Red Fox Rd. S. E., Cedar Rapids, IA 52403. Phone: (319) 363-7395.

Class 47-C
Members of Class 47-C will hold a reunion in October 1991 in Albuquerque, N. M. **Contact:** Bob Campion, P. O. Box 1712, Fulton, TX 78358.

Class 49-B
Members of Class 49-B will hold a reunion October 18–21, 1991, in San Antonio, Tex. **Contacts:** Roy Wampler, 2634 Oro Blanco Dr., Colorado Springs, CO 80917. Phone: (719) 597-1848. John Stolly, 11323 Cotillion Dr., Dallas, TX 75228. Phone: (214) 681-8290.

49th Fighter Group
Members of the 49th Fighter Group/49th Tactical Fighter Wing will hold a reunion June 19–23, 1991. **Contact:** John Roth, 1017 Adams S. E., Albuquerque, NM 87108. Phone: (505) 268-2903.

Class 50-G
Members of pilot Class 50-G will hold a reunion September 11–13, 1991, in Winona, Minn. **Contact:** Lt. Col. Ralph E. Petz, USAF (Ret.), 1635 Edgewood Rd., Winona, MN 55987. Phone: (507) 452-9297.

Class 52-B
Members of Class 52-B will hold a reunion October 11–15, 1991, in Boston, Mass. **Contact:** Jack Lee, 14 Morrison Rd., Windham, NH 03087. Phone: (603) 432-9632.

52d Troop Carrier Squadron
The 52d Troop Carrier Squadron, 63d Troop Carrier Wing (Donaldson AFB, S. C.), will hold a reunion September 19–22, 1991, at the Holiday Inn–Riverfront in Saint Louis, Mo. **Contact:** Lt. Col. James F. Delaney, USAF (Ret.), 502 Westfield Dr., O'Fallon, IL 62269. Phone: (618) 632-6757.

Class 54-Q
Members of USAF–California Eastern Airways pilot primary Class 54-Q are planning to hold a reunion in October 1991 at Columbus AFB, Miss. **Contact:** Lt. Col. Joseph Viscount, Jr., USAF (Ret.), 53 Chatham Ave., Milford, CT 06460. Phone: (203) 874-7729.

62d Troop Carrier Group
Veterans of the 62d Troop Carrier Group (World War II) will hold a reunion August 29–September 1, 1991, in Seattle, Wash. **Contact:** John Rodkey, W. 1403 Courtland, Spokane, WA 99205. Phone: (509) 327-4925.

78th Fighter Wing
Members of the 78th Fighter Wing will hold a reunion May 30–June 2, 1991, at the Embassy Suites Hotel in San Rafael, Calif. **Contacts:** Robert A. Rayford, P. O. Box 1112, Alexandria, LA 71309. Phone: (800) 256-2891. Bob Douglass, 885 Olive Ave., Suite B, Novato, CA 94945. Phone: (415) 892-3451 or (415) 954-5940.

81st Tactical Fighter Wing
The 81st Tactical Fighter Wing will hold its reunion October 8–15, 1991, at the Hale Koa Hotel in Honolulu, Hawaii. **Contact:** Terrie Heisel, Armed Services Tour and Travel, 1860 Ala Moana Blvd., Suite 405, Wailana Building, Honolulu, HI 96815. Phone: (800) 356-1232 or (808) 946-4802.

89th Attack Squadron
The 89th Attack Squadron will hold a reunion October 16–19, 1991, at the Holiday Inn in Cocoa Beach, Fla. **Contact:** Lt. Col. Robert L. Mosley, USAF (Ret.), 8630 S. Tropical Trail, Merritt Island, FL 32952. Phone: (407) 777-0821.

89th Military Airlift Wing
Members of the 89th Military Airlift Wing "Sam Fox" will hold a reunion September 26–29, 1991, at Andrews AFB, Md. **Contacts:** Lt. Col. Ron Tillotson, 89th MAW, Mail Stop 3, Andrews AFB, MD 20331-5000. Col. Edward M. Bullard, Commander, 89th MAW/CC, Andrews AFB, MD 20331-5000 (include self-addressed envelope). Phone: (301) 981-5702.

92d Troop Carrier Squadron
The 92d Troop Carrier Squadron, 439th Troop Carrier Group, will hold a reunion August 15–17, 1991, in San Antonio, Tex. **Contact:** William L. Schaefer, 240 Pineapple St., Satellite Beach, FL 32937.

93d Troop Carrier Squadron
Members of the 93d Troop Carrier Squadron, 439th Troop Carrier Group, will hold a reunion September 18–22, 1991, at the Marriott Hotel in El Paso, Tex. **Contact:** Lt. Col. Thomas L. Morris, USAF (Ret.), 456 St. George's Ct., Satellite Beach, FL 32937. Phone: (407) 773-6960.

95th Bomb Group
Veterans of the 95th Bomb Group who served during World War II will hold a reunion September 4–10, 1991, in Reno, Nev. **Contact:** David Dorsey, 125 Clark St., Clarks Green, PA 18411. Phone: (717) 587-2290.

96th Bomb Wing
The 96th Bomb Wing will hold a reunion October 10–12, 1991, in Abilene, Tex. **Contact:** Ken Hess, 4509 Cleveland Dr., Plano, TX 75093. Phone: (214) 596-3415.

97th Bomb Group
Members of the 97th Bomb Group will hold a reunion September 25–28, 1991, at the Red Lion Hotel in Omaha, Neb. **Contact:** Harry Alsaker, 1308 Jackson, Missoula, MT 59802. Phone: (406) 543-5388.

111th Tactical Recon Squadron
Veterans of the 111th Tactical Reconnaissance Squadron (World War II) will hold a reunion August 14–18, 1991, at the Hampton Inn in Flint, Mich. **Contact:** Chuck Metcalfe, 597 Hamilton Rd., Mount Morris, MI 48458. Phone: (313) 686-8608.

314th Composite Wing
Members of the 314th Composite Wing, 5th Air Force, will hold a reunion June 19–23, 1991, in Nashville, Tenn. **Contacts:** Bob Kendall or Mel Hiller, Box 35372, Louisville, KY 40232.

314th Fighter Squadron
Veterans of the 314th Fighter Squadron who served during World War II will hold a reunion May 18–19, 1991, at the Holiday Inn Hotel in Harrisburg, Pa. **Contact:** Harry Steffy, 32 W. Main, Adamstown, PA 19501.

350th SRS
Members of the 350th Search and Rescue Squadron will hold a reunion June 21–23, 1991, in Tucson, Ariz. **Contact:** Lt. Col. John L. Loggins, USAF (Ret.), 1803 Penina Dr., Crosby, TX 77532. Phone: (713) 328-4446.

363d Fighter Group
Veterans of the 363d Fighter Group/363d Mustang Fighter Group and associated units will hold a reunion June 4–6, 1991, in Saint Louis, Mo. **Contact:** Fred Munder, 4326 Osceola, Saint Louis, MO 63116. Phone: (314) 481-2653.

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.

364th Fighter Group
The 364th Fighter Group will hold a reunion September 12–15, 1991, at the Marriott Hotel in Seattle, Wash. **Contact:** Dan Leftwich, 6630 Caldero Ct., Dayton, OH 45415. Phone: (513) 890-3641.

384th Bomb Group
Members of the 384th Bomb Group, 8th Air Force, will hold a reunion in the UK May 2–7, 1991. **Contact:** Frederick Nowosad, Box 1021-A, Rahway, NJ 07065. Phone: (201) 388-2250.

394th Bomb Group
Members of the 394th Bomb Group will hold a reunion in conjunction with the B-26 Marauder's fiftieth anniversary, April 18–21, 1991, in Baltimore, Md. **Contact:** Col. Elden G. Shook, USAF (Ret.), P. O. Box 413, Enon, OH 45323. Phone: (513) 864-2983.

437th OMS
The 437th Organizational Maintenance Squadron will hold a reunion July 5–7, 1991, at the Marriott Hotel in Charleston, S. C. **Contact:** Bill D. Jones, 1605 Harrod Ln., Greensboro, NC 27410. Phone: (919) 852-3196 or (919) 279-6511.

440th Troop Carrier Group
Veterans of the 440th Troop Carrier Group who served during World War II will hold a reunion September 27–29, 1991, in San Antonio, Tex. **Contact:** Tony Ferrucci, 551 S. Concord St., Seattle, WA 98108. Phone: (206) 762-3677.

453d Bomb Group
Members of the 453d Bomb Group, 2d Air Division, 8th Air Force, will hold a reunion July 3–6, 1991, in Dearborn, Mich. **Contact:** Dan Reading, 601 Woodcrest Ave., La Habra, CA 90631. Phone: (213) 691-2994.

454th Bomb Group
The 454th Bomb Group will hold a reunion in August 1991 in Charleston, S. C. **Contact:** 454th Bomb Group Association, P. O. Box 678, Wheat Ridge, CO 80034.

456th BW/100th ARW
Members of the 456th Bomb Wing and 100th Air Refueling Wing, which included the 903d and 349th Air Refueling Squadrons stationed at Beale AFB, Calif., between 1973 and 1978, will hold a reunion June 14–16, 1991, in Sacramento, Calif. **Contact:** William F. Turner, 3833 Montecito, Denton, TX 76205. Phone: (817) 387-7669.

461st Bomb Wing
Members of the 461st Bomb Wing who served between 1960 and 1968 at Amarillo AFB, Tex., will hold a reunion October 3–6, 1991, in Fort Worth, Tex. **Contact:** Charles L. Brown, 3018 Shady Knoll Ln., Bedford, TX 76021. Phone: (817) 498-7334.

497th Recon Technical Group
The 497th Reconnaissance Technical Group (RTG), stationed at Lindsey AS, West Germany, will hold a reunion May 17–18, 1991, in Wiesbaden-Schierstein, Germany. Members and friends are invited to attend or send their memorabilia and anecdotes. **Contact:** Capt. James Ledy, USAF, 497th RTG, Box 2531, APO New York 09633. AUTOVON: 314-339-2191. Phone: 011-49-611-82-2191.

500th Bomb Squadron
Veterans of the 500th Bomb Squadron, 345th Bomb Group (World War II), will hold a reunion September 1–5, 1991, in San Antonio, Tex. **Contact:** Col. William J. Cavoli, USAF (Ret.), 2147 Encino Loop, San Antonio, TX 78259-1902.

530th Fighter Squadron
Members of the 530th Fighter Squadron will hold a reunion September 4–8, 1991, in Rapid City, S. D. **Contact:** F. H. Wilbourne, 4118 Keagy Rd., Salem, VA 24153. Phone: (703) 387-0562.

906th Air Refueling Squadron
The 906th Air Refueling Squadron will hold a reunion October 9–13, 1991, at the Hyatt Regency West Hotel in Houston, Tex. **Contact:** Kemp F. Martin, 8433 Katy Freeway, Suite 102, Houston, TX 77024-1997. Phone: (713) 467-5435.

3650th Medical Squadron
Members of the 3650th Medical Squadron and base personnel who were stationed at Sampson AFB, N. Y., will hold a reunion July 19–21, 1991, in Atlanta, Ga. **Contacts:** Roberta H. Caruthers, 1081 Cherokee Heights, Stone Mountain, GA 30083. Phone: (404) 296-5026. Lt. Col. R. F. Goldsboro, USAF (Ret.), P. O. Box 771, 2425 W. Main St., Millville, NJ 08332. Phone: (609) 825-8935.

Class 48-B
Members of Class 48-B are planning to hold a reunion this fall in Las Vegas, Nev. **Contact:** T. R. Leeder, 5130 E. Charleston, S-316, Las Vegas, NV 89110.

Class 51-F
I would like to hear from members of Class 51-F (Reese AFB, Tex./Vance AFB, Okla.) who would be interested in holding a fortieth-anniversary reunion in September 1991. **Contact:** C. B. Robinson, 205 Ridgecrest Cir., Denton, TX 76205. Phone: (817) 382-6118.

465th Service Squadron
The 465th Service Squadron and 354th Airdrome Squadron, 8th Air Force (World War II), are planning to hold a reunion this fall. **Contact:** Bill Butts, 2706 Philo, San Marcos, TX 78666. Phone: (512) 392-2517. ■

MOVING?

Let us know your new address six weeks in advance so that you don't miss any copies of AIR FORCE.

Clip this form and attach your mailing label (from the plastic bag that contained this copy of your magazine), and send to:

Air Force Association
Attn: Change
of Address
1501 Lee Highway
Arlington, VA
22209-1198

Please print your NEW address here:

Please fasten your mailing label here

NAME

ADDRESS

CITY, STATE, ZIP CODE

DON'T LET MEDICAL EXPENSES SOAR GET PROTECTION WITH AFA's CHAMPLUS®

A CHAMPUS Supplement Which Helps Limit Your Unreimbursed Medical Expenses.

CHAMPUS is a federally-funded health benefits program designed to help service families pay for medical care in civilian medical facilities, including doctor charges. However, with CHAMPUS there is a gap as to what percentage of medical expenses get reimbursed and what you have to pay out-of-pocket. That's why you need CHAMPLUS®. As a member of the Air Force Association, you are eligible to purchase one of the best CHAMPUS Supplements available, with competitively low rates.

FEATURES THE NEW EXPENSE PROTECTOR BENEFIT

This benefit limits out-of-pocket expenses for CHAMPUS covered expenses in any single calendar year to $1,000 for any one insured person (or $2,000 for all insured family members combined). Once those out-of-pocket expense maximums are reached, CHAMPLUS® will pay 100% of CHAMPUS covered charges for the remainder of that year.

An example of how the Benefit works:

You are hospitalized for 35 days and the hospital charges you $330 per day -- $95 per day more than allowed by CHAMPUS. Your out-of-pocket expense would be $3,325. With the Expense Protector Benefit your cost would be limited to $1,000. All covered costs over this amount -- for the entire calendar year -- would be paid.

ELIGIBLE APPLICANTS

All AFA members under age 65 who are receiving retirement pay based on their military service, spouses under age 65 of active duty or retired members and their unmarried dependent children under age 21, or 23 if in college, are eligible. Upon reaching age 65, your coverage will automatically be converted to AFA's Medicare Supplement Program.

RENEWAL PROVISION

Your coverage will continue as long as you remain eligible for CHAMPUS benefits, the Master Policy with AFA remains in force, your membership continues, and you pay your premiums.

There is no waiting period for active duty members who enroll within 30 days of retirement if their dependents have been insured for two years previously.

EXCEPTIONS AND LIMITATIONS

There is a 12-month waiting period for conditions which were treated 12 months prior to the effective date of insurance. After the coverage has been in effect for 24 consecutive months, all pre-existing conditions will be covered. Children of active duty members over age 21 (age 23 if in college) will continue to be eligible if they have been declared incapacitated and if they are insured under CHAMPLUS® on the date so declared. Coverage for these older age children will only be provided upon notification to AFA and payment of a special premium amount.

EXCLUSIONS

This plan does not cover and no payment shall be made for: routine physical examinations or immunizations; domiciliary or custodial care; dental care (except as required as a necessary adjunct to medical or surgical treatment); routine care of the newborn or well-baby care; injuries or sickness resulting from declared or undeclared war or any act thereof or due to acts of intentional self-destruction or attempted suicide, while sane or insane; treatment for prevention or cure of alcoholism or drug addiction; eye refraction examinations; prosthetic devices (other than artificial limbs and artificial eyes), hearing aids, orthopedic footwear, eyeglasses and contact lenses; expenses for which benefits are or may be payable under Public Law 89-614 (CHAMPUS).

LOOK AT WHAT AFA CHAMPLUS® PAYS

Care	Retired	Active Duty
Inpatient civilian hospital care	the 25% of allowable charges not paid by CHAMPUS, plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year	the greater of the total daily subsistence fees, or the $25 hospital charge not paid by CHAMPUS
Inpatient military hospital care	the daily subsistence fee	the daily subsistence fee
Outpatient care (covers emergency room treatment, doctor bills, pharmaceuticals, and other professional services; see exclusions for limitations)	the 25% of allowable charges not paid by CHAMPUS, after the deductible has been satisfied, plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year	the 20% of allowable charges not paid by CHAMPUS after the deductible has been satisfied, plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year

CHAMPLUS® offers many attractive benefits. For a complete description of the Plan, including exceptions and limitations, please refer to the Certificate of Insurance, or call our Insurance Division toll-free at

1-800-727-3337
x4905

To enroll in the program, complete the application. →

RATES

For Military Retirees and Dependents
QUARTERLY PREMIUM SCHEDULE
In-Patient Benefits Only

Member's Attained Age*	Member	Spouse	Each Child
under 50	$25.27	$54.15	$17.97
50-54	37.76	59.03	17.97
55-59	55.35	63.18	17.97
60-64	66.13	79.66	17.97

For Military Retirees and Dependents
QUARTERLY PREMIUM SCHEDULE
In-Patient and Out-Patient Benefits

Member's Attained Age*	Member	Spouse	Each Child
Under 50	$39.00	$79.32	$40.84
50-54	51.25	87.34	40.84
55-59	70.85	115.33	40.84
60-64	89.00	132.80	40.84

*Note: Premium amounts increase with the member's attained age.

For Dependents of Active Duty Personnel
ANNUAL PREMIUM SCHEDULE
In-Patient Benefits Only

	Member	Spouse	Each Child
All Ages	None	$12.89	$7.72

In-Patient and Out-Patient Benefits

	Member	Spouse	Each Child
All Ages	None	$51.52	$38.61

APPLICATION FOR AFA CHAMPLUS®

Group Policy GMG-FC70
Mutual of Omaha Insurance Co.
Home Office: Omaha, Nebraska

Full name of Member_____
Rank Last First Middle

Address_____
Number and Street City State Zip Code

Date of Birth_____ Current Age____ Height_____ Weight_____ S.S.N._____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below: ❑ I am currently an AFA Member ❑ I enclose $21 for annual AFA membership dues. (includes subscription ($18) to AIR FORCE Magazine)

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (check one)
❑ AFA CHAMPLUS® PLAN I (for military retirees & dependents)
❑ AFA CHAMPLUS® PLAN II (for dependents of active-duty personnel)

Coverage Requested (check one)
❑ Inpatient Benefits Only ❑ Inpatient and Outpatient Benefits

Person(s) to be insured (check one)
❑ Member Only ❑ Member & Children
❑ Spouse Only ❑ Spouse & Children
❑ Member & Spouse ❑ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis, but, if desired, they may be made on either a semi-annual (multiply by 2), or annual (multiply for 4) basis.

Quarterly (annual) premium for member (age ____) $_____
Quarterly (annual) premium for spouse (based on members' age) $_____
Quarterly (annual) premium for ____ children @ $ $_____
Total premium enclosed $_____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Insured Dependents	Relationship to Member	Date of Birth (Month/Day/Year)

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such preexisting conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date_____, 19____ _____
(Member's Signature)

Form 6173GH App.

Application must be accompanied by a check or money order. Send remittance to: Air Force Association, Insurance Division, 1501 Lee Highway, Arlington, VA 22209-1198

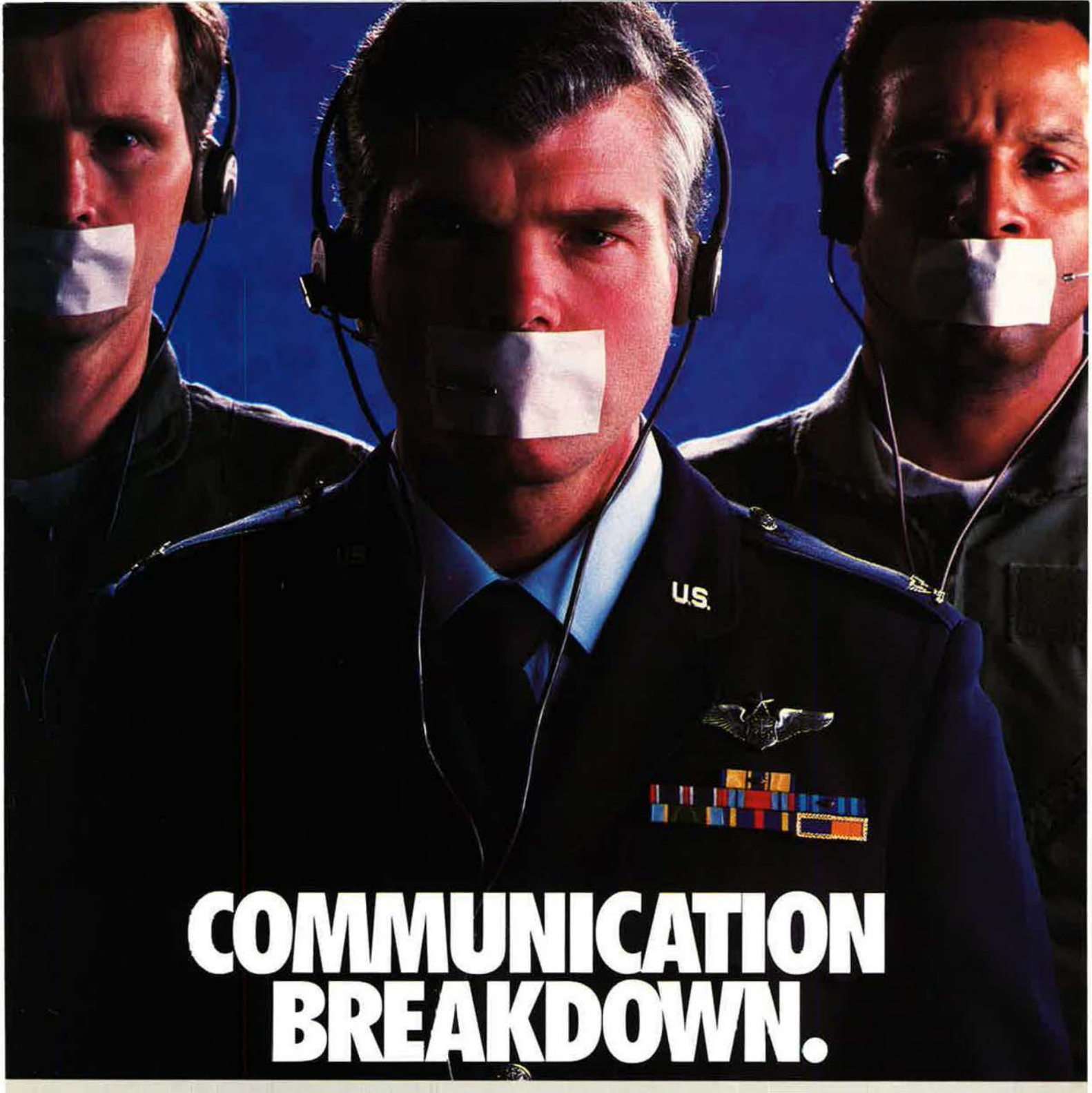
Bob Stevens'

"There I was..."

Cartoonist Bob Stevens is ill and may be out of action for several months. In the meantime, we'll rerun a few of his previous panels.

This panel appeared seventeen years ago this month. Every fighter pilot in every era has been in a similar situation. Bob waxed poetic in the original introduction:

> "Missing an easy enemy kill
> May be cause for colossal chagrin
> But nothing at all like a critical call
> When a fighter jock's all buckled in."



COMMUNICATION BREAKDOWN.

DON'T LET CO-SITE INTERFERENCE GAG YOU.

When the battle heats up, the communication heats up. And, so does the self-jamming.

Suddenly, side conversations, whistles and background noise cripple command central. Your most important communicators are "gagged."

Magnavox has the solution.

Our new UHF Co-Site System stops self-jamming on large platforms. It lets you talk without being stepped on.

Magnavox's UHF Co-Site System is a real-time managed network that supports up to 16 Receiver/Transmitters. It's proven military hardware that's low in power consumption and Have Quick compatible.

Now, you don't have to experience a breakdown in communications. Talk with Magnavox.

Magnavox
Government and Industrial Electronics Company

1313 Production Road, Fort Wayne, IN 46808 USA Phone 219-429-6000 FAX 219-429-5459

WHAT KIND OF PEOPLE MAKE THE BEST FIGHTERS?

The performance proven team of Northrop/McDonnell Douglas. They've just completed designing the new YF-23 Advanced Tactical Fighter. And no one is more qualified to build the F-23 than Northrop/McDonnell Douglas.

Over the past 15 years, we've established a reputation as the premier team in fighter aircraft technology. Together, we've built over 1,000 F/A-18s and we've produced over 10,000 supersonic fighters between us. That's more than the rest of the U.S. aerospace industry combined.

Many companies can design fighters, but only one team is a proven performer in designing *and* building them. Now, we've proven it again with the YF-23.

Our team will be there to see the F-23 through production. And make sure it's an undeniable success.

ATF-23

NORTHROP/MCDONNELL DOUGLAS TEAM